EFFECT OF SPEED GOVERNOR ON TRANSIENT STABILITY OF MULTIMACHINE POWER SYSTEM

BY

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A THESIS

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CERTIFICATE

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

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ABSTRACT

The implementation of modern electronic and micro-processor based control system has made the response of speed governors very fast. In this study we have shown the effect of this type of governors on transient stability of a power system.

The interconnected grid system of Bangladesh Power Development Board is taken as a model for this study. The steady state conditions prior to the fault are taken from the drawing no. 3754 N-7013 TO 03 studied by Lahmeyer International, GMBH. Lumping all the generators operating in a power station to a single unit, the set of swing equations for each equivalent unit are deduced consdering the effect of damper winding and speed governors. In solving the swing equations, the variation of shaft power with rotor speed is calculated from the equations derived for speed control mechanism (governor). This derived differential equations are represented in the form of a block diagram.

To obtaine the power transfer between different pairs of machines, the driving point and transfer admittances between hypothetical machine internal-voltage-buses were calculated eliminating all other nodes by matrix node elimination method. All the loads were replaced by constant shunt addmittance between the corresponding bus and ground. Swing equations were solved by Runge -Kutta fourth order approximation method.

Three-phase short circuit of four different types covering

major disturbances, such as generation rejection, load rejection and loss of transmission facilities at four different points were studied considering governor action and also neglecting governor action. Each fault was studied with three different modes of CB operations; (a) without autorecloser,(b) unsustained fault and use of autorecloser and (c) sustained fault and use of autorecloser. Taking Ghorasal-132 equivalent machines as the reference the relative rotor angles of all the equivalent machines were plotted by the computer.

The following facilities are available in the generalized computer program developed for the proposed work:

(1) Determination of driving point and transfer admittance at pre-fault, during fault and post-fault conditions.

(2) Determination of driving point and transfer impedances at pre-fault,during fault and post fault conditions.

(3) Solution of the swing equations by Rungee-Kutta fourth order approximation with or without governor action.

(4) Plotting of the swing curves.

This program can be used for any number of buses, generators, and CB/Autorecloser time setting.

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CHAPTER-1

INTRODUCTION

1.1 INTRODUCTION: Electrical energy plays an important role in industrial development and civilization as a whole. Electric systems were initially operated as individual units but the increased necessity of electrical power and increased reliability suggested the interconnection of a number of isolated and relatively smaller power networks. Interconnection is advantageous from the point of both economy and reliability, because fewer machines are required as reserve for operation at peak load and fewer machines are running as spinning reserve to take care of sudden, unexpected jumps in loads and the power failure at one part of the system can be compensated by supplying (or feeding) power from other parts of the system. Interconnection of systems brought many new problems, most of which have been solved satisfactorily. The disturbance caused in one system may spread to interconnected system unless proper relays and circuit breakers are used at the point of interconnection. The intrrconnected system must have the same nominal frequency. The synchronous machines of one system must remain in step with the interconnected system. Again the location of power station which is determined by the environmental condition and economic reasons are often away from the load and are likely to be near fuel centres requiring the construction of long transmission lines to transfer energy from source to load centres. This makes the power system network larger and more and more complex. However if the tie lines connecting the different isolated power system are such that the amount of synchronizing power that the lines are able to transfer at the time of faults at any part of the system is not enough and the CB are not properly designed, some of the machines may loose synchronism. There is also considerable danger of steady state pull-out if the power on the tie line is not carefully controlled. So stability study becomes very important to ensure more stable supply with increased service of reliability demanded by consumers specially with automatic industries and vital installations. This study of a large power system provides its present performance and the possibilities of its future expansions.

The problem of system stability has its begining when synchronous machines were first operated in parallel and it is defined[4] as the tendency of a power system or its component parts to develope forces to maintain synchronism and equilibrium. Maintaining synchronism between various parts of a power system becomes increasingly difficult as the power system continues to grow.

Depending on the type and magnitude of disturbances, power system stability may be classified as steady state stability, dynamic stability and transient stability.

The steady state stability techniques are used when the power transfer changes gradually. The maximum power flow possible under this condition through a particular point is called the steady state stability limit.

Dynamic stability is the ability of a power system to maintain stability for small disturbances and to prevent growth of oscillations. Dynamic instability occurs generally due to lack of damping torque.

A system is said to be transiently stable if the system remains in synchronism during a sudden disturbance. The maximum power flow possible under this condition through a particular point is called the transient stability limit. Transient stability study provides informations related to the capability of a power system to remain in synchronism during major disturbances resulting from either the loss of generating or transmission facilities, sudden or sustained load changes, or mementary faults. Specially transient stability study provides the changes in the powers, speeds and torques of the machines of the power system during and immediately following a disturbance. In order to provide the reliability required by the dependance on continous electric service, it is very important to design the power system to remain stable under any reasonable disturbances.

Most of the early transient stability studies were limited in scope because of the small capacity of the punch card calculators generally used in that time. The availability of large scale digital computers in the middle 1950^{s} providedequipment of sufficient capacity and speed to requirements of major power system problems.

Transient stability study may be done by various methods. All the methods need to solve the swing equations of the synchronous machines in the system along with the impedance or admittance matrix and with other system dynamics. The number of differential equations required for a machine depends on the detail needed to represent accurately the machine performance. Two[1,7] first order differential equations are needed for the simplest representation and ranges as many as ten or more when governor, excitation effects as well as detailed modelling of the synchronous machines are taken into account. The 'step by step' method solution of swing equations requires a large number of approximation and assumption on system behaviours. The method of equal area criterion may successfully be applied for a pair of machines. The differential equations in transient stability study can also be solved by using numerical solution. "Runge-Kutta fourth order approximation" method is used here for the solution of the swing equations.

The power system of Bangladesh is divided into two zones, namely Eastern and Western grids. The whole area of Eastern zone is covered by Eastern grid whereas Western zone is covered by the Western grid. The installed capacity is 1316 MW in Eastern grid and 421.5 MW in Western grid. For relaiable supply of electrical power at steady state, peak demand must be equal to or less than installed capacity minus reserve generating capacity. The reserve generating capacity of a grid system is generally considered as the total capacity of the two largest units. The shortage of generation in the Western grid can be compensated either by constructing new stations in that region or transfering the excess power from the Eastern grid through interconnector. The later is used in Bangladesh because all the natural resources are located in the Eastern zone. The interconnector ensures the industrial development in the Western zone at reduced generation cost.

The modern view of stability problem dates from the 1924 winter convention of the American Institute of Electrical Engineers when the results of the first Laboratory tests on miniature systems proportioned to simulate a power system having long transmission line was presented. Since then a lot of work has been done on it. In Bangladesh University of Engineering and Technology,several theses have already been completed by Mr. Enamul Haq in 1977, Mr. Raisuddin in 1977, Mr. Hamidul Haq in 1983 and by some others. Since governor action is slow in response, and damping torque is negligible compared to accelarating torque all the workers neglect the effect of these factors. However advent of fast electronic and microprocessor circuits used in the modern generating stations are much faster. So it has become important to consider the effect of governor in transient stability studies for more realistic results.

In the present work, an attempt has been made to study transient stability of Bangladesh Power Development Board with governor and damping effects taken into consideration.

CHAPTER - 2

POWER SYSTEM REPRESENTATION

2.1 INTRODUCTION

In this section we discuss in brief the modelling of some of the components of a power system as it is pertinent to our studies. The components are:

- (a) Transmission network consisting of
  - i) Transmission lines
  - ii) Transformers
  - iii) Static capacitors and reactors
- (b) Loads
- (c) Shynchronous machines and the associated controls such as excitation system, governors, etc.

The complexity[7] of the model depends to a great extent on the type of study undertaken and the accuracy desired. In the stability study, the transmission network can be assumed to be in steady state[7] since the time constants associated with it are much smaller compared to the time constant of the synchronous machine. There are standard notations or symbols for representation of the various elements like generators, transformers, reactor, transmission lines, loads etc. American standard assciation (ASA) has assigned a set of standard symbols and device numbers to all components found in an electric system. The network diagrams of power systems used in this study are drawn with the help of these symbols.

2.2 TRANSMISSION LINE REPRESENTATION

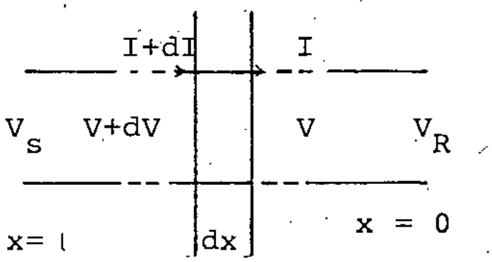


Fig. 2.1

From the fig. 2.1, where, on a per line to neutral basis, a small element of length dx at a distance x from the receiving end is considered, we have

$$\frac{dv}{dx} = zI$$

and $\frac{dI}{dx} = yV$

where,

z = series impedance per phase per unit length

y = shunt admittance per phase per unit length

From the above two equations we get

$$\frac{d^2V}{dx^2} = z\frac{dI}{dx} = zyV$$

$$\frac{d^2I}{dx^2} = y\frac{dV}{dx} = zyI$$

upon solving the two equations we get

$$V(x) = V_R\cosh\gamma x + I_R Z_C \sinh\gamma x \qquad \ldots \qquad (1)$$

$$I(x) = I_R\cosh\gamma x + \frac{V_R}{Z_C}\sinh\gamma x \qquad \ldots \qquad (2)$$

where $\gamma = \sqrt{zy}$ = Propagation constant

$Z_C = \sqrt{z/y}$ = Characteristic impedance of the line

From equations (1) and (2) we can draw the π-equivalent circuit as in fig. 2.2.

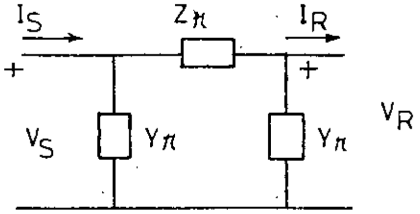


Fig. 2.2

From fig.2.2. and equations (1) and (2) we can write

$$Z_\pi = Z_C \sinh\gamma\ell$$

$$= z\ell \frac{\sinh \gamma\ell}{\gamma\ell}$$

$$\simeq z\ell(1 + \frac{(\gamma\ell)^2}{6})$$

and $Y_\pi = \frac{y\ell}{2} \; \frac{\tanh \gamma\ell/2}{\gamma\ell/2}$

$$\simeq \frac{y\ell}{2} \{1 - \frac{(\gamma\ell)^2}{12}\}$$

A further approximation will involve assuming $\gamma\ell << 1$ which is true for line upto 200 miles.

$\therefore Z_\pi = z\ell = Z$ (total series inpledance)

$Y_\pi = \frac{y\ell}{2} = \frac{Y}{2}$ (total shunt admittance)

The π -equivalent circuit obtained under such approximation is called a nominal π-circuit and can be drawn as in Fig.2.3.

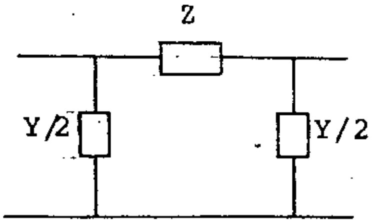


Fig. 2.3

2.3 REPRESENTATION OF TRANSFORMERS

i) Two winding transformers: The equivalent circuit of a transformer is shown in the fig.where all the quantities are referred to the side 1. In power transformers, the shunt branch current is negligible as compared to the load current and hence can be omitted from the circuit. Under this circumstance the equivalant circuit reduces to a simple circuit as shown in fig. 2.4(b).

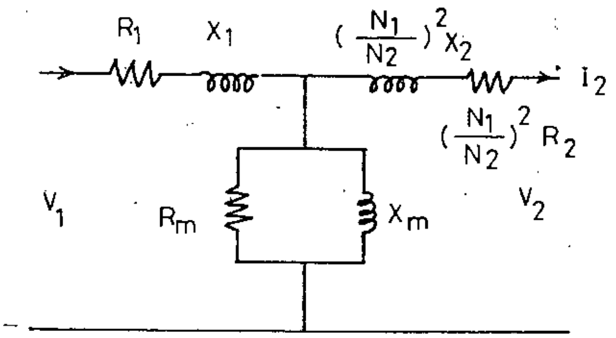


Fig. 2.4(a)

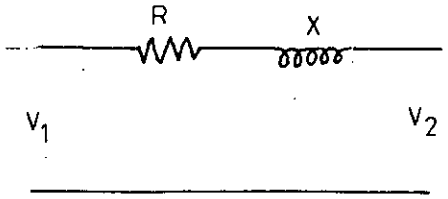


Fig. 2.4(b)

ii) Three winding transformers: Three winding transformers are represented, by Y-circuits such that the impedance of each branch is the impedance of corresponding winding and the sum of the impedances of each pair of branches equals the short-circuit impedance between the corresponding pair of windings with the remaining windings open.Magnetizing current is neglected.

The following relations are in use[4,20]

$$Z_1 = \frac{1}{2}\,(Z_{12} + Z_{13} - Z_{23})$$

$$Z_2 = \frac{1}{2}\,(Z_{12} + Z_{23} - Z_{13})$$

$$Z_3 = \frac{1}{2}\,(Z_{13} + Z_{23} - Z_{12})$$

where,

$Z = R + jX$

Z_{12} = Leakage impedance of primary with secondary short-circuited and tertiary open.

Z_{23} = leakage impedance of secondary with tertiary short-circuited and primary open.

Z_{13} = leakage impedance of primary with tertiary short-circuited and secondary open.

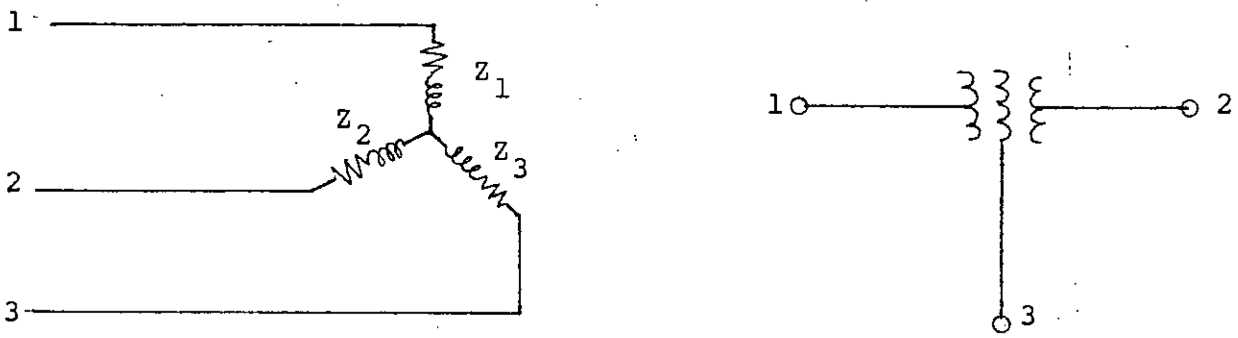


Fig. 2.5

2.4 LOAD REPRESENTATION

In representation of load for load flow and stability studies, it is important to know the variation of real and reactive power with variation of voltage. At a typical bus, load may consist of

1. Induction motors 50% - 70%
2. Heating and lighting 20% - 30%
3. Synchronous motors 5% - 10%

Although it would be accurate to consider the PV and QV characteristics of each of these loads for simulation, the analytic treatment would be very complicated. For analytic purpose there are mainly three[7] ways of representating the loads:

i) Constant power representation: here both the specified MW and MVR are assumed constant. This type of representation is used in load flow studies.

ii) Constant current representation: in this scheme the load current $\bar{I}$ is computed as

$$\bar{I} = \frac{P - jQ}{\bar{V}^*} = |\bar{I}| \underline{\angle \theta - \phi}$$

where $\bar{V} = V \underline{\angle \theta}$

and $\theta = \tan^{-1} (\frac{Q}{P})$ is the power factor angle.

The magnitude of $\bar{I}$ is held constant.

iii) Constant impedance representation : this is the most frequently used representation[7,2] of loads in stability studies. If the load MW and MVA are assumed known and is to remain constant, then equivalent impedance is computed as

$$\bar{Z} = \frac{\bar{V}}{\bar{I}} = \frac{V^2}{P-jQ}$$

or, $\bar{Y} = \frac{1}{Z} = \frac{P-jQ}{V^2}$

2.5 REPRESENTATION OF FAULTS:

A 3 ϕ short cricuit is represented by connecting the point of fault to the neutral bus. If there is a 3ϕ to ground fault at the ith bus as shown in the fig. 2.6(a), during fault, the ith bus can be treated as a ground bus or reference bus '0'. The line impedances connected between the faulted bus and other buses can be treated as an impedance between corresponding bus and ground as shown in fig. 2.6(b).

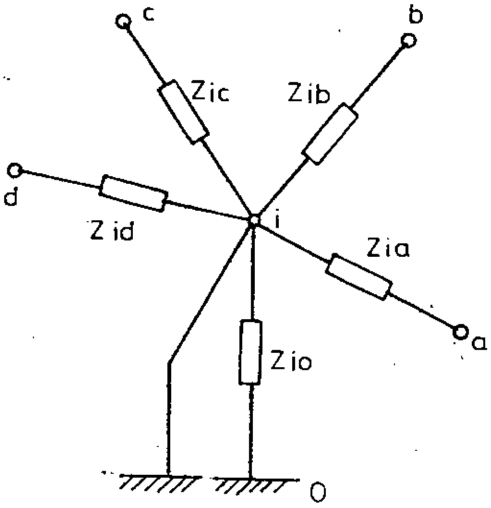


Fig.2.6(a)

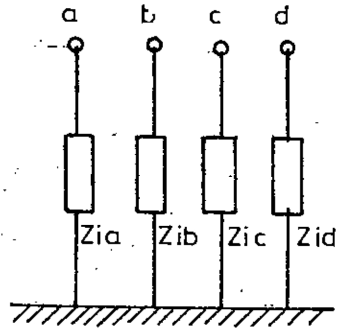


Fig.2.6(b)

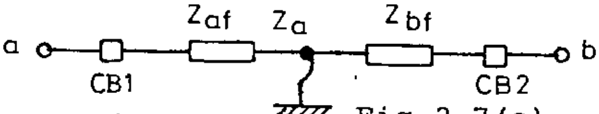


Fig.2.7(a)

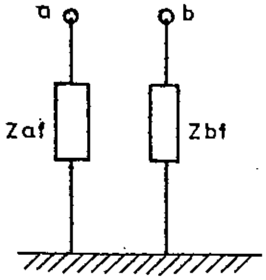


Fig. 2.7(b)

If the fault occurs at any point of a transmission line between the buses 'a' and 'b' as shown in fig. 2.7(a) and the impedance from bus 'a' to faulted point and from bus 'b' to faulted point are Z_{af} and Z_{bf} respectively then during fault condition the impedances Z_{af} and Z_{bf} act as impedances from bus 'a' to ground and from bus 'b' to ground respectively as shown in fig 2.7(b). If the circuit breaker CB1 opens first and circuit breaker CB2 still remains closed then only Z_{bf} acts as an impedance between bus 'b' and ground.

2.6 SYNCHNONOUS MACHINE REPRESENTATION

In transient stability study, involving short period of time in the order of second or less, a synchnonous machine can be represented[13,23,24,26] by a voltage source which is constant in magnitude but continously changing in angle in back of direct axis transient reactance. The voltage behind the direct axis transient reactance can be determined from

$$\bar{E}' = \bar{V}_t + \bar{I}_a R_e + j\bar{I}_a X'_d \quad \dots \quad (3)$$

where, $\bar{E}'$ = voltage behind direct axis transient reactance
$\bar{V}_t$ = terminal voltage
$\bar{I}_a$ = armature current
R_e = effective armature resistance
X'_d = direct axis transient reactance

The representation of a synchnonous machine for our analysis is shown in fig. 2.8.

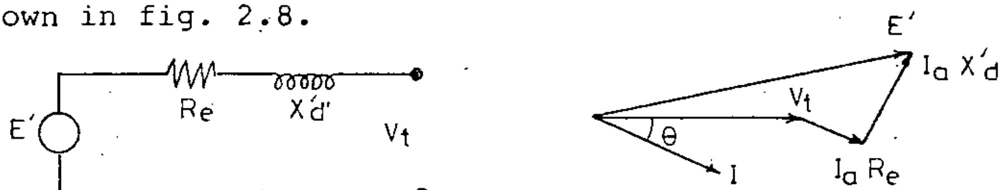


Fig.2.8

This representation neglects the saliency, saturation of flux path and assumes constant flux linkage and a small acceleration or retardation.

2.7 MISCELLANEOUS EQUIPMENT

In stability analysis of a power system, equipment like[2] buses, current-transformers, switches, circuit-breakers etc. are considered as having negligible impedance and shunt elements like potential-transformers, lightning arresters and coupling capacitors are considered open-circuited.

CHAPTER 3

DETERMINATION OF TRANSFER AND DRIVING POINT ADMITTANCES

3.1 INTRODUCTION

There are many power system problems, specially the transient stability study,[7,11,12] in which the method of driving point and transfer admittances are the convenient means of solving power system networks consisting of several number of generators or loads where power enters or leaves the network. In the past, network analysers have been used widely to determine these admittances which is inconvenient and inaccurate. Presently digital computers are widely used to determine the impedances or admittances.

3.2 DEFINITION AND DETERMINATION OF DRIVING POINT AND TRANSFER ADMITTANCES

A schematic represantation of a general n-machine network as it presents itself in most power-system network problems is shown in fig. 3.1. The rectangle represents a passive (impedance) linear network of any form, to which there are applied n-external voltages of the synchronous machines. One side of each voltage source is connected to a common or neutral terminal '0'; the other side is connected to various points of the network, numbered from 1 to n. The voltages $\bar{E}_1$ through $\bar{E}_n$ commonly represent voltages behind transient reactances, in which case the transient

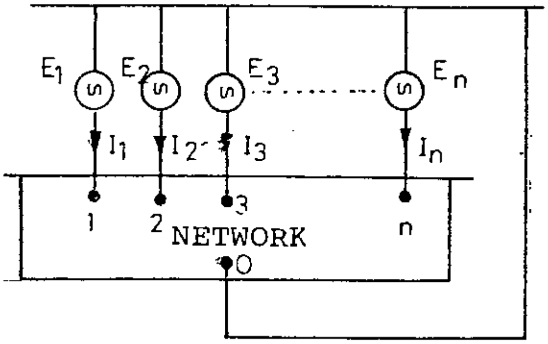


Fig.3.1

reactances are to be regarded as parts of the network inside the rectangle. Let the currents flowing into the network at the terminals 1,2,3......... n be called $\bar{I}_1$, $\bar{I}_2$, ...$\bar{I}_n$. Since the network has been assumed linear the currents supplied by the various machines may be written as a linear function[2] of the applied voltages as

$$\bar{I}_1 = \bar{Y}_{11}\bar{E}_1 + \bar{Y}_{12}\bar{E}_2 + \ldots\ldots\ldots\ldots + \bar{Y}_{1n}\bar{E}_n$$

$$= \sum_{k=1}^{n} \bar{Y}_{1k}\,\bar{E}_k$$

$$\bar{I}_2 = \bar{Y}_{21}\,\bar{E}_1 + \bar{Y}_{22}\bar{E}_2 + \ldots\ldots\ldots\ldots + \bar{Y}_{2n}\bar{E}_n$$

$$= \sum_{k=1}^{n} \bar{Y}_{2k}\,\bar{E}_k$$

$$\vdots$$

$$\bar{I}_n = \bar{Y}_{n1}\bar{E}_1 + \bar{Y}_{n2}\bar{E}_2 + \ldots\ldots\ldots\ldots + \bar{Y}_{nn}\,\bar{E}_n$$

$$= \sum_{k=1}^{n} \bar{Y}_{nk}\,\bar{E}_k$$

In general, we can write,

$$\bar{I}_i = \sum_{k=1}^{n} \bar{Y}_{ik}\,\bar{E}_k$$

$$i = 1,\ 2,\ 3,\ \ldots\ldots\ n$$

where Y's are complex numbers known as the terminal self and mutual admittances[2]. $\bar{Y}$ is a self or driving point admittances when $k = i$ and mutual or transfer admittances when $i \neq k$.

3.3 EXPERIMENTAL MEASUREMENT OF Y's

By letting all voltages except $\bar{E}_1$ become zero, we obtain

$$\bar{I}_1 = \bar{Y}_{11}\,\bar{E}_1$$

$$\bar{I}_2 = \bar{Y}_{21}\,\bar{E}_1$$

$$\vdots$$

$$\bar{I}_n = \bar{Y}_{n1}\,\bar{E}_1$$

Permits us to define the Y's as follows

$\bar{Y}_{11} = \bar{I}_1/\bar{E}_1$ when all except $\bar{E}_1$ are zero

$\bar{Y}_{21} = \bar{I}_2/\bar{E}_1$ when all except $\bar{E}_1$ are zero

$$\vdots$$

$\bar{Y}_{n1} = \bar{I}_n/\bar{E}_1$ when all except $\bar{E}_1$ are zero

We can similarly define all the other Y's. So the general relation between $\bar{Y}$, $\bar{I}$ and $\bar{E}$ can be written as

$\bar{Y}_{ji} = \bar{I}_j/\bar{E}_i$ where i and j varies from 1 to n.

By using the above defination of Y's we can experimentally determine all values of Y's using the relations given above.

3.4 DETERMINATION OF 'BUS ADMITTANCE MATRIX' BY CALCULATION

The network matrix obtained from the positive sequance admittances between the buses of a power system is called a bus admittance matrix[20]. The bus admittance matrix gives the mathematical representation of the layout of a power system. The bus admittance matrix is a two dimensional array of the self and mutual admittance of the buses. The number of rows and columns of this matrix is equal to the number of the buses in the system. All the diagonal elements of this system matrix are the self admittances of the buses and off diagonal elements of this matrix are the mutual admittances. The elements of the bus admittance matrix are often complex.

A clue to a method of determining bus admittances matrix is found by considering an n-terminal passive linear network having no nodes (Junctions) except the terminals. Such a network has, in general, an impedance element connected between each pair of terminals (including the neutral) as shown in fig. 3.2. for a network of four terminals, including neutral (a 3 machine system). In this retwork there are six impedance elements. For a network of m terminals (or n=(m-1) machines, if there are no loads or other shunt branches in the network, then m=n) there are, in general, $m(m-1)/2 = n(n+1)/2$ elements[2]. If any of these elements are lacking, they may be considered to be present as elements of zero self-admittance (i.e. infinite impedance or open circuit). If two or more elements are parallel, they may be replaced by an equivalent single element having an admittance equal to the sum of the admittances of the sevaral paralled elements. From this view point any network may be reduced to a network having one and only one element connected between each pair of nodes and having m(m-1)/2 elements. This form of network is called a mesh circuit.

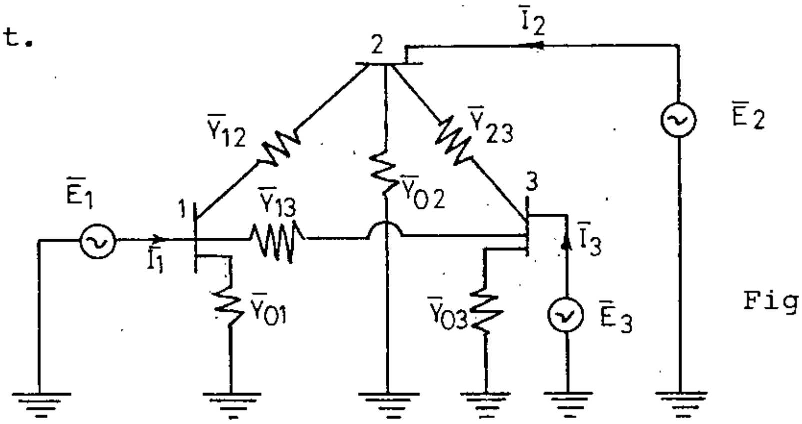


Fig. 3.2

Let $\bar{I}_1, \bar{I}_2, \bar{I}_3 \dots\dots\dots \bar{I}_n$ be the currents supplied by the buses of an n bus system, their voltages being $\bar{E}_1, \bar{E}_2, \bar{E}_3 \dots\dots \bar{E}_n$. If the admittance between the pair of buses (say p and q) is $\bar{Y}_{pq}$ them from 'kirchoff current law' we can write considering the system similar as fig 3.2 as :-

$$\bar{I}_1 = \bar{y}_{12}(\bar{E}_1 - \bar{E}_2) + \bar{y}_{13}(\bar{E}_1 - \bar{E}_3) + \dots\dots\dots \dots + \bar{y}_{1n}(\bar{E}_1 - \bar{E}_n) + \bar{y}_{01}\bar{E}_1$$

$$= (\bar{y}_{12} + \bar{y}_{13} + \dots\dots + \bar{y}_{1n} + \bar{y}_{01})\bar{E}_1 + (-\bar{y}_{12})\bar{E}_2 + \dots + (-\bar{y}_{1n})\bar{E}_n$$

$$= \bar{Y}_{11}\bar{E}_1 + \bar{Y}_{12}\bar{E}_2 + \dots\dots\dots\dots + \bar{Y}_{1n}\bar{E}_n$$

where $\bar{Y}_{11} = \bar{y}_{12} + \bar{y}_{13} + \dots\dots\dots\dots\dots + \bar{y}_{1n} + \bar{y}_{10}$

$= \sum^{n} \bar{y}_{1i} + \bar{y}_{10}$ is the self admittance or driving point admittance.

and $\bar{Y}_{12} = -\bar{y}_{12}$, $\bar{Y}_{13} = -\bar{y}_{13}$ and so on. These admittances are called transfer or mutual admittances. The transfer or mutual admittances can be written in general form as

$$\bar{Y}_{1i} = -\bar{y}_{1i} \quad \text{where } i = 2 \text{ to } n.$$

Similary we have,

$$\bar{I}_2 = \bar{Y}_{21}\bar{E}_1 + \bar{Y}_{22}\bar{E}_2 + \dots\dots\dots\dots + \bar{Y}_{2n}\bar{E}_n$$

$$\vdots$$

$$\bar{I}_n = \bar{Y}_{n1}\bar{E}_1 + \bar{Y}_{n2}\bar{E}_2 + \dots\dots\dots\dots + \bar{Y}_{nn}\bar{E}_n$$

The above equations can be written in matrix form as

$$\begin{bmatrix} \bar{I}_1 \\ \bar{I}_2 \\ \vdots \\ \bar{I}_n \end{bmatrix} = \begin{bmatrix} \bar{Y}_{11} & \bar{Y}_{12} & \dots\dots\dots & \bar{Y}_{1n} \\ \bar{Y}_{21} & \bar{Y}_{22} & \dots\dots\dots & \bar{Y}_{2n} \\ \vdots & \vdots & & \vdots \\ \bar{Y}_{n1} & \bar{Y}_{n2} & \dots\dots\dots & \bar{Y}_{nn} \end{bmatrix} \begin{bmatrix} \bar{E}_1 \\ \bar{E}_2 \\ \vdots \\ \bar{E}_n \end{bmatrix}$$

or $\bar{I} = \bar{Y}_{BUS}\bar{V}$

The matrix $\bar{Y}_{BUS}$ is termed as 'BUS ADMITTANCE MATRIX' The diagonal elements are the self admittance and the off diagonal elements are the mutual admittances. SElf admittances can be written in general form as

$$\bar{Y}_{ii} = \sum_{i=1}^{n} \bar{y}_{ij} + \bar{y}_{oj}$$

$$j = 1 \quad i \neq j$$

and mutual admittances as

$$\bar{Y}_{ij} = -\bar{y}_{ij} \qquad \begin{matrix} i = 1,n \\ j = 1,n \end{matrix} \quad i \neq j$$

3.5 ALGORITHM FOR DETERMINING MACHINE TO MACHINE ADMITTANCES AND NETWORK REDUCTION

In stability studies the transfer admittances between the different pairs of generators are required. For this purpose, it becomes convenient to assume a hypothetical internal voltage bus for each generator. To obtain the admittance between the generators, all the system buses excepting the assumed internal voltage buses are to be eliminated. Since we require the transfer admittance between the pair of different generators, both for faulted and post fault conditions the 'Y. bus matrix' must be reduced depending upon the fault condition which will be discussed at the end of this section.

There are different methods of node elimination. For example nodes may be eliminated by eliminating one bus at a time, i.e. the matrix coefficients are reduced by one column and one row at a time. This is continued until the required no. of nodes are left[2]. Computation time in this case is high. This computation time may be appreciably reduced by performing the method of matix node elimination as described below. All the buses of the system including the internal voltage buses are numbered serially[4]. For convenience numbering starts from the buses to be retained, in this case the internal voltage buses.

To obtain the required bus admittance matrix : Let us consider a transmission system having n buses (excluding ground bus) with m generator buses ($m < n$) having a multiport representation as shown in fig 3.3 In order to obtain the transfer admittances between different pairs of generators, we have to follow the following steps, sequantially:

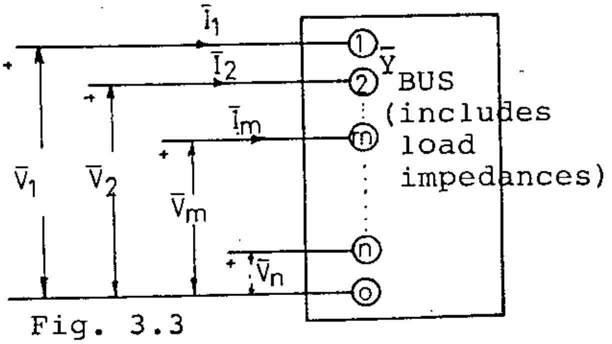


Fig. 3.3

Step 1:

Determine the bus admittance matrix $\bar{Y}_{BUS}$ as described previously. Without loss of generality the first m buses are designated as generator buses.

Step 2:

Replace all the bus loads by a constant shunt admittance $\bar{Y}_{Li}$ between ith bus and ground bus as

$$\bar{Y}_{Li} = \frac{P_{Li} - jQ_{Li}}{E_i^{\,2}} \qquad i = 1,2 \ldots\ldots\ldots\ldots n.$$

If there is no load at a particular bus j, $\bar{Y}_{Lj} = 0$. Modify $\bar{Y}_{BUS}$ by using

$$\bar{Y}_{BUS} = \bar{Y}_{BUS(old)} + \text{diag}\ (\bar{Y}_{Li})$$

Note that only the diagonal elements of $\bar{Y}_{BUS}$ are modified. Fig.3.4 shows the n-port representation with modified $\bar{Y}_{BUS}$.

Step 3:

This modified $\bar{Y}_{BUS}$ is augmented by the impedances of the synchronous machines corresponding to the direct axis transient reactances.[7] Let the voltages of the new buses be denoted by $\bar{E}_1$, $\bar{E}_2$ .... $\bar{E}_m$ and admittances of the machines be $\bar{Y}_1$, $\bar{Y}_2$ ...... $\bar{Y}_m$. These voltages are obtained by converting the sheduled generation at the generator[7,8,16,23] buses into equivalent voltage sources which are constant in magnitude but continously change in angle, in back of direct axis transient reactances as follows: (Fig.3.4).

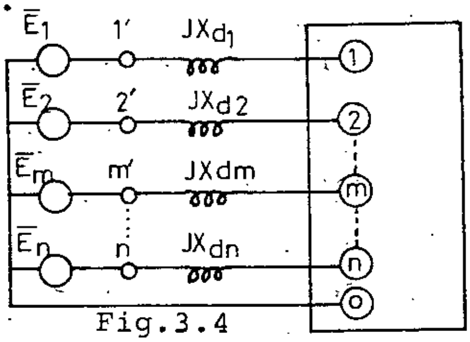


Fig.3.4

$$\bar{E}_t=\bar{V}_i+j\bar{X}_{di}\frac{P_{ai}-jQ_{Gi}}{V_i^*}$$

(i = 1,2 ...... m)

or $\bar{E}_t=|\bar{E}_i|\,\angle\delta_i$

where $\bar{X}_{di}$ = direct axis transient reactances of ith machine

$\bar{E}_i$ = voltage behind the transient reactance of the ith machine.

Since there are m numbers of machine, m new internal buses are thus created and the overall bus admittance matrix is obtained as follows (for the purpose of clarity internal buses are denoted by 1', 2', ...m').

Let modified $\bar{Y}_{BUS}$ (after inclusion of load impedances) be partitioned as:

$$\bar{Y}_{BUS} = \begin{array}{c|cc|cc|} & \multicolumn{2}{c}{m} & \multicolumn{2}{c}{n-m} \\ \hline & \bar{Y}_{11}\cdots\cdots\cdots & \bar{Y}_{1m} & \bar{Y}_{1,m+1}\cdots\cdots\cdots & \bar{Y}_{1n} \\ m & \vdots & & \vdots & \\ & \bar{Y}_{m1}\cdots\cdots\cdots & \bar{Y}_{mm} & \bar{Y}_{m,m+1}\cdots\cdots\cdots & \bar{Y}_{mn} \\ \hline & \bar{Y}_{m+1,1}\cdots\cdots & \bar{Y}_{m+1,m} & \bar{Y}_{m+1,m+1}\quad\cdots & \bar{Y}_{m+1,n} \\ n-m & \vdots & & & \\ & \bar{Y}_{n,1}\cdots\cdots & \bar{Y}_{n,m} & \bar{Y}_{n,m+1}\cdots\cdots\cdots & \bar{Y}_{nn} \\ \hline \end{array}$$

$$= \begin{array}{c|cc|} & m & n-m \\ \hline & \bar{Y}_1 & \bar{Y}_2 \\ n-m & \bar{Y}_3 & \bar{Y}_4 \\ \hline \end{array}$$

where $\bar{Y}_1$ of dimension mxm corresponds to the buses where generators are connected. $\bar{Y}_2$, $\bar{Y}_3$, $\bar{Y}_4$ are the other submatrices. Let the machine admittance matrix be denoted by

$$\bar{Y} = \text{diag}\ (\bar{y}_1, \ \ldots\ldots\ldots\ldots \ , \bar{y}_m)$$

Then the new $\bar{Y}_{BUS}$ of dimension (n+m) X (n+m) is symbolically represented as

$$\bar{Y}_{BUS} = \begin{array}{c|c|cc|} & m & m & n-m \\ \hline m & \bar{Y} & -\bar{Y} & 0 \\ \hline m & -\bar{Y} & \bar{Y}_1 + \bar{y} & \bar{Y}_2 \\ n-m & 0 & \bar{Y}_3 & \bar{Y}_4 \\ \hline \end{array} \qquad \ldots \qquad (1)$$

Setp 4:

The bus admittance at the interval nodes is obtained by applying the network reduction method. Before applying the network reduction formula, the fault condition must be appropriately reflected in the matrix. Thus if a symmetrical 3ϕ to ground fault at bus p is to be simulated, the row and column corresponding to the pth bus is deleted[7] during faulted condition and the diagonal elements of the above matrix must be reduced by $\bar{Y}_{BUSip}(i=1,\ldots\ldots m+n)$ because of the CB actions for the post fault condition.

Setp 5:

In the final stage of obtaining the machine to machine admittances, the modified bus admittance matrix(1) can be grouped as shown below:

$$\bar{Y}_{BUS} = \left[\begin{array}{c:cc} \bar{Y} & -\bar{Y} & 0 \\ \hdashline -\bar{Y} & \bar{Y}_1+\bar{Y} & \bar{Y}_2 \\ 0 & \bar{Y}_3 & \bar{Y}_4 \end{array}\right]$$

The partioned bus admittance matrix is written in terms of four submatrices as shown below

$$\bar{Y}_{BUS} = \left[\begin{array}{c|c} \bar{K} & \bar{L} \\ \hline \bar{L}^T & \bar{M} \end{array}\right]$$

where $\bar{K}$ is a submatrix of self and mutual admittances for the bus to be retained (mxm)

$\bar{M}$ is the submatix of self and mutual admittances for the bus to be eliminated (nxn)

$\bar{L}$ and $\bar{L}^T$ are submatrices consisting of mutual admittances between the buses to be retained and

From equation (2),

$$\bar{I}_a = \bar{K}\,\bar{V}_a + \bar{L}\,\bar{V}_x$$

$$\bar{I}_x = \bar{L}^T\,\bar{V}_a + \bar{M}\,\bar{V}_x$$

Since $\bar{I}_x$ is the vector composed of the currents entering the nodes to be eliminated, it should be zero. Therefore,

$$\bar{V}_x = \bar{M}^{-1}\,\bar{L}^T\,\bar{V}_a$$

and

$$\bar{I}_a = \bar{K}\,\bar{V}_a - \bar{L}\,\bar{M}^{1}\,\bar{L}^T\bar{V}_a$$

$$= (\bar{K} - \bar{L}\,\bar{M}^{1}\,\bar{L}^T)\,\bar{V}_a$$

$$= \bar{Y}\,\bar{V}_a$$

where $\bar{Y} = \bar{K} - \bar{L}\,\bar{M}^{-1}\,\bar{L}^T$ ... (3)

which is the bus admittance matrix for the network consist - of only the fictitious nodes at which E's of the machines are connected. Since E's are constant in magnitude so it is unnecessaary to develop a load flow program to calculate the electrical output power of the generators (and hence the bus voltages) in each step in solving the swing equations. The absence of load flow program in solving the swing equations of multi-machines system reduces the computer computational time appreciably.

3.6 COMPUTER PROGRAM

A computer program has been developed to calculate voltage back of transient reactances of machines and internal voltage angle employing equation (1) and to calculate the driving point and transfer admittances of machines using network reduction for a) prefault b) during fault and c) post fault conditions.

The input data required for this program are number of machines, terminal voltages of machines (magnitude and angles), transient reactances of machines, real and imaginary powers of machines, number of buses, impedances of transmission lines of the network, line charging admittances, and Loads on different buses.

With all these inputs, the computer first calculates the magnitudes and angles of voltages back of transient reactances. Depending upon the fault, the program forms the modified $\bar{Y}_{BUS}$ matrices. The machine to machine admittance matrix is then obtained by using equation (3) for faulted condition, post fault condition and prefault condition. The program is very simple and the detail program is given in the appendix. The detail flowchart for the above calculation is given below in fig.3.5.

CHAPTER 4

SWING EQUATION

4.1 INTRODUCTION

In this section we develop the swing equation for multimachine system to study the transient behaviour of a power system resulting from major disturbances such as faults, switching operation, sudden rejection of load or generation, etc. A major disturbance upsets the balance between mechanical input and electrical output of the generators with the result that some generators may accelerate while others may decelerate. The rotor angles of the different machines will undergo wide variation and if the swing of a machine is too large it may not be able to comeback to stable position and thus it may loose synchronism. The unstable generator will be disconnected from the system thus causing another disturbance which may lead to worse consequences. Synchronism must be maintained by timely operation of the circuit braker(CB); otherwise both voltages and frequencies may deviate so widely from the normal values that cascading outages and system separation may occur. Transient stability simulation studies are carried out to study these phenomena and the results enable the engineer to plan and coordinate his protection scheme efficiently. Critical clearing time of the CB can be computed and protection zones of distance relays during transient swings can be adjusted to values from short circuit and load flow studies. Transient stability studies are more complex since they involve the electro-mechanical dynamics of the synchronous machines and its associated controls such as excitation and governor system.

4.2 POWER ANGLE EQUATION FOR n-BUS SYSTEM

Let us consider an n-machine system to derive the electrical output power interms of driving point and transfer admittances. For simplicity, a 4-generator system is shown in fig.4.1.The current flow from the generators to the system can be written as

$$\bar{I}_1 = \bar{E}_1 \bar{Y}_{11} + \bar{E}_2 \bar{Y}_{12} + \dots\dots\dots\dots + \bar{E}_n \bar{Y}_n$$

$$\bar{I}_2 = \bar{E}_1 \bar{Y}_{21} + \bar{E}_2 \bar{Y}_{22} + \dots\dots\dots\dots + \bar{E}_n \bar{Y}_{2n}$$

$$\vdots$$

$$\bar{I}_n = + \bar{E}_1 \bar{Y}_{n1} + \bar{E}_2 \bar{Y}_{n2} + \dots\dots\dots\dots + \bar{E}_n \bar{Y}_{nn}$$

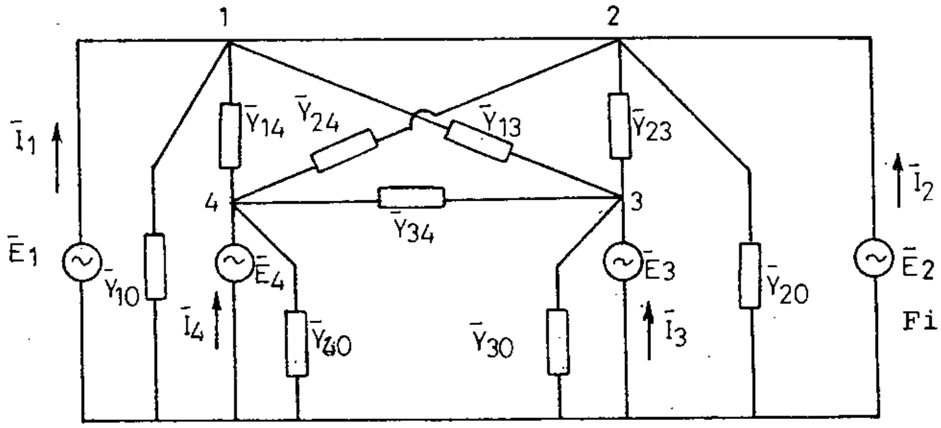


Fig.4.1

In general form the above equations can be written as

$$\bar{I}_i = + E^{-}{}_{1} \bar{Y}_{i1} \underline{/\delta_1 + \theta_{i1}} + \bar{E}_2 \bar{Y}_{i2} \underline{/\delta_2 + \theta_{i2}} + \dots\dots + \bar{E}_n \bar{Y}_{in} \underline{/\delta_n + \theta_{in}}$$

$$= \sum_{j=1}^{n} E_j V_{ij} \underline{/\delta_j + \theta_{ij}}$$

where $\bar{I}_i$ is the current from ith generator to the system and i varies from 1 to n.

The real power flow from a generator to the system can be written as

$$P = \bar{E}.\bar{I}$$

$$= E\ I\ \cos\theta\ \Big]_{I}^{E}$$

$\therefore$ Real power from ith generator to the system is

$$P_i = E_i . I_i \cos\theta_i \Big]_{I_i}^{E_i}$$

$$= E_i \sum_{j=1}^{n} E_j\ Y_{ij}\ \text{Cos}\ (\delta_i - \delta_j - \theta_{ij})$$

where i = 1, 2, ... n.

Since j is the only variable within sumation, so the above equation can be written as

$$P_i = \sum_{j=1}^{n} E_i E_j\ Y_{ij}\ \cos\ (\theta_{ij} - \delta_i + \delta_j)$$

where i = 1, 2, 3, ... n

E_i and E_j = internal voltage magnitude of the ith and jth bus respectively

Y_{ij} = driving point admittance when i = j and transfer admittance when i ≠ j

δ = internal voltage angle or power angle

$$T = \frac{WR^2}{g} \quad \alpha_m \qquad \ldots \quad (1)$$

where,

W = weight in lb. of the rotating parts of the machine

R = Radius of gyration in ft.

WR^2 = moment of inertia, lb-ft^2

g = acceleration due to gravity, ft/sec^2

α_m = mechanical angular acceleration, radian/sec^2

T = algebric sum of all torques, ft-lb.

The electrical angle θ_e equals $\frac{P}{2}$ times the mechanical angle θ_m.

Thus $$\theta_e = \frac{P}{2}\,\theta_m \qquad \ldots \quad (2)$$

where P = Number of poles of the machine

The frequency f in cycles per seconds is

$$f = \frac{P}{2} \cdot \frac{RPM}{60} \qquad \ldots \quad (3)$$

Then from equation (2) and equation (3), the electrical angle in radian is

$$\theta_e = \frac{60f}{RPM}\,\theta_m \qquad \ldots \quad (4)$$

The electrical angular position δ of the rator in radian with respect to the synchronously rotating armature mmf wave is given by

$$\delta = \theta_e - W_o t$$

where W_o = rated synchronous speed, rad/sec

t = time, sec.

$$T = \frac{WR^2}{g} \cdot \frac{RPM}{60f} \cdot \frac{d^2\delta}{dt^2} \qquad \ldots \qquad (8)$$

It is desirable to express the torque T in per unit (PU) which is the ratio of the actual torque to the base torque. The base torque T_B is defined[4] as the torque required to develop rated power at rated speed. Thus, base torque T_B is

$$T_B = \frac{\text{Base KVA X } (550/0.746)}{2\pi \;\; (RPM/60)}$$

where the base torque is in ft-lbs.

∴ From equation (8), T in PU is

$$T_{PU} = \frac{T}{T_B}$$

$$= \frac{\frac{WR^2}{g} \cdot \left(\frac{RPM}{60}\right)^2 \; (2\pi/f) \; (0.746/550)}{\text{Base KVA}} \cdot \frac{d^2\delta}{dt^2} \qquad \ldots (9)$$

The inertia constant H of a machine is defined[4] as,

$$H = \frac{(1/2)(WR^2/g)(2\pi)^2 (RPM/60)^2 (0.746/550)}{\text{Base KVA}}$$

Putting in equation (9),

$$T_{PU} = \frac{H}{\pi f} \; \frac{d^2\delta}{dt^2}$$

i.e.the net mechanical torque called accelarating torque T_a acting on the rotor of a generator is

$$T_a = \frac{H}{\pi f} \cdot \frac{d^2\delta}{dt^2} \qquad \ldots \qquad (10)$$

The torque acting on the rotor of a generator include the mechanical input torque from the prime mover, torques due to rotational losses (friction, windage, core loss), electrical output torques and damping torque due to prime-mover,generator and power system. The electrical and mechanical torques acting on the rotor of a motor are of opposite sign.

4.4 EFFECT OF DAMPER WINDING ON SWING EQUATION

During hunting or swing of a machine, a difference will exist between the rotor speed of the generator and the speed of the armature mmf wave. This relative speed induces a voltage in the damper winding thus causing a current to flow through it. This current produces a torque so as to oppose the very cause and help to restore the synchronous speed of the rotor. The torque or power developed in the damper winding is proportional to the rate of change of rotor speed with respect to the synchronously rotating armature mmf wave. Mathematically damping torque or power[23] can be written as

$$T_d \text{ or } P_d = D \frac{d\delta}{dt}$$

where D = constant depending on the type of damper winding, mainly on the resistance of the damper winding.

The difference between the input and output power of a generator is equal to the change of KE plus the torque or power developed in damper winding. So if we neglect the rotational losses, the accelarating torque T_a is

$$\begin{aligned} T_d + T_a &= T_m - T_e \\ &= P_{gi} - P_{go} \qquad \ldots \qquad (11) \end{aligned}$$

where T_m = mechanical torque

T_e = electrical torque

T_d = damping torque

From (11), $P_{gi} - P_{go} = T_d + T_a$

$$= D \frac{d\delta}{dt} + \frac{H}{\pi f} \frac{d^2\delta}{dt^2}$$

$$\text{or} \quad \frac{d^2\delta}{dt^2} = \frac{\pi f}{H} \left\{ P_{gi} - P_{go} - D \frac{d\delta}{dt} \right\} \qquad \ldots \quad (12)$$

This is a homogeneous higher order non-linear differential equation. Practically, the accelerating power or the difference between the input and output power is much higher than the damping torque or power.

4.5 SWING EQUATION WITH SPEED GOVERNOR CHARACTERISTICS

The effect of speed governor is not normally considered in most transient stability studies as the speed governor is slow in response and can not come into effect in the short time interval of transient stability study. However, with modern control cuircuits using microprocessor, electronic control device etc. the speed governors are very fast and comes into effect within the study time of the transient stability. So it becomes important to include the effect of speed governors in transient stability study in order to get more accurate and realistic results.

The governor characteristic[10] for a large steam turbo-alternator is shown in fig 4.2 and it is seen that there is a 4% drop in speed between no load and full load on the turbine.

first consider the problem of controlling the real power output of electric generators within the prescribed area in response to change in system speed (ΔW) and tie line loading or the relation of these to each other, so as to maintain the scheduled system speed and the established interchange with other area within predetermined limits. The term 'automatic load frequency control (ALFc)' is often used to identify this problem area.

4.6 FUNDAMENTAL CHARACTERISTICS OF THE POWER CONTROL MECHANISM OF AN INDIVIDUAL GENERATOR

The real power in a power system is being controlled by controlling the driving torques of the individual turbines (steam or hydro) of the system. Fig 4.4 shows in a highly schematical fashion, the operating features of such a speed governing system.

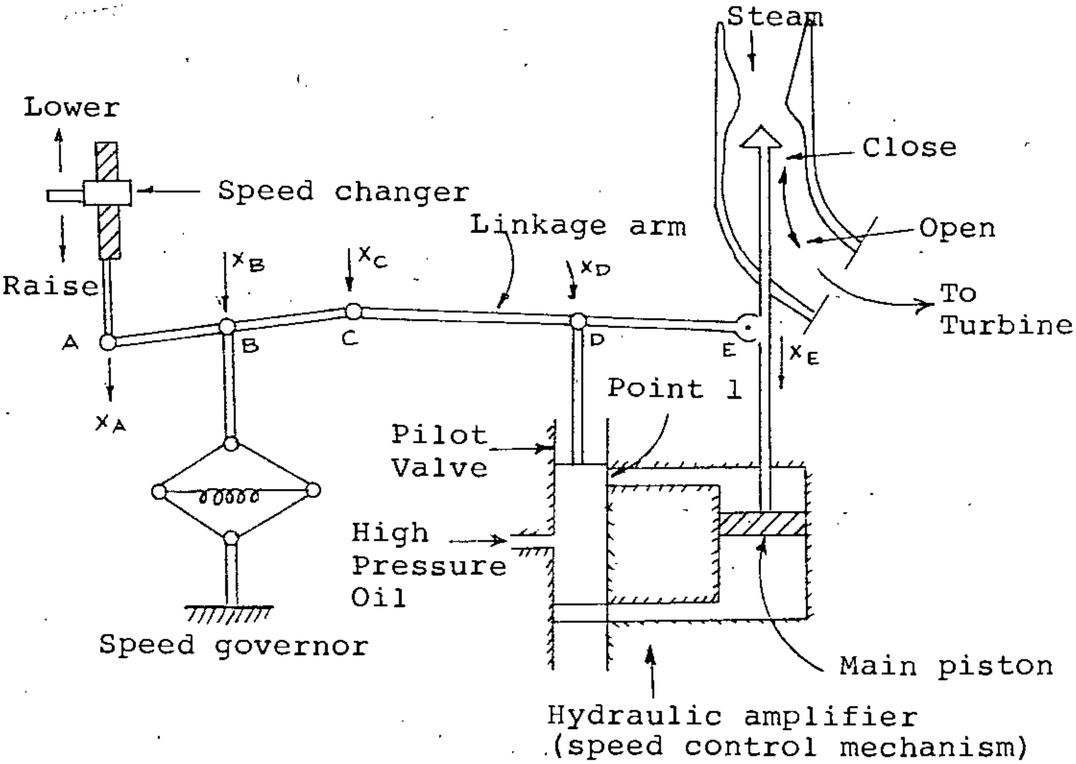


Fig. 4.4

By controlling the position X_E, of the governor-controlled valves (or gates, in the case of hydroturbine), we can exert control over the flow of high-pressure steam (or water) through the turbine, and thus the turbine torque, which, via the electromechanical mechanism determines the generator real power output P_g.

Very large mechanical forces, needed to position the main valve (or gate) against the high steam (or hydro) pressure, are obtained via several stages of hydro amplifiers. In our simplified version we show only one stage. The input to this amplifier is the position X_D of the pilot valve. The output is the position X_E of the main piston. Because the high pressure hydraulic fluid exerts only a slight differential force on the pilot valve, the force amplification is very large. The position of the pilot valve can be affected via the linkage system in three ways:

(1) Directly, by moving the linkage point A by "raise" on "lower" commands of the speed changer.

(2) Indirectly, via feed back, due to position changes of the main piston.

(3) Indirectly, via feedback, due to position changes of linkage point B resulting from speed changer.

The working of the mechanism can be explained as follows: if we give a rise command to the speed changer the link point

A moves downward. At this time no speed changes have taken place, which means that point B is fixed and since linkage arm 1 and 2 are stiffly coupled and so on arms 3 and 4, points C and D therefore move upward. The pilot valve opens point 1 as it moves upward with point D. High pressure oil flows through the open point 1 and causes the main piston to move downward. As a result of this downward movement of main piston, more steam flow into the turbine which means an increase in generator output. It can be shown similarly that a speed drop will give the same effect.

4.7 MATHEMATICAL MODEL OF SPEED-GOVERNING SYSTEM:

To obtain a mathematical model of speed-governing system, let us assume all the incremental movements ΔX_A, ... ΔX_E caused by the speed-changer command power ΔP_C or movement of linkage point B due to ΔW are positive in the directions indicated.

Since all linkage movements are small, we have the linear relationships[5],

$$\Delta X_C \underset{-}{\propto} \Delta f \quad \text{when} \quad \Delta P_C = 0$$

$$= K_1 \Delta f$$

$$\Delta X_C \underset{-}{\propto} -\Delta P_C \quad \text{when} \quad \Delta f = 0$$

$$= -K_2 \Delta P_C$$

when both ΔP_C and Δf exist, then

$$\Delta X_C = K_1 \Delta f - K_2 \Delta P_C \qquad \ldots \qquad (14(a))$$

where K_1 and K_2 are positive constant and depends upon the lengths of the linkage arms 1 and 2 and upon the proportional constants of the speed changer and the speed governor.

Similarly we can write

$$\Delta X_D = K_3 \, \Delta X_C + K_4 \, \Delta X_E \qquad \ldots \qquad (14(b))$$

where the positive constants K_3 and K_4 depend upon the lengths of the linkage arms 3 and 4.

If we assume that the oil flow into the hydraulic motor is proportional to position ΔX_D of the Pilot valve, we obtain the following relationship for the position of the main piston:

$$\Delta X_E = K_5 \int (-\Delta X_D) \, dt \qquad \ldots \qquad (15)$$

where the positive constant K_5 depends upon orifice and cylinder geometrics and fluid pressure.

By taking the Laplace of equations (14) and (15) we get

$$\Delta X_C(S) = K_1 \, \Delta F(S) - K_2 \, \Delta P_C(S)$$

$$\Delta X_D(S) = K_3 \, \Delta X_C(S) + K_4 \, \Delta X_E(S)$$

$$\Delta X_E(S) = - \frac{\Delta X_D(S)}{S} \, K_5 .$$

From the above equations we can write,

$$\begin{aligned} K_4 \, \Delta X_E(S) &= \Delta X_D(S) - K_3 \, \Delta X_C(S) \\ &= \Delta X_D(S) - K_3 K_1 \, \Delta F(S) + K_3 K_2 \, \Delta PC(S) \\ &= \frac{S}{K_S} \, \Delta X_E(S) - K_1 K_3 \, \Delta F(S) + K_2 K_3 \, \Delta P_C(S) \end{aligned}$$

$$\therefore \; \Delta X_E(S) = \frac{K_2 K_3 \, \Delta P_C(S) - K_1 K_3 \, \Delta F(S)}{K_4 + S/K_5} \qquad \ldots \qquad (16)$$

where we introduce, $\Delta F(S) = L\{\Delta f\}$

$$\Delta X_E(S) = L\{\Delta \chi_E\}$$

$$\Delta P_C(S) = L\{\Delta P_C\}$$

we can rewrite the equation (16) as follows

$$\Delta X_E(S) = \frac{K_G}{1 + ST_G} \{\Delta P_C(S) - \frac{1}{R} \Delta F(S)\}$$

$$= G_G(S) \{\Delta P_C(S) - \frac{1}{R} \Delta F(S)\} \quad \ldots \quad (17)$$

where, $R = \frac{K_2}{K_1}$ = speed regulation due to governor action

$K_G = \frac{K_2 K_3}{K_4}$ = Static gain of speed governing mechanism

$T_G = \frac{1}{K_4 K_5}$ = time constant of speed-governing mechanism

$G_G(S) = \frac{K_G}{1+ST_G}$ = transfer function of speed-governing mechanism.

T_G is a measure of the reaction speed of the mechanism. Normal values are less than 100 ms.[5]

4.8. TURBINE MODEL

We are not primarily interested in turbine valve position rather in the resulting generator power increase ΔP_g. The change in valve position, ΔX_E, causes an incremental increase in turbine power, ΔP_T, which, via the electromechanical interactions within the generator, will result in an increased generator power ΔP_g.

This overall mechanism is relatively complicated, particularly if the generator voltage simultaneously undergoes wild swings due to major network disturbances. If we assume that the voltage level is constant and the torque variations are of small size, then an incremental analysis gives a relatively simple dynamic relationship between ΔX_E and ΔP_g. Such an analysis reveals considerable differences, not only between steam turbines and hydroturbines, but also between various types (reheat and nonreheat) of steam turbines. In the crudest[5] model representation we can characterize a non-reheat turbine generator with a single gain factor K_T and a single time constant T_T and thus write,

$$G_T(S) = \frac{\Delta P_g(S)}{\Delta X_E(S)} = \frac{K_T}{1+ST_T} \qquad \ldots \qquad (18)$$

Typical time constant T_T lies in the range 0.2 to 2 sec.[5,13]

The second order differential equation (12) can be written as two first order differential equations

$$\frac{d\delta}{dt} = W - W_o \qquad \ldots \qquad (19)$$

$$\text{and} \quad \frac{dw}{dt} = \frac{\pi t}{H}\left(P_{gi} - P_{go} - D\frac{d\delta}{dt}\right)$$

$$= \frac{\pi f}{H}\{P_{gi} - P_{go} - D(W - W_o)\} \qquad \ldots \qquad (20)$$

Taking laplace of equation (20) we have

$$SW(S) = \frac{\pi f}{H}\{P_{gi}(S) - P_{go}(S) - D(W(S) - \frac{W_o}{S})\}$$

$$\text{or } \{\frac{H}{\pi f}S + D\}\, W(S) = P_{gi}(S) - P_{go}(S) + \frac{DW_o}{S}$$

$$\therefore \quad W(S) = \frac{P_{gi}(S) - P_{go}(S)}{D(1+ST)} + \frac{W_o}{S(1+ST)} \qquad \ldots \qquad (21)$$

$$\text{where } T = \frac{H}{\pi f D}$$

In standard block diagram symbols equations (17), (18) and (21) can be represented as in fig. 4.5

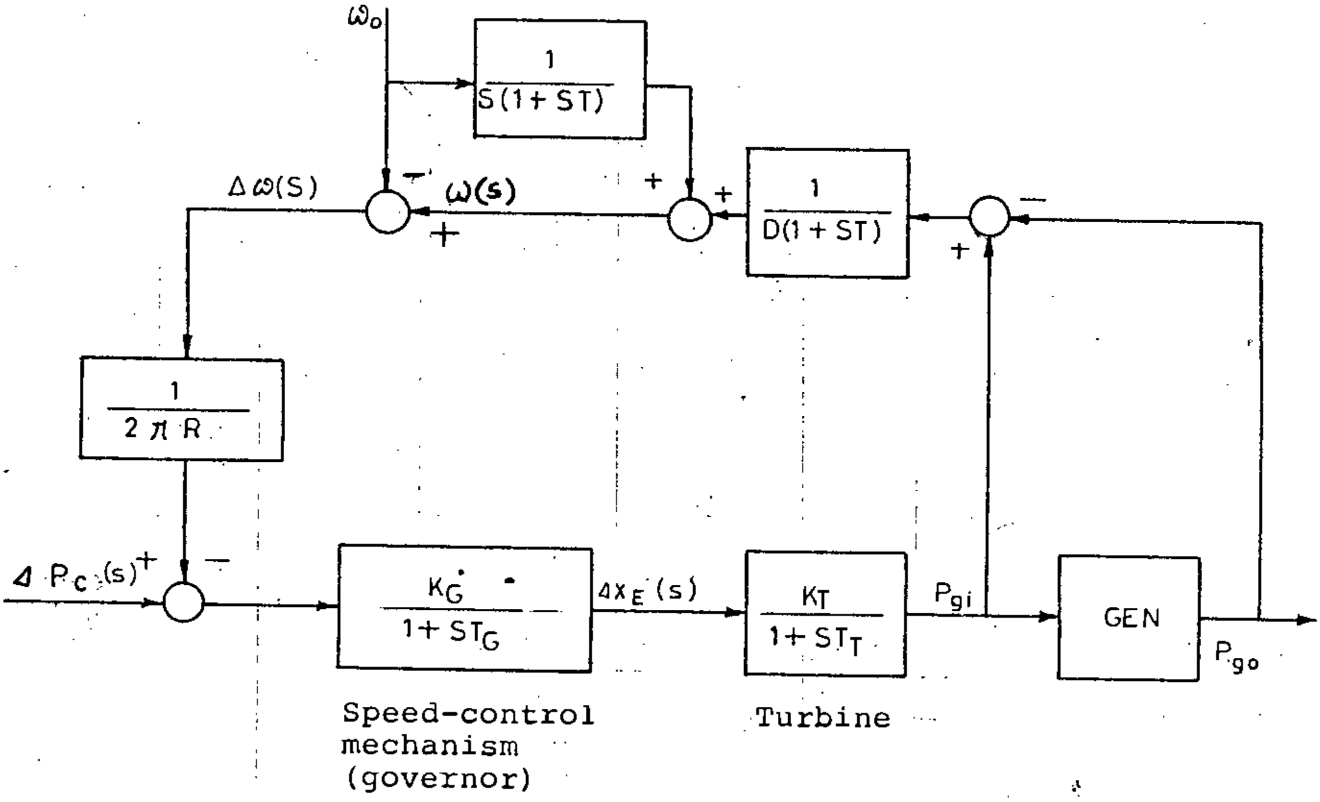


Fig. 4.5

This diagram represents the linearlized model of a non-reheat turbine controller, including the speed governor. It is very practical to arrange so that the proportionality constants K_G X K_T is unity, and we then have,

$K_G K_T = 1.$

From the block diagram in fig 4.5 we directly obtain the following relationships:

$$\Delta X_E(S) = \frac{1}{1+ST_G}\{\Delta P_C(S) - \frac{1}{RW_o}\Delta W(S)\}$$

$$P_{gi}(S) = \frac{1}{1+ST_T}\Delta X_E(S) \qquad \text{(where R is in PU)}$$

By taking inverse transformation of the above equations, we get the following two differential equations:

$$\frac{d}{dt}(X) = \frac{1}{T_G}\{P_{mo} - \frac{1}{RW_o}\Delta W - X\} \qquad \text{where}$$

$$X = X_E^o + \Delta X_E$$

$$\frac{d}{dt}(P_{gi}) = \frac{1}{T_T}(X - P_{gi})$$

$$P_{mo} = P_C^o + \Delta P_C$$

So if we want to take the effect of speed governor control during transient periods, we must solve the equations given below for the jth machine of a n machines system somultaneously.

$$\frac{d^2\delta_j}{dt^2} = \frac{\pi f}{H_j}\left\{P_{gji} - P_{goj} - D_j\frac{d\delta_j}{dt}\right\}$$

$$\frac{dX_j}{dt} = \frac{1}{T_{Gj}}(P_{moj} - \frac{W_j - W_o}{RW_o} - X_j)$$

$$\frac{dP_{gij}}{dt} = \frac{1}{T_{Tj}}(X_j - P_{gij})$$

It is quite possible that the turbine command signal during a transient swing would be of such a magnitude as to command a turbine power beyond the capability of the turbine. The valve position X must lie within limits

$$0 < X < P_{max}$$

and we must make sure, in our computer program, that X never can exceed these limits.

Similarly we get 3 X n higher order differential equations for n-machines which are to be solved simultaneously for obtaining swing curves.

4.9 REDUCTION OF GENERATORS TO A SINGLE UNIT

When [12, 19,20, 27] two or more generators are connected to a common bus or a number of generating units are operating in a generating station on different busbars, then the generators or generating stations can be replaced by a single generator having equivalent inertia constant H_e which is given by

$$H_e = H_1 \frac{S_1}{S_b} + H_2 \frac{S_2}{S_b} + \ldots\ldots + H_n \frac{S_n}{S_b}.$$

where S_1, S_2, ..., S_n are the MVA ratings of the generator,

H_1, H_2, ..., H_n are the inertia constants of the generators and

S_b is the base MVA.

The above equation can be obtained as follows:
Let the power delivered by a machine having inertia constant

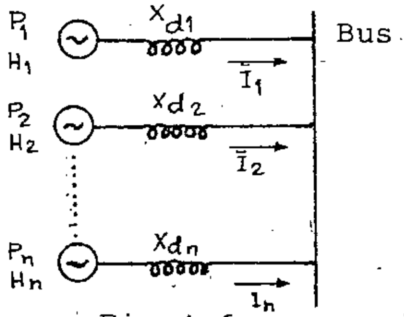


Fig.4.6

H and rating S be P. Then the total current supplied by the generator is

$$\bar{I} = \bar{I}_1 + \bar{I}_2 + \ldots\ldots\ldots\ldots + \bar{I}_n = \sum_{i=1}^{n} \bar{I}_i$$

where subscripts 1, 2, ..., n are denoted as machine numbers. Since the toal power delivered by the system of generators is the sum of the delivered power outputs, we get

$$P = P_1 + P_2 + \ldots\ldots\ldots\ldots + P_n = \sum_{i=1}^{n} P_i$$

Since n machines are connected in parallel, the system can be replaced by simply one machine whose equivalent reactance (or impedance) will be the parallel combination of the armature reactances, or the equivalent reactance $\bar{X}_d$ can be expressed as

$$\frac{1}{\bar{X}_d} = \frac{1}{\bar{X}_{d1}} + \frac{1}{\bar{X}_{d2}} + \ldots\ldots\ldots\ldots + \frac{1}{\bar{X}_{dn}}$$

or $\bar{Y}_d = \bar{Y}_{d1} + \bar{Y}_{d2} + \ldots\ldots\ldots\ldots + \bar{Y}_{dn}$

$$= \sum_{i=1}^{n} \bar{Y}_{di}$$

In per unit values total power

$$\frac{P}{S_b} = \frac{P_1}{S_b} + \frac{P_2}{S_b} + \ldots\ldots\ldots\ldots + P_n/S_b$$

where S_b = Base MVA

Multiplying both sides by time of operation t, the above equation can be written as

$$\frac{P.t}{S_b} = \frac{P_1 t}{S_b} + \frac{P_2 t}{S_b} + \ldots\ldots\ldots\ldots + \frac{P_n t}{S_b}$$

$$= \frac{P_1 t}{S_1} \frac{S_1}{S_b} + \frac{P_2 t}{S_2} \frac{S_2}{S_b} + \ldots\ldots\ldots + \frac{P_n t}{S_n} \frac{S_n}{S_b}$$

If P's are in MW, t in seconds and S's are in MVA, then all these terms have the unit MJ/MVA, which is the recommended unit for interia constant H's of the generators, thus

$$H = H_1 \frac{S_1}{S_b} + H_2 \frac{S_2}{S_b} + \ldots\ldots\ldots + H_n \frac{S_n}{S_b}$$

CHAPTER 5

SOLUTION OF SWING EQUATIONS

5.1 TECHNIQUE OF SOLVING 3n-HIGHER ORDER DIFFERENTIAL EQUATIONS:

There are 3 X n higher order differential equations for n-machine system which are to be solved for swing curves. The electrical output power P_{ei} of the ith generator is a nonlinear function of the dependent variables δ_i which make the differential equations non-linear. In general, no analytical solutions exist for non-linear differential equations and therefore, these system differential equations must be solved numerically. There are several numerical methods of solving differential equations. In this analysis equations are solved by Runge-Kutta method.

The equations to be solved for the ith machine are —

$$D_i \frac{d\delta_i}{dt} + \frac{H_i}{\pi f} \frac{d^2\delta_i}{dt^2} - P_{ai} = 0 \quad \ldots\ldots \quad (1(a))$$

$$\frac{dX_i}{dt} = \frac{1}{T_{Gi}} \left(P_{moi} - \frac{W_i - W_o}{RW_o} - X_i\right) \quad \ldots \quad (1(b))$$

$$\frac{dP_{si}}{dt} = \frac{1}{T_{Ti}} (X_i - P_{si}) \quad \ldots \quad (1(c))$$

where $P_{ai} = P_{si} - P_{ei}$ = accelerating power

The second order equation 1(a) can be written[14,23,25] as two simulataneous first order differential equation by putting

$$\frac{d\delta_i}{dt} = W_i - W_o \qquad \ldots \qquad (2(a))$$

So equation 1(a) becomes

$$\frac{H_i}{\pi f}\;\frac{dW_i}{dt} + D_i(W_i - W_o) - P_{ai} = 0$$

or $$\frac{dW_i}{dt} = -\frac{\pi f D_i}{H_i}(W_i - W_o) + \frac{\pi f}{H_i}\left\{P_{si} - \sum_{j=1}^{n} E_i E_j Y_{ij} \cos(\theta_{ij} - \delta_i + \delta_j)\right\} \qquad (2(b)$$

and other two of equation (1) are

$$\frac{dX_i}{dt} = \frac{1}{T_{Gi}}\left\{P_{moi} - \frac{W_i - W_o}{W_o R} - X_i\right\} \qquad \ldots \qquad (2(c))$$

$$\frac{dP_{si}}{dt} = \frac{1}{T_{Ti}}\left\{X_i - P_{si}\right\} \qquad \ldots \qquad (2(d))$$

So for a single machine, we can write the second order differential equation into two first order differential equations and we have to solve four first order differential equations in order to take the effect of speed-governor into account. Similaryly, for n —machines system we need to solve 4 X n first order differential equations to obtain the swing curves.

To solve the equations we used Runge-Kutta fourth order approximation in which the order of the error is $(\Delta T)^5$, where (ΔT) is the time interval.

From equations (2)

$$\frac{d\ \delta_i}{dt} = f_1(W_i)$$

$$\frac{dW_i}{dt} = f_2(\delta_i, P_{si})$$

$$\frac{dX_i}{dt} = f_3\ (X_i,\ W_i)$$

and $$\frac{dP_{si}}{dt} = f_4\ (X_i,\ P_{si})$$

If $W_i(0)$ and $\delta_i(0)$, $X_i(0)$ and $P_{si}(0)$ are the velocity of the rotor, angle of the rotor, intermediate variable and the shaft or turbine output power respectively of the ith machine at t=0, then, their corresponding values at $t = 0 + \Delta\ t$ can be obtained from the following expressions

$$W_i' = W_i^o + \Delta W_i^o$$

$$\delta_i' = \delta_i^o + \Delta\delta_i^o$$

$$X_i' = X_i^o + \Delta X_i^o \qquad \ldots \qquad (3)$$

and $$P_{si}' = P_{si}^o + \Delta P_{si}^o$$

where $\Delta W_i^o, \Delta\delta_i^o$, ΔX_i^o and ΔP_{si}^o are the rotor velocity increment, rotor angle increment, intermediate variable increment and shaft power increment respectively of the ith machine during the time interval of t=0 and $t=0 + \Delta t$. The values of ΔW_i^o, $\Delta\delta_i^o$, ΔX_i^o, ΔP_{si}^o can be obtained from the following relations

$$\Delta\delta_i^o = \Delta t\,(m_{1i} + 2m_{2i} + 2m_{3i} + m_{4i})/6 \qquad \ldots \qquad (4(a))$$

$$\Delta W_i^o = \Delta t\,(n_{1i} + 2n_{2i} + 2n_{3i} + n_{4i})/6 \qquad \ldots \qquad (4(b))$$

$$\Delta X_i^o = \Delta t\,(L_{1i} + 2L_{2i} + 2L_{3i} + L_{4i})/6 \qquad \ldots \qquad (4(c))$$

$$\Delta P_{si}^o = \Delta t\,(K_{1i} + 2K_{2i} + 2K_{3i} + K_{4i})/6 \qquad \ldots \qquad (4(d))$$

These m's, n's L's and K's are the changes in the δ_i, W_i X_i, and P_{si} respectively obtained using derivatives evaluated at predetermined points ($t=t_o$). The first set of estimation of changes are obtained from

$$m_{1i} = W_{i(t)} - W_o$$

$$n_{1i} = \frac{\pi f}{H_i}\{P_{si(t)} - P_{ei(t)} - D_i(W_{i(t)} - W_o)\}$$

$$i = 1, 2, \ldots\ldots\ldots, n$$

where $W_{i(t)}$, $P_{si(t)}$ and $P_{ei(t)}$ are ith machine speed, shaft and output electrical power respectively at time t. The second set of changes in δ_i and W_i are obtained from

$$m_{2i} = \{(W_{i(t)} + \frac{n_{1i}}{2}) - W_o\}$$

$$n_{2i} = \frac{\pi f}{H_i}\{P_{si(t)} - P_{eI}^{(1)} - D_i(W_{i(t)} + \frac{n_{1i}}{2}) - W_o\}$$

$$i = 1, 2, \ldots\ldots\ldots\ldots\ldots, n$$

where $P_{ei}^{(1)}$ are the machine powers powers when the internal voltage angles are $\delta_{i(t)} + (m_{1i}/2)$.

The third set of estimation are obtained from

$$m_{3i} = \{(W_{i(t)} + \frac{n_{2i}}{2}) - W_o\}$$

$$n_{3i} = \frac{\pi f}{H_i} \{ P_{si(t)} - P^{(2)}_{ei(t)} - D_i(W_{i(t)} + \frac{n_{2i}}{2} - W_o\}$$

$$i = 1, 2, \ldots\ldots\ldots\ldots, n$$

When $P^{(2)}_{ei}$ are obtained from a second solution of the network equations with voltage angles equal to

$$\delta_{i(t)} + (m_{2i}/2)$$

The forth estimates are obtained from

$$m_{4i} = \{(W_{i(t)} + n_{3i}) - W_o\}$$

$$n_{4i} = \frac{\pi f}{H_i} \{ P_{si(t)} - P^{(3)}_{ei(t)} - D_i(W_{i(t)} + \frac{n_{2i}}{2} - W_o) \}$$

$$i = 1, 2, \ldots\ldots\ldots\ldots, n$$

where $P^{(3)}_{ei(t)}$ are obtained from a third solution of the network equations with internal voltage angles equal to

$$\delta_{i(t)} + m_{3i}$$

The final estimates of the internal voltage angles δ_i and machine speeds at time (t+ Δt) are obtained by substituting the m's and n's into equations 4(a) and 4(b) respectively. By using this new values of δ_i and W_i we find the estimations of L's and K's as follows:

$$L_{1i} = \frac{1}{T_{Gi}} \{ P_{moi} - \frac{W_{i(t)} - W_o}{W_o R} - X_{i(t)} \}$$

$$L_{2i} = \frac{1}{T_{Gi}} \{ P_{moi} - \frac{W_{i(t)} - W_o}{W_o R} - (X_{i(t)} + L_{1i}/2) \}$$

$$L_{3i} = \frac{1}{T_{Gi}} \{ P_{moi} - \frac{W_{i(t)} - W_o}{RW_o} - (X_{i(t)} + L_{2i}/2 \}$$

$$L_{4i} = \frac{1}{T_{Gi}} \{ P_{moi} - \frac{W_{i(t)} - W_o}{RW_o} - (S_{i(t)} + L_{3i} \}$$

and $$K_{1i} = \frac{1}{T_{Ti}} \{ X_{i(t)} - P_{si(t)} \}$$

$$K_{2i} = \frac{1}{T_{Ti}} \{ X_{i(t)} - (P_{si(t)} + K_{1i}/2) \}$$

$$K_{3i} = \frac{1}{T_{Ti}} \{ X_{i(t)} - (P_{si(t)} + K_{2i}/2) \}$$

$$K_{4i} = \frac{1}{T_{Ti}} \{ X_{i(t)} - (P_{si(t)} + K_{3i}) \}$$

The final estimates of intermadiate variable (X_i) and shaft or turbine output power (P_{si}) at time ($t + \Delta t$) are obtained by substituting the L's and K's into equations 4(c) and 4(d) respectively. Then the time is advanced by Δt and the process is repeated until t equals the maximum time T_{max}.

5.2 COMPUTER PROGRAM:

A subroutine has been developed to solve the swing equations for m number of generatorsby using Rung-Kutta forth order approximation. For this program the input data required are the machine to machine transfer and driving point admittances during fault,post fault and pre fault conditions, the internal voltage magnitude with angles. These datas are obtained by using the flow chart given in the previous chapter. The other datas required are: inertia constants, time constants for governors and turbines, real power output of the machines.

This subroutine in turn calls two other subroutines (1) to calculate the accelerating power,(2) to calculate the turbine output power considering the effect of speed governor. The detail computer programmes are given in the appendix and the flow chart for Runge-Kutta solution is given in Fig.5.1.

5.3 FLOW CHART

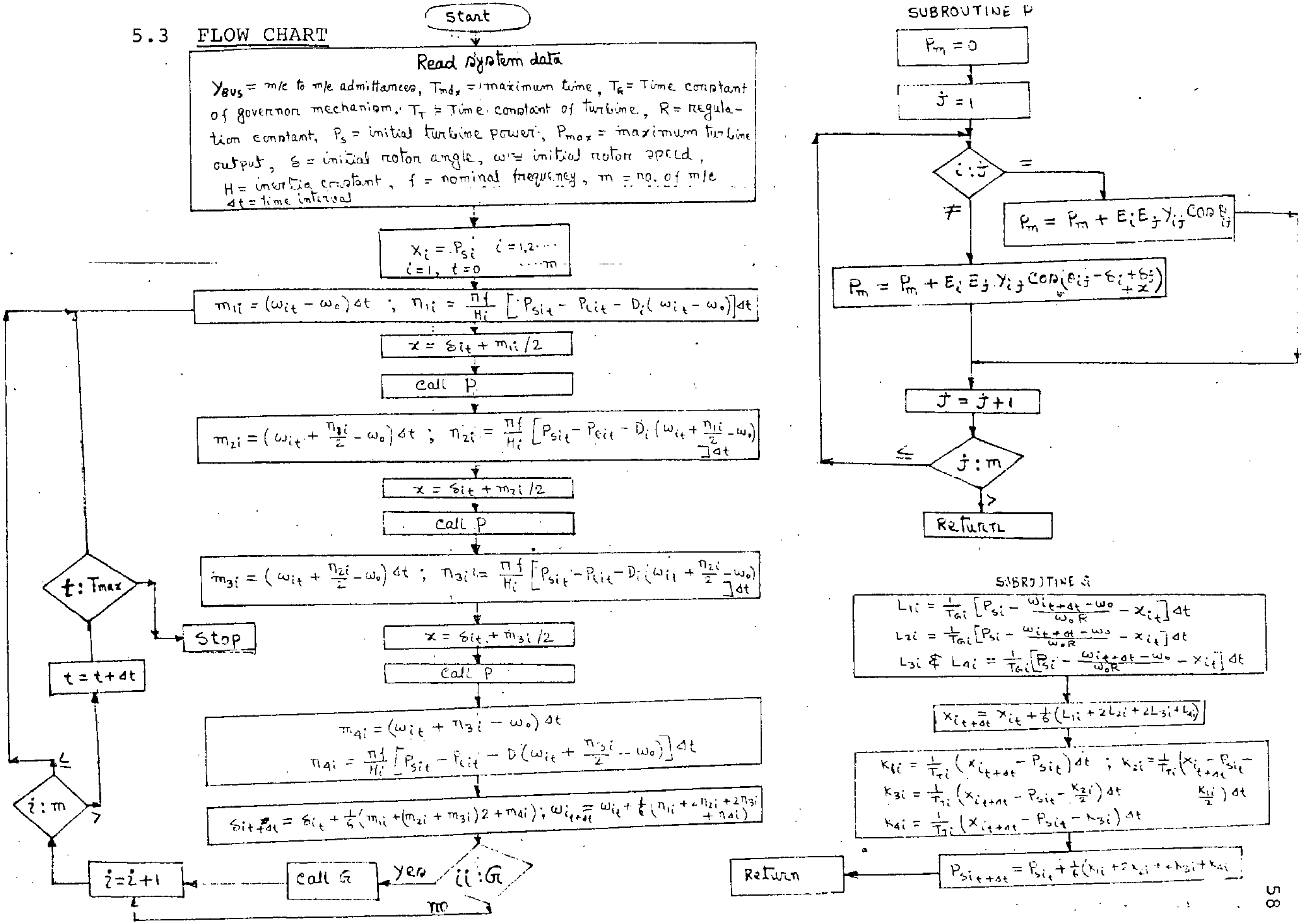


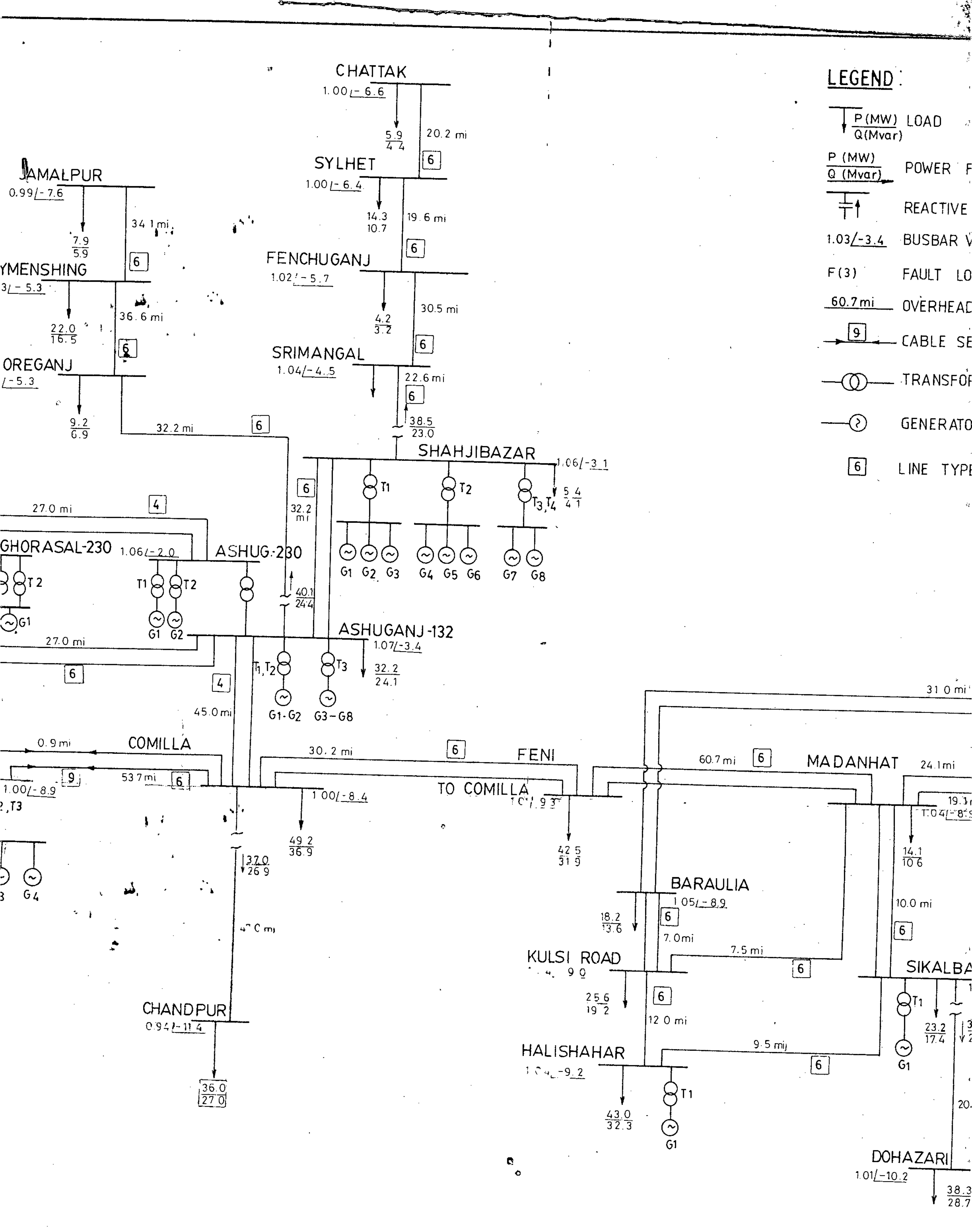
Fig. 5.1

CHAPTER 6

SYSTEM MODEL AND RESULTS

6.1 INTRODUCTION:

The national grid system of Bangladesh Power Development Board (BPDB) with East-West interconnector and expected peak demand of 1380 MW in 1987 is considered as a model for this study. There are a total number of 51 buses 85 transmission lines with 46 generators operating in 13 different power stations to deliver the peak load as shown in Drawing-1. The generator data i.e. the rated MW, rated MVA, Engine type, direct-axis transient reactance and inertia constant are given in Table-1. The transformer data connected to generator and the interbus transformer data are given in Table-2 and Table-3 respectively. All the technical data necessary for transient stability study, specially for the governor mechanism, are not available. Standard values are assumed for this study as shown in Table-4. To reduce the computational time, all the radial load lines are replaced by a single load connected at the radiating bus. After replacing the radial load lines, there are only 36 buses having 69 transmission lines connected between them. The bus number, bus name, bus voltage magnitude in PU with angle in degree and bus loads in MW and MVAR are given in Table-5. The line parameters i.e. different conected buses, line impedances in PU and charging admittances in PU is given in Table-6. The equivalent inertia constants, equivalent reactances, total generating real and reactive powers in PU along with calculated internal bus voltages in PU and angle in degree is given in Table-7.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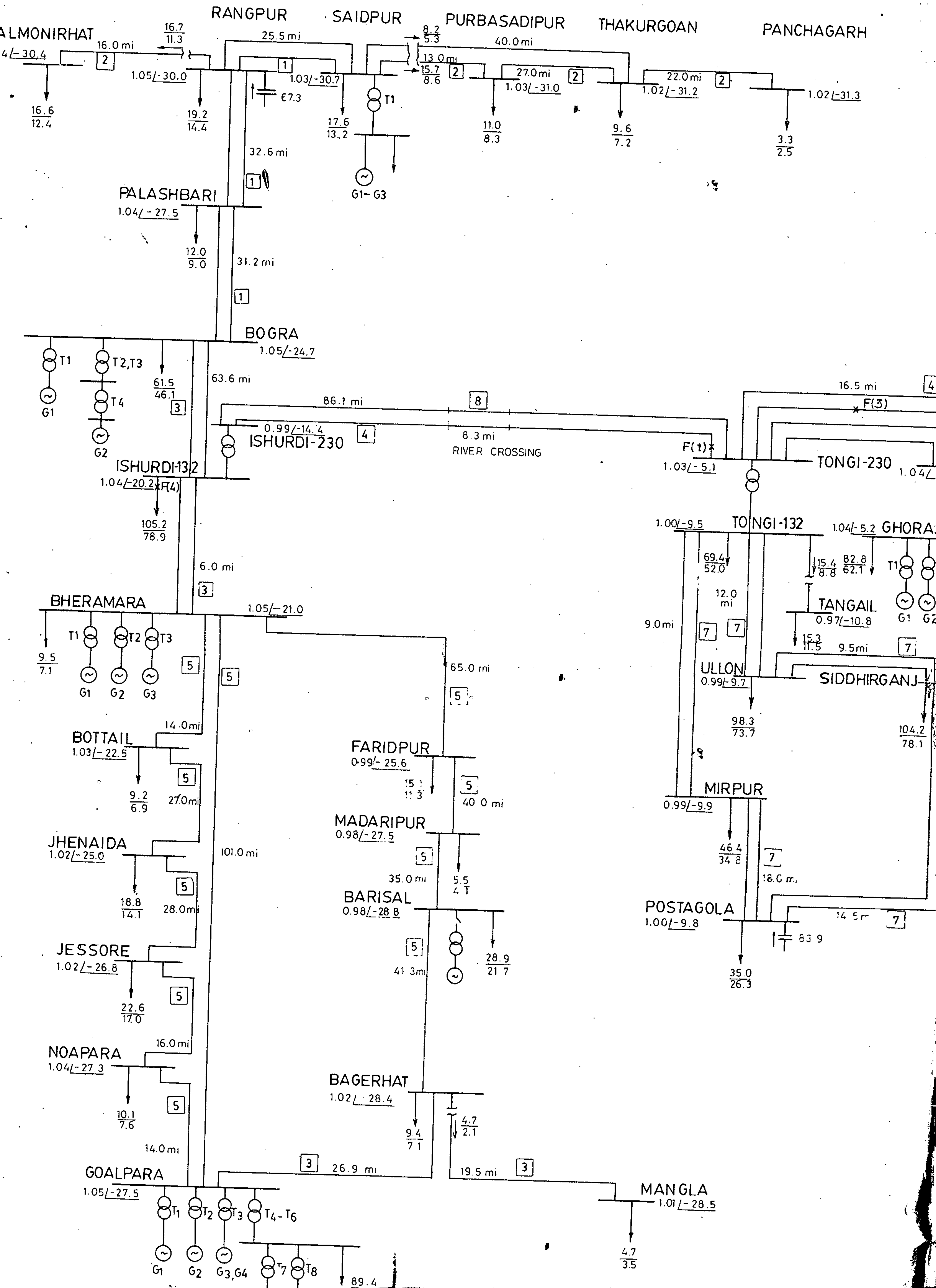
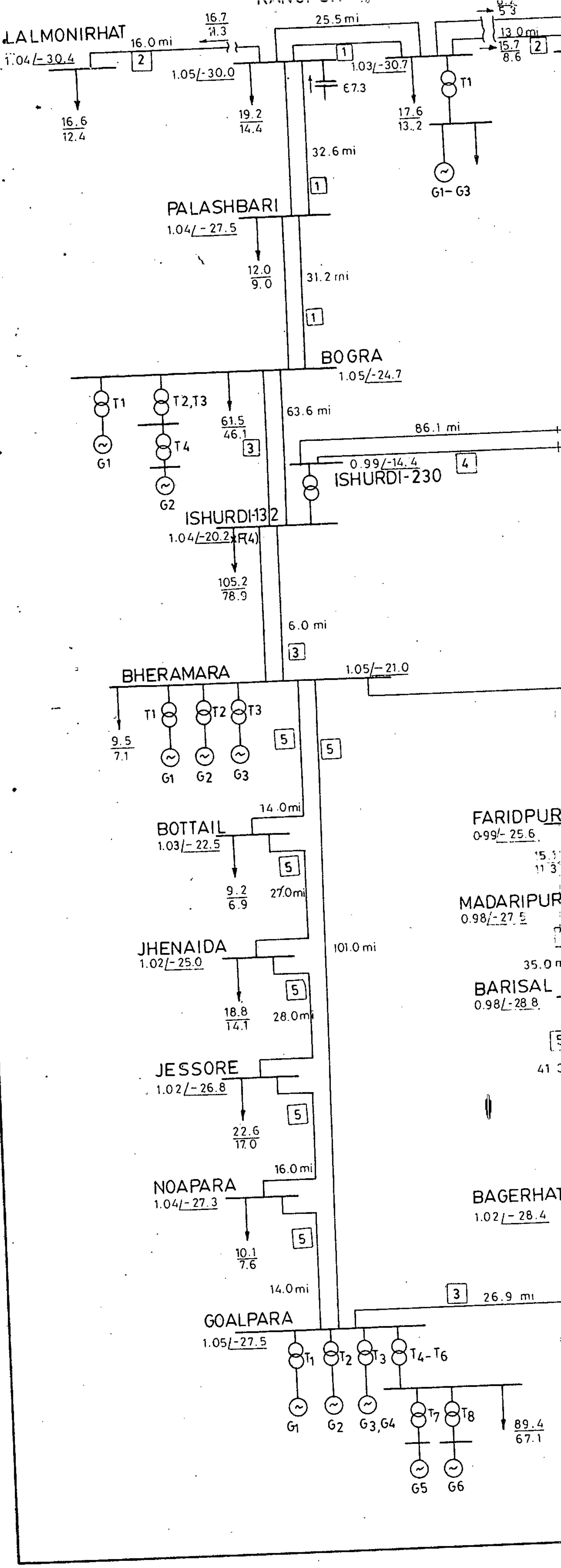
5.9
4.4
20.2 mi
6
SYLHET
1.00/-6.4
14.3
10.7
19.6 mi
6
FENCHUGANJ
1.02/-5.7
4.2
3.2
30.5 mi
6
SRIMANGAL
1.04/-4.5
22.6 mi
6
38.5
23.0
SHAHJIBAZAR
1.06/-3.1
5.4
4.1
T1
T2
T3,T4
G1 G2 G3
G4 G5 G6
G7 G8
JAMALPUR
0.99/-7.6
7.9
5.9
34.1 mi
6
YMENSHING
3/-5.3
22.0
16.5
36.6 mi
6
OREGANJ
/-5.3
9.2
6.9
32.2 mi
6
6
32.2 mi
27.0 mi
4
GHORASAL-230
1.06/-2.0
T2
T1
T2
G1
G1 G2
ASHUG-230
40.1
24.4
27.0 mi
6
ASHUGANJ-132
1.07/-3.4
T1,T2
T3
32.2
24.1
G1-G2
G3-G8
4
45.0 mi
0.9 mi
COMILLA
9
53.7 mi
6
1.00/-8.9
2,T3
1.00/-8.4
49.2
36.9
30.2 mi
6
FENI
TO COMILLA
1.0/-9.3
42.5
31.9
3
G4
37.0
26.9
40 mi
CHANDPUR
0.94/-11.4
36.0
27.0
31.0 mi
60.7 mi
6
MADANHAT
24.1 mi
19.1
1.04/-8.9
14.1
10.6
BARAULIA
1.05/-8.9
18.2
13.6
6
7.0 mi
7.5 mi
6
10.0 mi
6
KULSI ROAD
9.0
25.6
19.2
6
12.0 mi
HALISHAHAR
-9.2
9.5 mi
6
43.0
32.3
T1
G1
SIKALBA
T1
G1
23.2
17.4
20.
DOHAZARI
1.01/-10.2
38.3
28.7
LEGEND:
P(MW)
Q(Mvar)
LOAD
P (MW)
Q (Mvar)
POWER F
REACTIVE
1.03/-3.4
BUSBAR V
F(3)
FAULT LO
60.7 mi
OVERHEAD
9
CABLE SE
TRANSFOR
GENERATO
6
LINE TYPE

DRAWING NO. 1



RANGPUR
SAIDPUR
PURBASADIPUR
THAKURGOAN
PANCHAGARH
LMONIRHAT
4/-30.4
16.0 mi
2
16.7
11.3
25.5 mi
1
1.05/-30.0
1.03/-30.7
67.3
8.2
5.3
13.0 mi
15.7
8.6
2
40.0 mi
27.0 mi
2
1.03/-31.0
22.0 mi
2
1.02/-31.2
1.02/-31.3
16.6
12.4
19.2
14.4
17.6
13.2
T1
11.0
8.3
9.6
7.2
3.3
2.5
32.6 mi
1
G1-G3
PALASHBARI
1.04/-27.5
12.0
9.0
31.2 mi
1
BOGRA
1.05/-24.7
T1
T2,T3
T4
G1
G2
61.5
46.1
3
63.6 mi
86.1 mi
8
0.99/-14.4
4
ISHURDI-230
8.3 mi
RIVER CROSSING
F(1)
1.03/-5.1
16.5 mi
4
F(3)
TONGI-230
1.04/
ISHURDI-132
1.04/-20.2
F(4)
105.2
78.9
6.0 mi
3
1.00/-9.5
TONGI-132
1.04/-5.2
GHORA
69.4
52.0
15.4
8.8
82.8
62.1
T1
G1
G2
BHERAMARA
1.05/-21.0
9.5
7.1
T1
T2
T3
G1
G2
G3
5
5
12.0 mi
TANGAIL
0.97/-10.8
9.0 mi
7
7
15.3
11.5
9.5 mi
7
65.0 mi
5
ULLON
0.99/-9.7
SIDDHIRGANJ
98.3
73.7
104.2
78.1
14.0 mi
BOTTAIL
1.03/-22.5
9.2
6.9
5
27.0 mi
FARIDPUR
0.99/-25.6
15.1
11.3
5
40.0 mi
MIRPUR
0.99/-9.9
46.4
34.8
7
18.0 mi
MADARIPUR
0.98/-27.5
JHENAIDA
1.02/-25.0
101.0 mi
18.8
14.1
5
28.0 mi
5
35.0 mi
5.5
4.1
BARISAL
0.98/-28.8
POSTAGOLA
1.00/-9.8
14.5 mi
7
83.9
35.0
26.3
JESSORE
1.02/-26.8
22.6
17.0
5
5
41.3 mi
28.9
21.7
16.0 mi
NOAPARA
1.04/-27.3
10.1
7.6
5
14.0 mi
BAGERHAT
1.02/-28.4
9.4
7.1
4.7
2.1
3
26.9 mi
19.5 mi
3
GOALPARA
1.05/-27.5
MANGLA
1.01/-28.5
4.7
3.5
T1
T2
T3
T4-T6
G1
G2
G3,G4
T7
T8
89.4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16.0 mi
2
16.7
11.3
16.6
12.4
1.05/-30.0
19.2
14.4
25.5 mi
1
67.3
1.03/-30.7
17.6
13.2
T1
G1-G3
5 3
13.0 mi
15.7
8.6
2
32.6 mi
1
PALASHBARI
1.04/-27.5
12.0
9.0
31.2 mi
1
BOGRA
1.05/-24.7
T1
G1
T2,T3
T4
G2
61.5
46.1
3
63.6 mi
86.1 mi
0.99/-14.4
4
ISHURDI-230
ISHURDI-132
1.04/-20.2
R(4)
105.2
78.9
6.0 mi
3
BHERAMARA
1.05/-21.0
9.5
7.1
T1
T2
T3
G1
G2
G3
5
5
14.0 mi
BOTTAIL
1.03/-22.5
9.2
6.9
5
27.0 mi
JHENAIDA
1.02/-25.0
18.8
14.1
5
28.0 mi
101.0 mi
JESSORE
1.02/-26.8
22.6
17.0
5
16.0 mi
NOAPARA
1.04/-27.3
10.1
7.6
5
14.0 mi
GOALPARA
1.05/-27.5
3
26.9 mi
T1
T2
T3
T4-T6
G1
G2
G3,G4
T7
T8
G5
G6
89.4
67.1
FARIDPUR
0.99/-25.6
MADARIPUR
0.98/-27.5
35.0
BARISAL
0.98/-28.8
BAGERHAT
1.02/-28.4

TABLE - 1

Name of the power station	Total number of generators	Generator number	Rated MW	Rated MVA	Engine type	Directo axis transient reactance in %	Inertia constant (H)
Kaptai	5	G_1, G_2	40	50	Hydro	30.0	3.861
		G_3-G_5	50	62.5	Hydro	30.0	4.0
Sikalbaha	1	G_1	60	75	Steam	24.0	4.85
Halishahar	1	G_1	10	12.5	Gas	20.0	7.0
Ashuganj-132	8	G_1, G_2	64	90	Steam	20.0	7.0
		G_3-G_8	20	25	Gas	24.0	6.0
Shahjibazar	8	G_1-G_3	9	18.5	Gas	18.0	6.5
		G_4-G_6	9	20.0	Gas	16.5	6.5
		G_7, G_8	10	12.5	Gas	18.0	6.5
Ashuganj-230	2	G_1, G_2	150	190	Steam	24.0	3.2
Ghorasal-230	1	G_1	210	233.3	Steam	24.7	2.22
Siddirgonj	4	G_1	50	62.5	Steam	29.0	4.6
		G_2-G_4	8	11.6	Steam	22.0	4.4

TABLE - 1 Contd.

Name of the power station	Total number of generators	Generator number	Rated MW	Rated MVA	Engine Type	Direct axis transient reactance in %	Inertia constant (H)
Ghorasal-132	2	G_1, G_2	55	68.7	Steam	20.2	4.425
Goalpara	6	G_1	60	75	Steam	21.9	5.5
		G_2	110	150	Steam	18.0	4.0
		G_3, G_4	28	35	BMGT	22.0	5.0
		G_5, G_6	10	15.9	Gas	23.5	6.5
Bheramara	3	G_1-G_3	20	32	Gas	21.5	4.5
Bogra	2	G_1	100	125	Steam	17.0	4.0
		G_2	5	8.9	RMGT	20.6	7.0
Saidpur	3	G_1-G_3	3.5	4.7	Diesel	30.55	3.85
Total	46		1,737.5	2,264.3			

TABLE - 2

Name of the power station	Total number of trans-former	Transformer number	MVA rating	Voltage rating	Impedance voltage in %
Kaptai	5	T_1, T_2	57.5	132 KV/11 KV	12.9
		T_3-T_5	75	132 KV/11 KV	16.0
Sikalbaha	1	T_1	72	132 KV/11 KV	10.5
Halishahar	1	T_1	12.5	132 KV/11 KV	10.0
Ashuganj-132	3	T_1, T_2	90	132 KV/11 KV	12.0
		T_3	150	132 KV/11 KV	12.0
Shahjibazar	4	T_1, T_2	60	132 KV/11 KV	11.85
		T_3, T_4	12.5	132 KV/11 KV	10.0
Asuhuganj-230	2	T_1, T_2	190	246 KV/11 KV	14.0
Ghorasal-230	2	T_1, T_2	125	230 KV/15.75 KV	15.0
Siddirgonj	3	T_1	60	132 KV/11 KV	19.2
		T_2, T_3	33.3	132 KV/11 KV	12.2
Ghorasal-132	2	T_1, T_2	70	132 KV/10.5 KV	13.0
Goalpara	8	T_1	72	132 KV/11 KV	10.7
		T_2	125	132 KV/11 KV	9.0
		T_3	70	132 KV/11 KV	9.0
		T_4-T_6	16.7	132 KV/22 KV	10.2
		T_7, T_8	15	33 KV/11 KV	7.05
Bheramara	3	T_1-T_3	27	132/11 KV	11.3
Bogra	4	T_1	125	132 KV/11 KV	12.0
		T_2, T_3	13.3	132 KV/33 KV	9.0
		T_4	8	33 KV/11 KV	9.0
Saidpur	1	T_1	13.3	132 KV/11 KV	12.0

TABLE - 3

Location	MVA rating	Voltage rating	Impedance voltage in %
Ashuganj	150	230 KV/132 KV	9.0
Ghorasal	150	230 KV/132 KV	9.0
Tongi	200	230 KV/132 KV	10.0
Ishurdi	2X150	230 KV/132 KV	9.0

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TABLE - 4

Name of the power station	Time constant of speed governor mechanism[5,13] T_G second	Time constant of Turbine[5,13] T_T second	Speed regulation[1,5,13] R PU	Maximum power output P_{gmax} MW
Kaptai	0.05	0.75	0.048	230
Sikalbaha	0.05	0.75	0.048	60
Halishahar	0.07	0.75	0.048	10
Ashuganj-132	0.07	0.75	0.048	248
Shahjibazar	0.07	0.75	0.048	74
Ashuganj-230	0.05	0.75	0.048	300
Ghorasal-230	0.07	0.50	0.048	210
Siddirgonj	0.05	0.75	0.048	74
Ghorasal-132	0.07	0.70	0.048	110
Goalpara	0.05	0.75	0.050	246
Bheramara	0.07	0.70	0.048	60
Bogra	0.05	0.70	0.048	105
Saidpur	0.05	0.75	0.050	10.5

6.2 FAULT SIMULATION

Three different modes of CB/Autorecloser operations are considered in this study for each type of faults. The three different modes of operations are:

MODE A : (Sustained faults)

Fault occurs at t=0.0 second and cleared at t=0.16 second (i.e 8 cycles) by the simultaneous operation of the CB at each end of the faulted line or near the faulted bus.

MODE B : (unsusteained faults and use of Autorecloser)

Fault occurs at t=0.0 second and cleared at t=0.16 second (i.e. 8 cycles) by the simultaneous operation of the CB at each end of the faulted line or near the faulted bus.

Successfully reclose the CB simultaneously at both ends of the faulted lines or near the faulted bus at t=0.56 seconds (i.e. 28 cycles).

MODE C : (Sustained faults and use of autorecloser)

Fault occurs at t=0.0 second and cleared at t=0.16 second (i.e. 8 cycles) by the simultaneous operation of the CB at each end of the faulted line or near the faulted bus.

Successfully reclose the CB simultaneously at both ends of the faulted lines or near the faulted bus at t=0.56 second (i.e. 28 cycles).

CB of the faulted line or near the faulted bus opens and lockout simultaneously at t=0.72 second (i.e. 36 cycles).

Faults of four different types are simulted by using Runge-Kutta method of fourth order approximation considering $\Delta t=0.02$ second.

Fault-1

Three-phase short circuit on one of the 230 KV transmission lines between Tongi-230 and Ishurdi-230 near the substation at Tongi-230.

Fault-2

Three-phase short circuit at Siddirganj-132 KV main bus.

Fault-3

Three-phase fault on one of the 230 KV transmission lines between Tongi-230 and Ghorasal-230 near the middle point.

Fault-4

Three-phase short circuit at (105.2+j 78.9) MVA load terminal near the substation Ishurdi-132.

6.3 RESULTS

Fault-1 (Fault on line near bus)

From the plotted swing curves (Fig.6.1 to Fig. 6.3) it is seen that when speed governor action neglected, Ghorasal-230 generator is stable in MODE A and MODE B operation but unstable in MODE C operation. However when speed governor action considered (Fig.6.4 to Fig.6.6) Ghorasal-230 generator is stable in all three modes of operation. All other generators are stable in the above cases, however, the swings of the generators are found wider when governor action is not considered.

Fault-2 (Fault at bus)

From the plotted swing curves (Fig.6.9 to Fig.6.11) it is seen that when speed governor action neglected Bogra-132 and Saidpur-132 generators are unstable with MODE B operations. However when speed governor action considered these two generators (Fig.6.12 to Fig.6.14) are stable with MODE B operation.

Fault-3 and Fault-4 (Fault at the middle point and load rejection)

Fault-3 and Fault-4 were simulated both with the governor action considered and not considered. In both cases all the generators in the system were found to be stable. But with governor action taken into consideration it is found that the relative swings of all the generators are much smaller than the swings of the generators when governor action is neglected (Fig.6.19 to Fig.6.30)

The above results obtained by this study with three different modes of circuit breaker/autorecloser operations are semmerized in Table-9.

The set of differential equations

$$\frac{dX_i}{dt} = \frac{1}{T_{Gi}} \left(P_{moi} - \frac{W_i - W_o}{RW_o} - X_i\right)$$

and

$$\frac{dP_{si}}{dt} = \frac{1}{T_{Ti}} (X_i - P_{si})$$

have been solved to find the dependence of shaft power P_s on the value of speed W. The results are plotted in Fig.6.7,[15,16] It is found that the shaft power output is dependent not only on speed W but also on the rate of speed with respect to time i.e. $\frac{dW}{dt}$. For the same time interval $\Delta t = .02$, dW was assumed equal to 2.5, 1.0 and 0.5 and it is found from the plots that change of shaft power is higher for larger value of $\frac{dW}{dt}$.

Also to find how the shaft power P_s and speed W varies with time, the values of P_s and W corresponding to <u>Fault-1, MODE C</u>, <u>Fault-2 MODE B</u> have been plotted in Fig. 6.8, Fig. 6.17 and Fig. 6.18 with and without considering governor action. When governor action is not considered speed W varies with time but shaft power P_s in constant. But when governor is considered shaft power varies inversely to speed W as related by the differential equations. It is found that for the same value of W the shaft power P_s is different because the shaft power P_s is also dependent on how fast W has reached that value. Aslo it is observed that shaft power P_s moves in the opposite direction of speed W i.e. when W is increasing P_s is decreasing and when W is decreasing, P_s is increasing.

TABLE-5

* * * VOLTAGE & LOADS OF DIFFERENT BUSES * * *

BUS NO.	BUS NAME	BUS VOLTAGE MAGNITUDE (PU)	BUS VOLTAGE ANGLE (DEG)	---BUS LOAD--- MW	---BUS LOAD--- MVAR
1	KAPTAI	1.0800	-7.800	0.0	0.0
2	SIKALBAHA	1.0400	-9.000	61.90	45.90
3	HALISHAHAR	1.0400	-9.200	43.00	22.30
4	ASHUGANG-132	1.0700	-3.400	72.30	45.50
5	SHAHJIBAZAR	1.0600	-3.100	43.90	27.10
6	ASHUGANG-230	1.0600	-2.000	0.0	0.0
7	GHORASAL-230	1.0400	-4.000	0.0	0.0
8	SIDDIRGANG	1.0000	-8.900	164.20	78.10
9	GHORASAL-132	1.0400	-5.200	82.60	62.10
10	GOALPARA	1.0500	-27.500	89.40	67.10
11	BHERAMARA	1.0500	-21.200	9.50	7.10
12	BOGRA	1.0500	-24.700	61.5	46.10
13	SAIDPUR	1.0300	-31.700	41.50	27.10
14	CHANDRAGHONA	1.0600	-8.200	44.70	33.50
15	MADANHAT	1.0400	-8.900	14.10	10.60
16	KULSI ROAD	1.0400	-9.000	25.50	19.20
17	BARULIA	1.0500	-3.900	18.20	13.60
18	FENI	1.0100	-9.300	42.50	31.90
19	COMILLA	1.0000	-8.400	56.20	63.85
20	POSTAGOLA	1.0000	-9.800	35.00	-57.60
21	MIRPUR	0.9900	-9.900	46.40	34.60
22	ULLON	0.9900	-9.700	98.30	73.70
23	TONGI-132	1.0000	-9.500	54.20	60.80
24	TONGI-230	1.0300	-5.100	0.0	0.0
25	ISHURDI-230	0.9900	-14.400	0.0	0.0
26	ISHURDI-132	1.0400	-20.200	105.20	78.90
27	FARIDPUR	0.9900	-25.600	15.10	11.30
28	MADARIPUR	0.9800	-27.500	5.50	4.10
29	BARISAL	0.9800	-28.800	26.50	21.70
30	BAGERHAT	1.0200	-28.400	14.10	9.20
31	NOAPARA	1.0400	-27.300	10.10	7.60
32	JESSOR	1.0200	-26.500	22.60	17.00
33	JHENAIDA	1.0200	-25.600	18.80	14.10
34	BATTAIL	1.0300	-22.500	9.20	6.90
35	PALASHBARI	1.0400	-27.500	12.[illegible]	9.[illegible]
36	RANGPUR	1.0500	-30.000	35.90	-41.60
			TOTAL LOAD =	1387.198	863.897

*** TABLE - 6 ***

*** LINE PARAMETER FOR THE SYSTEM UNDER STUDY ***

SERIAL NO.	BUS CODE P-Q	LINE IMPEDANCE ZL-PQ- (PU)	CHARGING ADMITTANCE YL-P & YL-Q (PU)	
1	1-14	0.00460+J 0.01770	0.0	+J 0.00217
2	14-15	0.01780+J 0.06770	0.0	+J 0.00779
3	1-15	0.02240+J 0.08550	0.0	+J 0.010[illegible]
4	15-18	0.05640+J 0.21530	0.0	+J 0.02520
5	15-18	0.05640+J 0.21530	0.0	+J 0.02520
6	2-15	0.00930+J 0.03550	0.0	+J 0.00420
7	2-15	0.00930+J 0.03550	0.0	+J 0.00420
8	15-16	0.00700+J 0.02660	0.0	+J 0.00310
9	2- 3	0.00860+J 0.03370	0.0	+J 0.00400
10	3-16	0.01120+J 0.04260	0.0	+J 0.00500
11	16-17	0.00650+J 0.02480	0.0	+J 0.00290
12	16-17	0.00650+J 0.02480	0.0	+J 0.00290
13	1-17	0.02880+J 0.11000	0.0	+J 0.01290
14	1-17	0.02880+J 0.11000	0.0	+J 0.01290
15	18-19	0.02810+J 0.10710	0.0	+J 0.01260
16	18-19	0.02810+J 0.10710	0.0	+J 0.01260
17	19- 4	0.03330+J 0.15530	0.0	+J 0.01800
18	19- 4	0.03330+J 0.15530	0.0	+J 0.01800
19	4- 9	0.02510+J 0.09580	0.0	+J 0.01120
20	4- 9	0.02510+J 0.09580	0.0	+J 0.01120
21	6- 7	0.00660+J 0.03270	0.0	+J 0.03280
22	6- 7	0.00660+J 0.03270	0.0	+J 0.03280
23	4- 5	0.02990+J 0.11420	0.0	+J 0.01340
24	4- 5	0.02990+J 0.11420	0.0	+J 0.01340
25	8- 9	0.02550+J 0.09720	0.0	+J 0.01140
26	8- 9	0.02550+J 0.09720	0.0	+J 0.01140
27	7-24	0.00490+J 0.02000	0.0	+J 0.02[illegible]
28	7-24	0.00490+J 0.02000	0.0	+J 0.02[illegible]
29	7-24	0.00490+J 0.02000	0.0	+J 0.02500
30	7-24	0.00490+J 0.02000	0.0	+J 0.02[illegible]
31	21-23	0.00840+J 0.03420	0.0	+J 0.00350
32	21-23	0.00840+J 0.03420	0.0	+J 0.00350
33	20-21	0.01670+J 0.05840	0.0	+J 0.00690
34	20-21	0.01670+J 0.05840	0.0	+J 0.00690

SERIAL NO.	BUS CODE P-Q	LINE IMPEDANCE ZL-PQ- (PU)	CHARGING ADMITTANCE YL-P & YL-Q (PU)
35	9-20	0.01350+ J 0.05510	0.0 +J 0.00560
36	9-20	0.01350+ J 0.05510	0.0 +J 0.00560
37	9-22	0.03880+ J 0.03610	0.0 +J 0.00370
38	9-22	0.03880+ J 0.03610	0.0 +J 0.00370
39	24-25	0.03210+ J 0.10420	0.0 +J 0.10450
40	24-25	0.03210+ J 0.10420	0.0 +J 0.10450
41	11-27	0.08060+ J 0.23800	0.0 +J 0.02620
42	27-28	0.04960+ J 0.14650	0.0 +J 0.01610
43	28-29	0.04340+ J 0.12820	0.0 +J 0.01410
44	29-30	0.05120+ J 0.15120	0.0 +J 0.01660
45	30-10	0.03330+ J 0.09850	0.0 +J 0.00990
46	10-11	0.12520+ J 0.30980	0.0 +J 0.04060
47	10-31	0.01740+ J 0.05130	0.0 +J 0.00560
48	31-32	0.01980+ J 0.05860	0.0 +J 0.00640
49	32-33	0.03470+ J 0.10250	0.0 +J 0.01130
50	33-34	0.03350+ J 0.09990	0.0 +J 0.01090
51	34-11	0.01740+ J 0.05130	0.0 +J 0.00560
52	11-26	0.00740+ J 0.02200	0.0 +J 0.00220
53	11-26	0.00740+ J 0.02200	0.0 +J 0.00220
54	12-26	0.07880+ J 0.23290	0.0 +J 0.02350
55	12-26	0.07880+ J 0.23290	0.0 +J 0.02350
56	12-35	0.03970+ J 0.12300	0.0 +J 0.01280
57	12-35	0.03970+ J 0.12300	0.0 +J 0.01280
58	35-36	0.04040+ J 0.12850	0.0 +J 0.01340
59	35-36	0.04040+ J 0.12850	0.0 +J 0.01340
60	13-36	0.03160+ J 0.10050	0.0 +J 0.01050
61	13-36	0.03160+ J 0.10050	0.0 +J 0.01050
62	22-23	0.01120+ J 0.04560	0.0 +J 0.00460
63	22-23	0.01120+ J 0.04560	0.0 +J 0.00460
64	8-19	0.05080+ J 0.19120	0.0 +J 0.02340
65	8-19	0.05080+ J 0.19120	0.0 +J 0.02340
66	4- 6	0.0 +J 0.0[illegible]	0.0 +J 0.0
67	23-24	0.0 +J 0.05[illegible]	0.0 +J 0.0
68	7- 9	0.0 +J 0.05[illegible]	0.0 +J 0.0
69	25-26	0.0 +J 0.03[illegible]	0.0 +J 0.0

TABLE-7

* * * VOLTAGE BACK OF TRANSIENT REACTANCE OF MACHINES * * *

BUS NO.	BUS NAME	TOTAL GENARATION REAL POWER (PU)	TOTAL GENARATION REACTIVE POWER (PU)	INTERNAL VOLTAGE MAGNITUDE	INTERNAL VOLTAGE ANGLE	EQUIVALENT REACTANCE	INERTIA CONSTANT
1	KAPTAI	1.550	1.454	1.2969	1.63	0.0+J 0.0177	11.3610
2	SIKALBAHA	0.650	0.459	1.2703	3.21	0.0+J 0.1677	3.6375
3	HALISHAHAR	0.100	0.075	1.2246	1.57	0.0+J 0.0855	0.6754
4	ASHUGANG-132	2.360	1.207	1.2564	7.80	0.1+J 0.2153	17.3200
5	SHAHJIBAZAR	0.495	0.140	1.1959	1.83	0.1+J 0.2153	9.1325
6	ASHUGANG-230	3.000	2.149	1.2941	19.63	0.0+J 0.0355	12.1600
7	GHORASAL-230	2.100	0.980	1.2423	11.04	0.0+J 0.0355	5.1793
8	SIDDIRGANG	0.740	0.488	1.2311	5.01	0.0+J 0.0200	4.4062
9	GHORASAL-132	1.091	0.387	1.1577	7.35	0.0+J 0.0337	6.0795
10	GOALPARA	0.930	1.527	1.1904	-23.47	0.0+J 0.0420	15.0920
11	BHERAMARA	0.300	0.850	1.3483	-16.58	0.0+J 0.0248	4.2230
12	BOGRA	0.800	0.580	1.1836	-10.62	0.0+J 0.0245	5.0230
13	SAIDPUR	0.105	0.025	1.1479	-14.09	0.0+J 0.1100	0.5428

```
                                                      YBUS DURING FAULT
                                                      -----------------
                         FAULTED BUS IS TONGI-230                                               FAJLT TYPE = 2
                         ------------------------                                               --------------
                MAG     ANGLE                 MAG     ANGLE                 MAG     ANGLE                 MAG     ANGLE                 MAG     ANGLE
----------------------------------------------------------------------------------------------------------------------------------------------------------
Y( 1, 1)=      3.49  -79.83 Y( 1, 2)=      0.83   78.61 Y( 1, 3)=      0.16   78.34 Y( 1, 4)=      0.28   83.18 Y( 1, 5)=      0.11   85.58
Y( 1, 6)=      0.07   76.52 Y( 1, 7)=      0.02   76.52 Y( 1, 8)=      0.08   80.89 Y( 1, 9)=      0.08   85.62 Y( 2, 1)=      0.83   78.61
Y( 2, 2)=      1.79  -87.23 Y( 2, 3)=      0.07   76.35 Y( 2, 4)=      0.10   81.30 Y( 2, 5)=      0.04   83.70 Y( 2, 6)=      0.03   74.64
Y( 2, 7)=      0.01   74.64 Y( 2, 8)=      0.03   79.01 Y( 2, 9)=      0.03   83.75 Y( 3, 1)=      0.16   78.34 Y( 3, 2)=      0.07   76.35
Y( 3, 3)=      0.40  -89.42 Y( 3, 4)=      0.02   81.09 Y( 3, 5)=      0.01   83.49 Y( 3, 6)=      0.01   74.43 Y( 3, 7)=      0.00   74.43
Y( 3, 8)=      0.01   78.80 Y( 3, 9)=      0.01   83.54 Y( 4, 1)=      0.28   83.18 Y( 4, 2)=      0.10   81.30 Y( 4, 3)=      0.02   81.09
Y( 4, 4)=      7.57  -87.94 Y( 4, 5)=      0.87   85.52 Y( 4, 6)=      0.57   76.43 Y( 4, 7)=      0.11   77.13 Y( 4, 8)=      0.18   85.16
Y( 4, 9)=      0.43   86.97 Y( 5, 1)=      0.11   85.58 Y( 5, 2)=      0.04   83.70 Y( 5, 3)=      0.01   83.49 Y( 5, 4)=      0.87   85.52
Y( 5, 5)=      3.52  -85.96 Y( 5, 6)=      0.22   78.83 Y( 5, 7)=      0.04   79.53 Y( 5, 8)=      0.07   87.57 Y( 5, 9)=      0.17   89.38
Y( 6, 1)=      0.07   76.52 Y( 6, 2)=      0.03   74.64 Y( 6, 3)=      0.01   74.43 Y( 6, 4)=      0.57   76.43 Y( 6, 5)=      0.22   78.83
Y( 6, 6)=      8.51  -88.48 Y( 6, 7)=      0.21   81.65 Y( 6, 8)=      0.06   77.73 Y( 6, 9)=      0.15   78.61 Y( 7, 1)=      0.02   76.52
Y( 7, 2)=      0.01   74.64 Y( 7, 3)=      0.00   74.43 Y( 7, 4)=      0.11   77.13 Y( 7, 5)=      0.04   79.53 Y( 7, 6)=      0.21   81.65
Y( 7, 7)=      5.87  -89.68 Y( 7, 8)=      0.02   75.02 Y( 7, 9)=      0.06   74.51 Y( 8, 1)=      0.08   80.89 Y( 8, 2)=      0.03   79.01
Y( 8, 3)=      0.01   78.80 Y( 8, 4)=      0.18   85.16 Y( 8, 5)=      0.07   87.57 Y( 8, 6)=      0.06   77.73 Y( 8, 7)=      0.02   75.02
Y( 8, 8)=      2.32  -88.98 Y( 8, 9)=      0.13   83.00 Y( 9, 1)=      0.08   85.62 Y( 9, 2)=      0.03   83.75 Y( 9, 3)=      0.01   83.54
Y( 9, 4)=      0.43   86.97 Y( 9, 5)=      0.17   89.38 Y( 9, 6)=      0.15   78.61 Y( 9, 7)=      0.06   74.51 Y( 9, 8)=      0.13   83.00
Y( 9, 9)=      3.75  -89.09 Y(10,10)=      3.92  -72.59 Y(10,11)=      0.49   83.45 Y(10,12)=      0.42   86.13 Y(10,13)=      0.03   80.64
Y(11,10)=      0.49   83.45 Y(11,11)=      2.40  -88.00 Y(11,12)=      0.31   79.69 Y(11,13)=      0.02   74.20 Y(12,10)=      0.42   86.13
Y(12,11)=      0.31   79.69 Y(12,12)=      2.79  -79.46 Y(12,13)=      0.12   68.90 Y(13,10)=      0.03   80.64 Y(13,11)=      0.02   74.20
Y(13,12)=      0.12   68.90 Y(13,13)=      0.30  -88.02 Y(
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                                    YBUS AFTER CLEARING THE FAULT
                                    -----------------------------
                FAULTED BUS IS TUNGI-230                                          FAULT TYPE = 2
                ------------------------                                          --------------
           MAG   ANGLE               MAG   ANGLE               MAG   ANGLE               MAG   ANGLE               MAG   ANGLE
---------------------------------------------------------------------------------------------------------------------------------
Y( 1, 1)=  0.47  -79.62 Y( 1, 2)=  0.84   78.52 Y( 1, 3)=  0.17   78.26 Y( 1, 4)=  0.42   81.72 Y( 1, 5)=  0.16   83.12
Y( 1, 6)=  0.29   79.03 Y( 1, 7)=  0.18   77.97 Y( 1, 8)=  0.13   76.90 Y( 1, 9)=  0.16   79.79 Y( 1,10)=  0.04   78.71
Y( 1,11)=  0.03   72.27 Y( 1,12)=  0.04   73.48 Y( 1,13)=  0.00   67.99 Y( 2, 1)=  0.84   78.52 Y( 2, 2)=  1.79  -87.18
Y( 2, 3)=  0.07   76.27 Y( 2, 4)=  0.15   78.85 Y( 2, 5)=  0.06   81.25 Y( 2, 6)=  0.11   77.16 Y( 2, 7)=  0.07   76.09
Y( 2, 8)=  0.05   75.03 Y( 2, 9)=  0.06   77.92 Y( 2,10)=  0.02   76.83 Y( 2,11)=  0.01   70.39 Y( 2,12)=  0.01   71.60
Y( 2,13)=  0.00   66.12 Y( 3, 1)=  0.17   78.26 Y( 3, 2)=  0.07   76.27 Y( 3, 3)=  0.40  -69.41 Y( 3, 4)=  0.03   78.63
Y( 3, 5)=  0.01   81.04 Y( 3, 6)=  0.02   76.95 Y( 3, 7)=  0.01   75.88 Y( 3, 8)=  0.01   74.82 Y( 3, 9)=  0.01   77.70
Y( 3,10)=  0.00   76.62 Y( 3,11)=  0.00   70.19 Y( 3,12)=  0.00   71.39 Y( 3,13)=  0.00   65.95 Y( 4, 1)=  0.42   81.72
Y( 4, 2)=  0.15   78.85 Y( 4, 3)=  0.03   78.63 Y( 4, 4)=  6.92  -86.60 Y( 4, 5)=  1.13   84.35 Y( 4, 6)=  1.61   80.08
Y( 4, 7)=  0.96   79.91 Y( 4, 8)=  0.40   78.09 Y( 4, 9)=  0.79.  81.72 Y( 4,10)=  0.21   80.89 Y( 4,11)=  0.15   74.45
Y( 4,12)=  0.17   75.66 Y( 4,13)=  0.01   70.19 Y( 5, 1)=  0.16   83.12 Y( 5, 2)=  0.06   81.25 Y( 5, 3)=  0.01   81.04
Y( 5, 4)=  1.13   84.35 Y( 5, 5)=  3.43  -85.64 Y( 5, 6)=  0.62   82.48 Y( 5, 7)=  0.35   82.31 Y( 5, 8)=  0.16   80.50
Y( 5, 9)=  0.21   84.13 Y( 5,10)=  0.05   83.29 Y( 5,11)=  0.06   76.85 Y( 5,12)=  0.07   78.07 Y( 5,13)=  0.00   72.58
Y( 6, 1)=  0.29   79.03 Y( 6, 2)=  0.11   77.16 Y( 6, 3)=  0.02   76.95 Y( 6, 4)=  1.61   80.08 Y( 6, 5)=  0.62   82.45
Y( 6, 6)=  6.96  -87.23 Y( 6, 7)=  1.44   63.98 Y( 6, 8)=  0.41   76.73 Y( 6, 9)=   .72   79.37 Y( 6,10)=  0.32   84.96
Y( 6,11)=  0.24   78.52 Y( 6,12)=  0.26   79.74 Y( 6,13)=  0.02   74.25 Y( 7, 1)=  0.18   77.97 Y( 7, 2)=  0.07   76.09
Y( 7, 3)=  0.01   75.86 Y( 7, 4)=  0.96   79.91 Y( 7, 5)=  0.35   82.31 Y( 7, 6)=  1.44   63.98 Y( 7, 7)=  4.94  -88.24
Y( 7, 8)=  0.29   74.80 Y( 7, 9)=  0.49   77.41 Y( 7,10)=  0.25   83.19 Y( 7,11)=  0.18   76.75 Y( 7,12)=  0.20   77.96
Y( 7,13)=  0.01   72.47 Y( 8, 1)=  0.13   76.91 Y( 8, 2)=  0.05   75.03 Y( 8, 3)=  0.01   74.82 Y( 8, 4)=  0.40   78.09
Y( 8, 5)=  0.16   80.50 Y( 8, 6)=  0.41   76.73 Y( 8, 7)=  0.29   74.80 Y( 8, 8)=  2.25  -89.18 Y( 8, 9)=  0.25   76.63
Y( 8,10)=  0.07   75.37 Y( 8,11)=  0.05   68.92 Y( 8,12)=   .06   70.15 Y( 8,13)=  0.00   64.66 Y( 9, 1)=  0.16   79.79
Y( 9, 2)=  0.06   77.92 Y( 9, 3)=  0.01   77.70 Y( 9, 4)=  0.79   81.73 Y( 9, 5)=  0.31   84.13 Y( 9, 6)=  0.72   79.37
Y( 9, 7)=  0.49   77.41 Y( 9, 8)=  0.25   76.63 Y( 9, 9)=  3.56  -88.11 Y( 9,10)=  0.11   79.38 Y( 9,11)=  0.08   71.94
Y( 9,12)=  0.09   73.15 Y( 9,13)=  0.01   67.66 Y(10, 1)=  0.04   78.71 Y(10, 2)=  0.02   76.83 Y(10, 3)=  0.00   76.62
Y(10, 4)=  0.21   80.89 Y(10, 5)=  0.08   83.29 Y(10, 6)=   .32   84.96 Y(10, 7)=  0.25   83.19 Y(10, 8)=  0.07   75.37
Y(10, 9)=  0.11   79.38 Y(10,10)=  2.74  -71.24 Y(10,11)=  0.64   81.68 Y(10,12)=  0.58   83.59 Y(10,13)=  0.04   78.10
Y(11, 1)=  0.03   72.27 Y(11, 2)=  0.01   70.39 Y(11, 3)=  0.00   70.18 Y(11, 4)=  0.15   74.45 Y(11, 5)=  0.06   76.85
Y(11, 6)=  0.24   78.52 Y(11, 7)=  0.18   75.75 Y(11, 8)=  0.05   68.93 Y(11, 9)=  0.08   71.94 Y(11,10)=  0.64   81.68
Y(11,11)=  2.29  -86.93 Y(11,12)=   .43   77.15 Y(11,13)=  0.03   71.66 Y(12, 1)=  0.04   73.48 Y(12, 2)=  0.01   71.60
Y(12, 3)=  0.00   71.39 Y(12, 4)=  0.17   75.66 Y(12, 5)=  0.07   78.07 Y(12, 6)=  0.26   79.74 Y(12, 7)=  0.20   77.96
Y(12, 8)=  0.06   70.15 Y(12, 9)=  0.09   73.15 Y(12,10)=   .58   83.59 Y(12,11)=  0.43   77.15 Y(12,12)=  2.68  -78.10
Y(12,13)=  0.13   68.73 Y(13, 1)=  0.00   67.99 Y(13, 2)=  0.00   66.12 Y(13, 3)=  0.00   65.95 Y(13, 4)=  0.01   70.18
Y(13, 5)=  0.00   72.56 Y(13, 6)=  0.02   74.25 Y(13, 7)=  0.01   72.47 Y(13, 8)=  0.00   64.66 Y(13, 9)=  0.01   67.66
Y(13,10)=   .04   78.10 Y(13,11)=  0.03   71.66 Y(13,12)=  0.13   68.73 Y(13,13)=  0.38  -67.96 Y(
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                                                   Z-BUS DURING FAULT
                                                   ------------------
                         FAULTED BUS IS TONGI-230                                                    FAULT TYPE = 2
                         ------------------------                                                    --------------
                 MAG    ANGLE                    MAG    ANGLE                    MAG    ANGLE                    MAG    ANGLE                    MAG    ANGLE
-----------------------------------------------------------------------------------------------------------------------------------------------------------
 Z( 1, 1)=      0.29    79.93 Z( 1, 2)=      1.29   101.32 Z( 1, 3)=      6.67   101.59 Z( 1, 4)=      3.59    96.75 Z( 1, 5)=      9.27    94.35
 Z( 1, 6)=     13.39   103.41 Z( 1, 7)=     58.67   103.41 Z( 1, 8)=     12.73    99.04 Z( 1, 9)=     11.79    94.31 Z( 2, 1)=      1.29   101.32
 Z( 2, 2)=      0.56    87.23 Z( 2, 3)=     15.27   103.58 Z( 2, 4)=      9.82    98.63 Z( 2, 5)=     25.40    96.22 Z( 2, 6)=     36.68   105.29
 Z( 2, 7)=    160.72   105.29 Z( 2, 8)=     34.89   100.92 Z( 2, 9)=     32.30    96.18 Z( 3, 1)=      6.67   101.59 Z( 3, 2)=     15.27   103.58
 Z( 3, 3)=      2.49    59.42 Z( 3, 4)=     51.53    98.94 Z( 3, 5)=    133.25    96.44 Z( 3, 6)=    192.45   105.50 Z( 3, 7)=    843.25   105.50
 Z( 3, 8)=    183.03   101.13 Z( 3, 9)=    169.47    96.39 Z( 4, 1)=      3.59    96.75 Z( 4, 2)=      9.82    98.63 Z( 4, 3)=     51.53    96.84
 Z( 4, 4)=      0.13    97.94 Z( 4, 5)=      1.15    94.41 Z( 4, 6)=      1.75   103.50 Z( 4, 7)=      8.95   102.80 Z( 4, 8)=      5.55    94.76
 Z( 4, 9)=      2.31    92.95 Z( 5, 1)=      9.27    94.35 Z( 5, 2)=     25.40    96.22 Z( 5, 3)=    133.25    96.44 Z( 5, 4)=      1.15    94.41
 Z( 5, 5)=      0.28    85.96 Z( 5, 6)=      4.53   101.10 Z( 5, 7)=     23.15   100.40 Z( 5, 8)=     14.36    92.36 Z( 5, 9)=      5.98    90.55
 Z( 6, 1)=     13.39   103.41 Z( 6, 2)=     36.66   105.29 Z( 6, 3)=    192.45   105.58 Z( 6, 4)=      1.75   103.50 Z( 6, 5)=      4.53   101.10
 Z( 6, 6)=       .12    88.48 Z( 6, 7)=      4.79    98.27 Z( 6, 8)=     17.55   102.19 Z( 6, 9)=      6.66   101.32 Z( 7, 1)=     58.67   103.41
 Z( 7, 2)=    160.72   105.29 Z( 7, 3)=    843.25   105.50 Z( 7, 4)=      8.95   102.80 Z( 7, 5)=     23.15   100.40 Z( 7, 6)=      4.79    98.27
 Z( 7, 7)=      0.17    89.68 Z( 7, 8)=     53.82   104.9  Z( 7, 9)=     17.82   105.42 Z( 8, 1)=     12.73    99.04 Z( 8, 2)=     34.89   100.92
 Z( 8, 3)=    183.03   101.13 Z( 8, 4)=      5.55    94.76 Z( 8, 5)=     14.36    92.36 Z( 8, 6)=     17.55   102.19 Z( 8, 7)=     53.82   104.90
 Z( 8, 8)=      0.43    88.98 Z( 8, 9)=      7.73    96.93 Z( 9, 1)=     11.79    94.31 Z( 9, 2)=     32.30    96.18 Z( 9, 3)=    169.47    96.39
 Z( 9, 4)=      2.31    92.95 Z( 9, 5)=      5.98    90.55 Z( 9, 6)=      6.66   101.32 Z( 9, 7)=     17.82   105.42 Z( 9, 8)=      7.73    96.93
 Z( 9, 9)=      0.27    99.69 Z(10,10)=      0.25    72.59 Z(10,11)=      2.04    96.46 Z(10,12)=      2.39    93.80 Z(10,13)=     36.50    99.29
 Z(11,10)=      2.04    96.43 Z(11,11)=      0.42    88.07 Z(11,12)=      3.21   100.24 Z(11,13)=     48.98   105.73 Z(12,10)=      2.39    93.8
 Z(12,11)=      3.21   100.24 Z(12,12)=      0.36    79.46 Z(12,13)=      8.04   111.03 Z(13,10)=     36.50    99.29 Z(13,11)=     48.98   105.73
 Z(13,12)=      8.04   111.03 Z(13,13)=      3.31    39.02 Z(
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                                              Z-BUS AFTER CLEARING THE FAULT
                                              ------------------------------
                       FAULTED BUS IS TONGI-23"                                                      FAULT TYPE = 2
                       ------------------------                                                      --------------
                MAG   ANGLE                  MAG   ANGLE                  MAG   ANGLE                  MAG   ANGLE                  MAG   ANGLE
-----------------------------------------------------------------------------------------------------------------------------------------------
 Z( 1, 1)=     0.29   79.62 Z( 1, 2)=      1.18  101.41 Z( 1, 3)=      6.07  101.67 Z( 1, 4)=      2.39   99.21 Z( 1, 5)=      6.18   96.80
Z( 1, 6)=      3.42  100.89 Z( 1, 7)=      5.48  101.96 Z( 1, 8)=      7.97  103.02 Z( 1, 9)=      6.24  100.14 Z( 1,10)=     23.06  101.22
Z( 1,11)=     30.94  107.66 Z( 1,12)=     28.35  106.45 Z( 1,13)=    422.51  111.94 Z( 2, 1)=      1.18  101.41 Z( 2, 2)=      0.56   87.18
Z( 2, 3)=     15.10  103.65 Z( 2, 4)=      6.55  101.08 Z( 2, 5)=     15.94   98.68 Z( 2, 6)=      9.37  102.77 Z( 2, 7)=     15.01  103.83
Z( 2, 8)=     21.83  104.90 Z( 2, 9)=     17.10  102.01 Z( 2,10)=     63.18  103.10 Z( 2,11)=     84.77  109.54 Z( 2,12)=     77.68  108.32
Z( 2,13)=  1184.91   113.81 Z( 3, 1)=      6.07  101.67 Z( 3, 2)=     15.10  103.65 Z( 3, 3)=      2.49   89.41 Z( 3, 4)=     34.38  101.29
Z( 3, 5)=     83.90   98.89 Z( 3, 6)=     49.14  102.98 Z( 3, 7)=     73.75  104.05 Z( 3, 8)=    114.52  105.11 Z( 3, 9)=     89.71  102.22
Z( 3,10)=    331.47  103.31 Z( 3,11)=    444.74  109.75 Z( 3,12)=    407.54  108.54 Z( 3,13)=   6216.71  114.02 Z( 4, 1)=      2.39   99.21
Z( 4, 2)=      6.55  101.08 Z( 4, 3)=     34.38  101.29 Z( 4, 4)=      0.14   86.60 Z( 4, 5)=      2.89   95.59 Z( 4, 6)=      0.62   99.85
Z( 4, 7)=      1.11  100.02 Z( 4, 8)=      2.47  101.83 Z( 4, 9)=      1.26   98.20 Z( 4,10)=      4.83   99.04 Z( 4,11)=      6.47  105.48
Z( 4,12)=      5.93  104.26 Z( 4,13)=     90.50  109.75 Z( 5, 1)=      6.18   96.80 Z( 5, 2)=     16.94   98.68 Z( 5, 3)=     88.90   98.89
Z( 5, 4)=      2.89   95.58 Z( 5, 5)=      0.29   85.64 Z( 5, 6)=      1.61   97.45 Z( 5, 7)=      2.87   97.61 Z( 5, 8)=      6.39   99.43
Z( 5, 9)=      3.26   95.80 Z( 5,10)=     12.48   96.63 Z( 5,11)=     16.74  103.07 Z( 5,12)=     15.34  101.86 Z( 5,13)=    234.01  107.35
Z( 6, 1)=      3.42  100.89 Z( 6, 2)=      9.37  102.77 Z( 6, 3)=     49.14  102.98 Z( 6, 4)=      0.62   99.85 Z( 6, 5)=      1.61   97.45
Z( 6, 6)=      0.15   87.23 Z( 6, 7)=      0.69   95.94 Z( 6, 8)=      2.44  103.20 Z( 6, 9)=      1.39  100.56 Z( 6,10)=      3.10   94.96
Z( 6,11)=      4.16  101.40 Z( 6,12)=      3.81  104.19 Z( 6,13)=     59.11  105.68 Z( 7, 1)=      5.48  101.96 Z( 7, 2)=     15.01  103.83
Z( 7, 3)=     75.75  104.05 Z( 7, 4)=      1.11  100.02 Z( 7, 5)=      2.87   97.61 Z( 7, 6)=      0.69   95.94 Z( 7, 7)=      0.20   88.24
Z( 7, 8)=      3.48  105.13 Z( 7, 9)=      2.05  102.51 Z( 7,10)=      4.08   96.74 Z( 7,11)=      5.47  103.18 Z( 7,12)=      5.02  101.97
Z( 7,13)=     76.52  107.46 Z( 8, 1)=      7.97  103.02 Z( 8, 2)=     21.93  104.90 Z( 8, 3)=    114.52  105.11 Z( 8, 4)=      2.47  101.83
Z( 8, 5)=      6.39   99.43 Z( 8, 6)=      2.44  103.20 Z( 8, 7)=      3.48  105.13 Z( 8, 8)=      0.44   88.13 Z( 8, 9)=      3.98  103.30
Z( 8,10)=     14.22  104.55 Z( 8,11)=     19.08  110.99 Z( 8,12)=     17.48  109.78 Z( 8,13)=    266.66  115.27 Z( 9, 1)=      6.24  100.14
Z( 9, 2)=     17.10  102.01 Z( 9, 3)=     89.71  102.22 Z( 9, 4)=      1.26   98.20 Z( 9, 5)=      3.26   95.80 Z( 9, 6)=      1.39  100.56
Z( 9, 7)=      2.05  102.51 Z( 9, 8)=      3.98  103.30 Z( 9, 9)=      0.28   88.11 Z( 9,10)=      8.85  101.55 Z( 9,11)=     11.87  107.99
Z( 9,12)=     10.88  106.78 Z( 9,13)=    165.89  112.26 Z(10, 1)=     23.06  101.22 Z(10, 2)=     63.18  103.10 Z(10, 3)=    331.48  103.31
Z(10, 4)=      4.83   99.04 Z(10, 5)=     12.48   96.63 Z(10, 6)=      3.10   94.96 Z(10, 7)=      4.08   95.74 Z(10, 8)=     14.22  104.55
Z(10, 9)=      8.85  101.55 Z(10,10)=      0.27   71.29 Z(10,11)=      1.56   98.24 Z(10,12)=      1.72   96.34 Z(10,13)=     26.30  101.83
Z(11, 1)=     30.94  107.66 Z(11, 2)=     84.77  109.54 Z(11, 3)=    444.74  109.75 Z(11, 4)=      6.47  105.48 Z(11, 5)=     16.74  103.07
Z(11, 6)=      4.16  101.40 Z(11, 7)=      5.47  103.18 Z(11, 8)=     19.08  110.99 Z(11, 9)=     11.87  107.99 Z(11,10)=      1.56   98.24
Z(11,11)=      0.44   86.93 Z(11,12)=      2.31  102.78 Z(11,13)=     35.29  108.27 Z(12, 1)=     28.35  106.45 Z(12, 2)=     77.68  108.32
Z(12, 3)=    407.54  108.54 Z(12, 4)=      5.93  104.26 Z(12, 5)=     15.34  101.86 Z(12, 6)=      3.81  104.19 Z(12, 7)=      5.02  101.97
Z(12, 8)=     17.48  109.78 Z(12, 9)=     10.88  106.78 Z(12,10)=      1.72   96.24 Z(12,11)=      2.31  102.78 Z(12,12)=      0.37   78.10
Z(12,13)=      7.52  111.20 Z(13, 1)=    432.51  111.94 Z(13, 2)=   1184.91  113.81 Z(13, 3)=   6216.72  114.02 Z(13, 4)=     90.50  109.75
Z(13, 5)=    234.01  107.25 Z(13, 6)=     59.11  105.68 Z(13, 7)=     76.52  107.46 Z(13, 8)=    266.66  115.27 Z(13, 9)=    165.89  112.26
Z(13,10)=     26.30  101.83 Z(13,11)=     35.29  108.27 Z(13,12)=      7.52  111.2  Z(13,13)=      3.32   87.96 Z(
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DATA FOR TIME VS. ANGLE(DEG) PLOTTING

TIME	KAPTAI	SIKALBAHA	HALISAHAR	ASUGANG -132-	SHAHJIBAZAR	ASUGANG -230-	GHORASAL -230-	SIDDIRGANG	GHORASAL-132	GOALPARA	BHERAMARA	BOGRA	SAIDPUR
0.0	1.63	3.21	1.57	7.35	1.83	10.67	11.64	5.11	7.36	-23.47	-16.58	-16.62	-14.89
0.020	1.66	3.25	1.60	7.49	1.87	10.93	12.29	5.24	7.61	-23.55	-16.64	-16.67	-14.88
0.040	1.75	3.39	1.69	7.91	2.00	11.85	14.24	5.95	8.36	-23.79	-16.80	-16.82	-14.83
0.060	1.90	3.61	1.84	8.61	2.20	13.37	17.48	7.15	9.61	-24.19	-17.06	-17.10	-14.75
0.080	2.12	3.92	2.06	9.59	2.59	15.49	21.96	8.82	11.34	-24.74	-17.44	-17.47	-14.66
0.100	2.40	4.33	2.35	10.84	2.91	18.20	27.73	10.94	13.55	-25.45	-17.92	-17.95	-14.55
0.120	2.77	4.83	2.71	12.38	3.43	21.49	34.69	13.52	15.22	-26.32	-18.51	-18.53	-14.46
0.140	3.22	5.43	3.15	14.20	4.09	25.35	42.82	16.54	19.35	-27.23	-19.20	-19.22	-14.38
0.160	3.76	6.13	3.68	16.32	4.91	29.78	52.10	19.99	22.91	-28.50	-20.01	-20.01	-14.35
0.180	4.42	6.94	4.30	18.73	5.91	34.75	62.47	23.85	25.89	-29.82	-20.93	-20.91	-14.38
0.200	5.22	7.88	5.16	21.40	7.19	39.86	72.20	27.91	31.04	-31.14	-21.73	-21.73	-14.44
0.220	6.22	8.98	5.98	24.29	8.85	44.67	79.43	31.92	35.11	-32.33	-22.12	-22.24	-14.48
0.240	7.44	10.27	7.09	27.43	10.94	49.17	84.09	35.92	39.10	-33.37	-22.07	-22.43	-14.49
0.260	8.92	11.78	8.42	30.65	13.51	53.33	86.18	39.84	43.00	-34.23	-21.56	-22.26	-14.46
0.280	10.66	13.52	9.98	34.52	16.54	57.11	85.79	43.71	46.80	-34.92	-20.59	-21.72	-14.37
0.300	12.39	15.51	11.79	38.44	20.06	60.49	83.07	47.49	50.46	-35.40	-19.15	-20.80	-14.19
0.320	15.01	17.75	13.87	42.37	24.05	63.40	78.29	51.14	53.94	-35.67	-17.27	-19.49	-13.90
0.340	17.63	20.26	16.23	46.06	28.49	65.79	71.77	54.62	57.20	-35.70	-14.97	-17.81	-13.47
0.360	20.55	23.03	18.86	51.23	33.33	67.60	64.06	57.85	60.18	-35.48	-12.28	-15.73	-12.85
0.380	23.70	26.06	21.76	55.65	38.49	68.79	55.76	60.81	62.82	-34.97	-9.26	-13.33	-12.02
0.400	27.23	29.33	24.96	59.89	43.91	69.30	47.59	63.38	65.06	-34.18	-5.97	-10.52	-10.93
0.420	30.94	32.82	28.41	63.99	49.48	69.13	40.28	65.54	66.86	-33.07	-2.48	-7.45	-9.55
0.440	34.87	36.50	32.09	67.82	55.09	68.29	34.49	67.24	68.18	-31.64	1.12	-4.11	-7.86
0.460	38.96	40.35	35.99	71.29	60.63	66.36	30.77	68.45	69.02	-29.88	4.74	-0.57	-5.83
0.480	43.24	44.34	40.09	74.23	65.99	64.93	29.48	69.18	69.28	-27.77	8.31	3.13	-3.44
0.500	47.59	48.43	44.34	76.89	71.08	62.64	30.79	69.43	69.29	-25.31	11.76	6.92	-0.67
0.520	52.01	52.59	48.73	78.93	75.76	60.16	34.69	69.21	68.80	-22.50	15.03	10.77	2.47
0.540	56.46	56.78	53.22	80.41	80.02	57.70	40.93	68.59	67.97	-19.33	18.09	14.63	5.98
0.560	60.68	60.96	57.76	81.34	83.70	55.46	49.10	67.61	65.89	-15.81	20.90	18.45	9.86
0.580	65.24	65.14	62.32	81.72	86.77	53.69	58.60	66.36	65.67	-11.93	23.46	22.19	14.07
0.600	69.51	69.23	66.87	81.58	89.19	52.59	68.74	64.95	64.41	-7.72	25.79	25.83	18.59
0.620	73.64	73.23	71.34	80.97	[illegible]	52.36	78.78	63.48	63.24	-3.14	27.92	29.35	23.35
0.640	77.60	77.09	75.72	79.98	91.92	53.16	88.06	62.09	62.31	1.73	29.87	32.71	28.36
0.660	81.36	80.80	79.95	78.68	92.23	55.37	96.00	60.91	61.73	6.89	31.71	35.92	33.37
0.680	84.89	84.32	84.07	77.17	91.86	58.11	102.17	60.04	61.60	12.31	33.49	38.95	38.49
0.700	88.17	87.63	87.83	75.57	90.95	62.22	106.29	59.62	62.01	17.95	35.27	41.82	43.57
0.720	91.17	90.71	91.40	73.96	89.24	67.27	109.21	59.67	63.00	23.78	37.11	44.49	48.53
0.740	93.97	93.52	94.67	72.47	87.10	73.09	107.92	60.31	64.62	29.75	39.08	47.02	53.29
0.760	96.26	96.06	97.63	71.20	84.52	79.41	105.53	61.56	66.83	35.81	41.24	49.42	57.79
0.780	98.33	98.30	100.22	70.24	80.59	85.97	101.29	63.44	69.62	41.92	43.64	51.67	61.94
0.800	100.06	100.23	102.45	69.67	79.41	92.46	95.64	65.93	72.91	48.03	46.32	53.86	65.71
0.820	101.44	101.83	104.27	69.57	75.12	98.55	89.13	68.99	76.60	54.08	49.30	55.98	69.04
0.840	102.49	103.10	105.69	69.97	71.83	103.95	82.45	72.53	80.56	60.02	52.59	58.07	71.90
0.860	103.20	104.04	106.70	70.91	68.57	108.42	76.31	76.46	84.67	65.80	56.16	60.14	74.29
0.880	103.58	104.64	107.29	72.39	65.77	111.77	71.39	80.63	88.78	71.36	59.98	62.23	76.19
0.900	103.64	104.92	107.48	74.38	63.23	113.86	68.27	85.05	92.76	76.64	63.99	64.26	77.64
0.920	103.41	104.88	107.27	76.85	61.17	114.65	67.35	89.48	96.47	81.62	68.14	66.54	78.66
0.940	102.91	104.55	106.69	79.70	59.69	114.17	68.85	93.81	99.83	86.25	72.36	68.81	79.32
0.960	102.16	103.95	105.70	82.95	58.85	112.49	72.79	97.95	102.75	90.50	76.57	71.17	79.68
0.980	101.19	103.11	104.53	86.64	58.75	109.75	79.00	101.82	105.17	94.34	80.71	73.65	79.84
1.000	100.04	102.06	103.02	90.47	59.44	106.19	87.07	105.31	107.06	97.76	84.72	76.26	79.89
1.020	98.74	100.83	101.28	94.45	60.95	102.12	96.45	108.35	108.40	100.74	88.52	79.00	79.92
1.040	97.35	99.48	99.37	98.48	63.32	97.87	106.42	110.89	109.22	103.29	92.06	81.87	80.05
1.060	95.89	98.04	97.34	102.49	66.53	93.86	116.23	112.91	109.56	105.40	95.29	84.85	80.37
1.080	94.42	96.56	95.25	106.38	70.55	90.46	125.17	114.39	109.59	107.08	98.16	87.93	80.99
1.100	92.98	95.10	93.17	110.08	75.33	88.13	132.65	115.35	109.14	108.33	100.65	91.07	81.98
1.120	91.51	93.70	91.15	113.52	80.78	86.85	138.24	115.84	108.56	109.18	102.72	94.23	83.39
1.140	90.36	92.41	89.25	116.65	86.91	87.10	141.68	115.89	107.95	109.64	104.39	97.36	85.28
1.160	89.20	91.28	87.54	119.41	93.29	88.89	142.84	115.57	107.34	109.74	105.63	100.41	87.66
1.180	88.35	90.34	86.05	121.79	100.11	92.22	141.75	114.95	106.88	109.49	106.47	103.31	90.51
1.200	87.66	89.62	84.85	123.76	107.10	97.01	138.55	114.11	106.66	108.93	106.92	106.01	93.81
1.220	87.22	89.19	83.97	125.31	114.14	103.07	133.56	113.13	106.77	108.09	107.02	108.45	97.48
1.240	87.07	89.04	83.45	126.46	121.07	110.15	127.24	112.11	107.28	106.99	106.80	110.57	101.45
1.260	87.21	89.20	83.32	127.23	127.72	117.88	120.24	111.12	108.22	105.66	106.32	112.33	105.61

GRAPH FOR UNSUSTAINED FAULT WITHOUT AUTORECLOSER

REFERENCE MACHINE 9 IS GHORASAL-132

3-PHASE FAULT BETWEEN TONGI-230 & ISHURDI-230 LINE AT TONGI-230 END   FAULT TYPE = 2

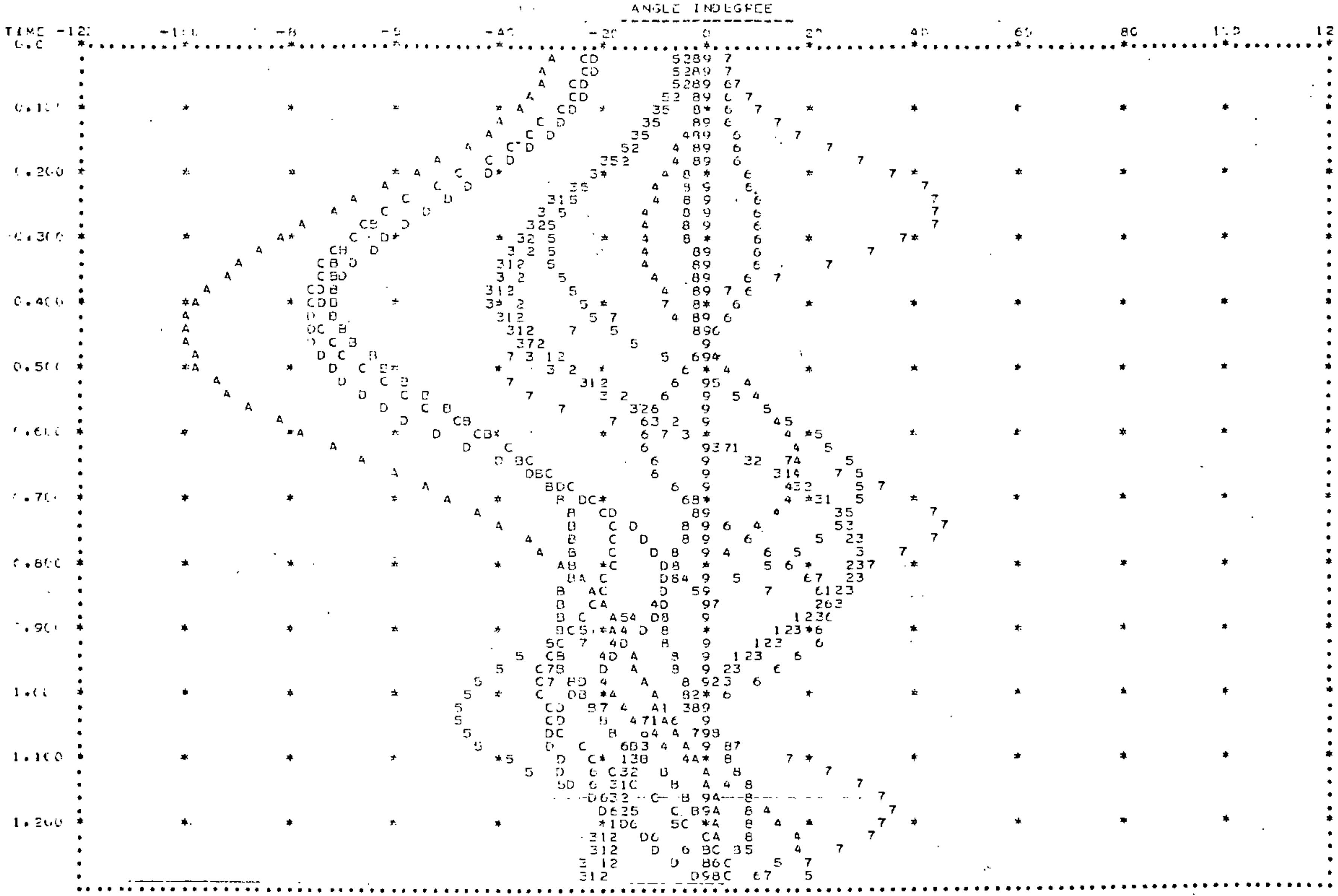

Fig. 6.1 (Without Governor)

* * * MEANING OF THE CODES * * *

1=KAPTAI   2=SIKALBAHA   3=HALISHAHAR   4=ASHUGANG-132   5=SHAHJIBAZAR   6=ASHUGANG-230   7=GHORASAL-230

8=SIDDIRGANG   9=GHORASAL-132   A=GOALPARA   B=BHERAMARA   C=BOGRA   D=SAIDPUR

DATA FOR TIME VS. ANGLE(DEG)PLOTTING

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TIME       KAPTAI    SIKAL-     HALI-   ASUGANG   SHAHJI-   ASUGANG  GHORASAL   SIDDIR-    GHORA-     GOAL-    BHERA-     BOGRA   SAIDPUR
                       BAHA     SAHAR     -132-     BAZAR     -230-    -230 -      GANG   SAL-132      PARA      MARA

0.0          1.63      3.31      1.57      7.35      1.83     10.63     11.64      5.00      7.35    -23.47    -16.55    -16.62    -14.69
0.020        1.67      3.25      1.60      7.49      1.87     10.93     12.29      5.24      7.61    -23.55    -16.64    -16.67    -14.88
0.040        1.75      3.39      1.69      7.91      2.00     11.85     14.24      5.96      8.36    -23.79    -16.80    -16.83    -14.83
0.060        1.90      3.61      1.84      8.61      2.20     13.37     17.43      7.15      9.61    -24.19    -17.06    -17.10    -14.75
0.080        2.12      3.92      2.06      9.59      2.51     15.49     21.93      8.82     11.34    -24.74    -17.44    -17.47    -14.66
0.100        2.40      4.33      2.35     10.84      2.91     18.20     27.73     10.94     13.55    -25.45    -17.92    -17.95    -14.55
0.120        2.77      4.83      2.71     12.38      3.43     21.49     34.69     13.52     16.22    -26.32    -18.51    -18.53    -14.46
0.140        3.22      5.43      3.15     14.20      4.09     25.35     42.82     16.54     19.35    -27.33    -19.20    -19.22    -14.38
0.160        3.76      6.13      3.68     16.32      4.91     29.78     52.10     19.99     22.91    -28.55    -20.01    -20.01    -14.35
0.180        4.42      6.94      4.30     18.73      5.91     34.75     62.47     23.85     26.89    -29.82    -20.93    -20.91    -14.38
0.200        5.22      7.88      5.06     21.40      7.14     39.96     72.20     27.91     31.04    -31.14    -21.73    -21.73    -14.44
0.220        6.22      8.98      5.98     24.29      8.85     44.67     79.43     31.92     35.11    -32.33    -22.12    -22.24    -14.48
0.240        7.44     10.27      7.09     27.43     10.94     49.17     84.09     35.90     39.11    -33.37    -22.07    -22.43    -14.49
0.260        8.92     11.78      8.42     30.85     13.50     53.33     86.18     39.81     43.00    -34.23    -21.56    -22.26    -14.46
0.280       10.60     13.52      9.98     34.52     16.54     57.11     85.79     43.71     46.81    -34.92    -20.59    -21.72    -14.37
0.300       12.69     15.51     11.79     38.44     20.06     60.49     83.07     47.49     50.46    -35.40    -19.15    -20.85    -14.19
0.320       15.01     17.75     13.87     42.57     24.05     63.40     78.28     51.14     53.94    -35.67    -17.27    -19.49    -13.90
0.340       17.63     20.20     16.23     46.86     28.49     65.79     71.77     54.62     57.20    -35.70    -14.57    -17.80    -13.47
0.360       20.55     23.03     18.96     51.27     33.33     67.60     64.06     57.85     60.18    -35.48    -12.28    -15.73    -12.85
0.380       23.76     26.16     21.78     55.60     38.49     68.79     55.76     60.80     62.82    -34.97     -9.26    -13.30    -12.02
0.400       27.23     29.33     24.96     59.89     43.91     69.30     47.59     63.38     65.06    -34.18     -5.97    -10.52    -10.93
0.420       30.94     32.82     28.41     63.99     49.48     69.13     40.28     65.54     66.86    -33.07     -2.48     -7.45     -9.55
0.440       34.97     36.50     32.09     67.82     55.09     68.29     34.49     67.24     68.18    -31.64      1.12     -4.11     -7.86
0.460       38.98     40.35     35.99     71.29     60.63     66.96     30.77     68.45     69.02    -29.88      4.74    -  .57     -5.63
0.480       43.24     44.34     40.09     74.33     65.99     64.93     29.48     69.13     69.38    -27.77      8.31      3.13     -3.44
0.500       47.59     48.43     44.34     76.89     71.08     62.64     30.79     69.43     69.29    -25.31     11.76      6.92      -.67
0.520       52.01     52.59     48.73     78.93     75.78     60.16     34.69     69.21     68.80    -22.50     15.03     10.77      2.47
0.540       56.40     56.78     53.22     80.41     80.02     57.70     40.93     68.59     67.97    -19.33     18.09     14.63      5.98
0.560       60.68     60.98     57.76     81.34     83.79     55.46     49.10     67.61     66.89    -15.81     20.90     18.45      9.86
0.580       65.24     65.14     62.32     81.72     86.77     53.69     58.66     66.36     65.67    -11.93     23.46     22.19     14.07
0.600       69.50     69.23     66.86     81.57     89.18     52.54     68.67     64.93     64.39     -7.67     25.92     25.93     18.65
0.620       73.62     73.21     71.33     80.93     90.98     52.18     78.51     63.40     63.15     -3.00     28.44     29.74     23.61
0.640       77.55     77.04     75.68     79.87     91.85     52.70     87.48     61.91     62.10      2.06     31.03     33.57     28.88
0.660       81.27     80.71     79.88     78.48     92.11     54.37     95.03     60.58     61.25      7.47     33.71     37.41     34.38
0.680       84.76     84.18     83.89     76.86     91.67     57.04    100.77     59.52     61.01     13.22     36.51     41.22     40.04
0.700       87.98     87.43     87.67     75.10     90.57     60.72    104.43     58.85     61.16     19.26     39.43     44.97     45.75
0.720       90.97     90.43     91.17     73.31     88.84     65.34    105.87     58.64     61.85     25.55     42.49     48.65     51.44
0.740       93.52     93.15     94.37     71.59     86.55     70.69    105.09     58.98     63.15     32.06     45.71     52.24     57.01
0.760       95.81     95.58     97.23     70.06     83.78     76.56    102.23     59.90     65.01     38.73     49.09     55.71     62.37
0.780       97.75     97.70     99.72     68.85     80.64     82.67     97.56     61.42     67.43     45.50     52.62     59.06     67.44
0.800       99.34     99.48    101.82     67.92     77.21     88.77     91.54     63.55     70.34     52.33     56.30     62.29     72.14
0.820      100.57    100.92    103.51     67.47     73.64     94.51     84.70     66.23     73.66     59.15     60.09     65.36     76.42
0.840      101.43    102.01    104.77     67.52     70.04     99.62     77.94     69.41     77.27     65.88     63.95     68.29     80.22
0.860      101.94    102.75    105.59     68.09     66.55    103.87     71.82     73.01     81.05     72.47     67.83     71.06     83.50
0.880      102.11    103.13    105.99     69.19     63.37    107.06     67.09     76.91     84.86     78.83     71.67     73.67     86.24
0.900      101.94    103.18    105.96     70.83     60.47    109.38     64.31     81.01     88.58     84.91     75.41     76.12     88.44
0.920      101.46    102.90    105.52     72.99     57.37    109.65     63.96     85.19     92.09     90.64     79.02     78.42     90.11
0.940      100.69    102.31    104.69     75.59     55.12    109.51     65.94     89.35     95.31     95.98     82.43     80.58     91.30
0.960       99.57    101.45    103.50     78.62     54.95    108.03     70.92     93.39     98.16    100.87     85.63     82.62     92.05
0.980       98.43    100.34    102.00     82.02     54.53    105.60     77.36     97.20    100.59    105.28     88.57     84.56     92.41
1.000       97.00     99.02    100.21     85.71     54.92    102.45     85.33    100.71    102.55    109.17     91.25     86.41     92.47
1.020       95.42     97.53     98.19     89.61     55.18     98.86     95.89    103.95    104.05    112.53     93.65     88.20     92.30
1.040       93.70     95.92     95.99     93.65     58.33     95.18    106.22    106.57    105.17    115.33     95.76     89.95      92.0
1.060       92.04     94.24     93.68     97.74     61.38     91.78    116.25    108.84    105.76    117.56     97.64     91.67     91.65
1.080       90.33     92.55     91.32    101.80     65.37     89.01    125.27    110.65    106.08    119.22     99.25     93.38     91.36
1.100       88.67     90.89     88.99    105.74     70.43     87.20    132.72    112.00    105.17    120.32    100.63     95.09     91.20
1.120       87.12     89.32     86.73    109.50     75.51     86.58     139.2    112.95    106.10    120.87    101.80     96.80     91.26
1.140       85.70     87.89     84.63    113.01     81.65     87.32    141.45    113.47    105.98    120.89    102.78     98.49     91.00
1.160       84.48     86.60     82.73    116.22     88.32     89.50    142.38    113.67    105.90    120.39    103.60    100.16     92.26
1.180       83.48     85.65     81.11    119.09      95.4     93.10    141.02    113.58    105.96    119.41    104.27    101.79     93.26
1.200       82.75     84.91     79.90    121.59    102.76     98.34    137.55    113.25    106.23    117.98    104.90    103.25     94.07
1.220       82.31     84.48     78.80    123.09    110.23    104.12    132.28    112.79    106.87    116.13    105.21    104.83     95.41
1.240       82.19     84.38     78.33    123.41    117.67    111.18    125.73    112.24    107.77    113.92    105.51    106.19     98.45
1.260       82.43     84.65     78.24    122.73     124.9    118.88    118.56    111.69    108.67    111.37    105.71    107.47    100.85
```

GRAPH FOR FAULT CLEARED AT 8 CYCLES LATER & RECLOSE AFTER 28 CYCLES

REFFERENCE MACHINE 9 IS GHORASAL-132

3-PHASE FAULT BETWEEN TONGI-230 & ISHURDI-230 LINE AT TONGI-230 END

FAULT TYPE = 2

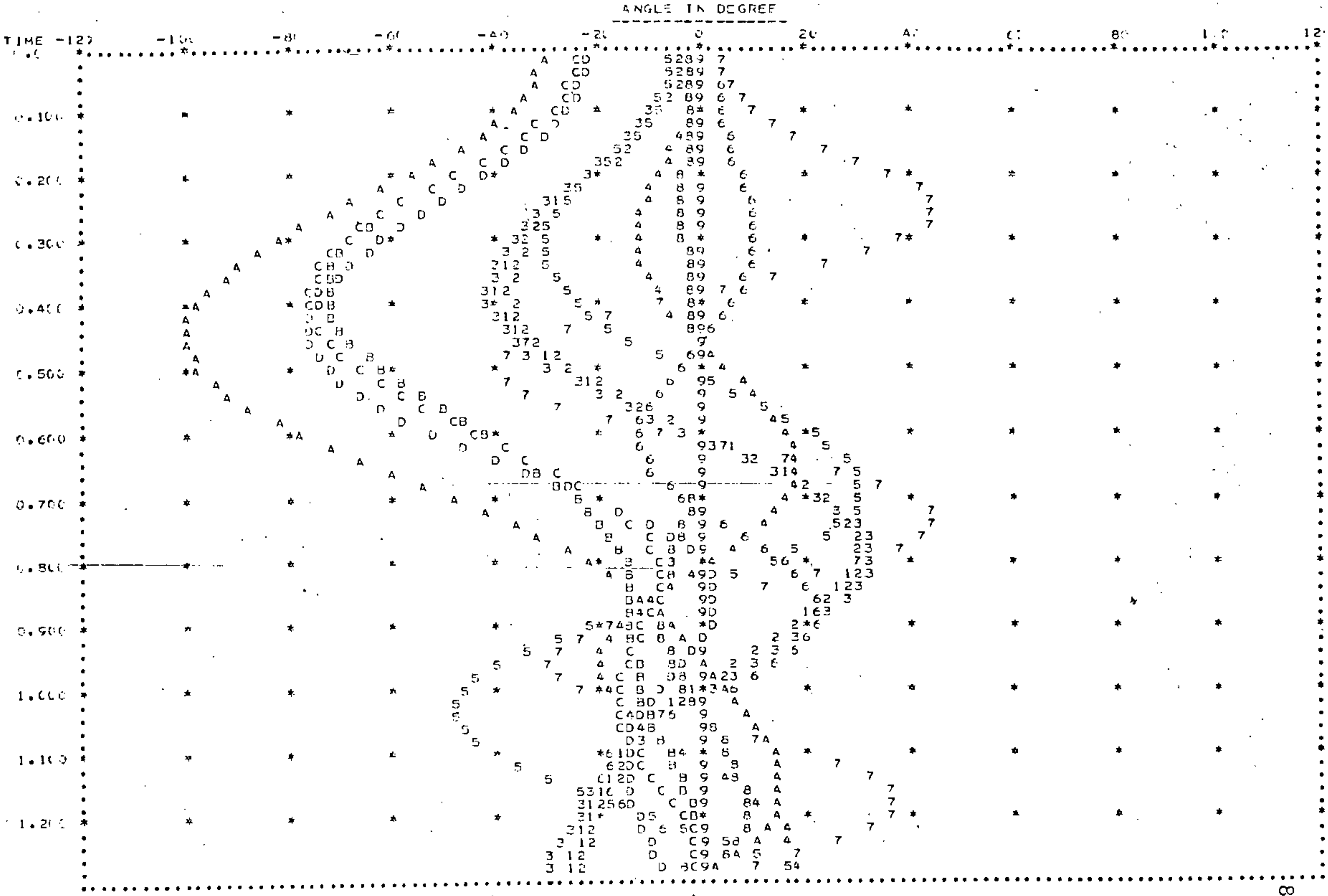

Fig.6.2 (Without Governor)

* * * MEANING OF THE CODES * * *

1=KAPTAI 2=SIKALBAHA 3=HALISHAHAR 4=ASHUGANG-132 5=SHAHJIBAZAR 6=ASHUGANG-230 7=GHORASAL-230

DATA FOR SPEED VS. POWER(PU) FOR GOVERNOR ACTION

TIME		KAPTAI	SIKAL-BAHA	HALI-SAHAR	ASUGANG -132-	SHAHJI-BAZAR	ASUGANG -230-	GHORASAL -230-	SIDDIR-GANG	GHORA-SAL-132	GOAL-PARA	BHERA-MARA	BOGRA	SAIDPUR
0.00	SPEED	314.16	314.16	314.16	314.16	314.16	314.16	314.16	314.16	314.16	314.16	314.16	314.16	314.16
	POWER	1.55	0.60	0.10	2.36	0.49	3.00	2.10	0.74	1.09	0.93	0.30	0.80	0.10
0.02	SPEED	314.21	314.24	314.21	314.40	314.23	314.69	315.30	314.58	314.61	314.02	314.07	314.07	314.19
	POWER	1.55	0.60	0.10	2.36	0.49	3.00	2.10	0.74	1.09	0.93	0.30	0.80	0.10
0.04	SPEED	314.26	314.32	314.27	314.65	314.27	315.22	316.43	315.00	315.03	313.88	313.97	313.97	314.21
	POWER	1.55	0.60	0.10	2.36	0.49	3.00	2.10	0.74	1.09	0.93	0.30	0.80	0.10
0.06	SPEED	314.32	314.39	314.32	314.89	314.33	315.75	317.54	315.41	315.46	313.74	313.88	313.88	314.24
	POWER	1.55	0.60	0.10	2.36	0.49	3.00	2.10	0.74	1.09	0.93	0.30	0.80	0.10
0.08	SPEED	314.38	314.47	314.38	315.13	314.46	316.27	318.64	315.81	315.88	313.61	313.79	313.79	314.25
	POWER	1.55	0.60	0.10	2.36	0.49	3.00	2.10	0.74	1.09	0.93	0.30	0.80	0.10
0.10	SPEED	314.44	314.55	314.44	315.38	314.56	316.78	319.71	316.21	316.29	313.47	313.69	313.75	314.25
	POWER	1.55	0.60	0.10	2.36	0.49	3.00	2.10	0.74	1.09	0.93	0.30	0.80	0.10
0.12	SPEED	314.51	314.64	314.51	315.62	314.67	317.28	320.75	316.60	316.69	313.34	313.60	313.60	314.24
	POWER	1.55	0.60	0.10	2.36	0.49	3.00	2.10	0.74	1.09	0.93	0.30	0.80	0.10
0.14	SPEED	314.59	314.72	314.59	315.88	314.80	317.78	321.76	316.95	317.08	313.21	313.50	313.51	314.21
	POWER	1.55	0.60	0.10	2.36	0.49	3.00	2.10	0.74	1.09	0.93	0.30	0.80	0.10
0.16	SPEED	314.68	314.82	314.66	316.13	314.95	318.26	322.74	317.35	317.45	313.08	313.41	313.42	314.17
	POWER	1.55	0.60	0.10	2.36	0.49	3.00	2.10	0.74	1.09	0.93	0.30	0.80	0.10
0.16	SPEED	314.78	314.91	314.75	316.39	315.11	318.73	323.68	317.71	317.81	312.95	313.31	313.33	314.14
	POWER	1.55	0.60	0.10	2.36	0.49	3.00	2.10	0.74	1.09	0.93	0.30	0.80	0.10
0.20	SPEED	314.94	315.04	314.88	316.57	315.43	318.48	321.57	317.67	317.74	313.05	313.63	313.57	314.11
	POWER	1.55	0.60	0.10	2.36	0.49	3.00	2.10	0.74	1.09	0.93	0.30	0.80	0.10
0.22	SPEED	315.12	315.20	315.04	316.78	315.79	318.22	319.34	317.64	317.67	313.19	314.00	313.85	314.13
	POWER	1.55	0.60	0.10	2.36	0.49	3.00	2.10	0.74	1.09	0.93	0.30	0.80	0.10
0.24	SPEED	315.33	315.37	315.22	317.02	316.18	317.93	317.09	317.61	317.60	313.33	314.40	314.15	314.16
	POWER	1.55	0.60	0.10	2.36	0.49	3.00	2.10	0.74	1.09	0.93	0.30	0.80	0.10
0.26	SPEED	315.56	315.57	315.41	317.25	316.59	317.63	314.87	317.55	317.51	313.48	314.81	314.47	314.21
	POWER	1.55	0.60	0.10	2.36	0.49	3.00	2.10	0.74	1.09	0.93	0.30	0.80	0.10
0.28	SPEED	315.80	315.78	315.63	317.47	317.02	317.28	312.76	317.50	317.41	313.65	315.21	314.79	314.27
	POWER	1.55	0.60	0.10	2.36	0.49	3.00	2.10	0.74	1.09	0.93	0.30	0.80	0.10
0.30	SPEED	316.05	316.00	315.85	317.67	317.44	316.91	310.92	317.41	317.28	313.83	315.61	315.13	314.35
	POWER	1.55	0.60	0.10	2.36	0.49	3.00	2.10	0.74	1.09	0.93	0.30	0.80	0.10
0.32	SPEED	316.31	316.23	316.09	317.84	317.84	316.48	309.15	317.27	317.10	314.02	315.99	315.46	314.47
	POWER	1.55	0.60	0.10	2.36	0.49	3.00	2.10	0.74	1.09	0.93	0.30	0.80	0.10
0.34	SPEED	316.57	316.46	316.33	317.95	318.21	316.00	307.86	317.13	316.89	314.24	316.34	315.83	314.61
	POWER	1.55	0.60	0.10	2.36	0.49	3.00	2.10	0.74	1.09	0.93	0.30	0.80	0.10
0.36	SPEED	316.83	316.69	316.57	317.99	318.53	315.47	307.06	316.86	316.62	314.47	316.66	316.13	314.78
	POWER	1.55	0.60	0.10	2.36	0.49	3.00	2.10	0.74	1.09	0.93	0.30	0.80	0.10
0.38	SPEED	317.07	316.90	316.82	317.95	318.79	314.90	306.85	316.57	316.30	314.72	316.52	316.42	314.99
	POWER	1.55	0.60	0.10	2.36	0.49	3.00	2.10	0.74	1.09	0.93	0.30	0.80	0.10
0.40	SPEED	317.30	317.10	317.05	317.93	318.97	314.31	307.29	316.23	315.93	314.99	317.12	316.72	315.23
	POWER	1.55	0.60	0.10	2.36	0.49	3.00	2.10	0.74	1.09	0.93	0.30	0.80	0.10
0.42	SPEED	317.51	317.29	317.27	317.63	319.15	313.71	308.34	315.83	315.52	315.26	317.26	316.96	315.49
	POWER	1.55	0.60	0.10	2.36	0.49	3.00	2.10	0.74	1.09	0.93	0.30	0.80	0.10
0.44	SPEED	317.67	317.44	317.47	317.35	319.04	313.15	309.93	315.43	315.10	315.55	317.32	317.17	315.79
	POWER	1.55	0.60	0.10	2.36	0.49	3.00	2.10	0.74	1.09	0.93	0.30	0.80	0.10
0.46	SPEED	317.81	317.58	317.65	317.01	318.92	312.67	311.92	315.02	314.67	315.85	317.31	317.32	316.08
	POWER	1.55	0.60	0.10	2.36	0.49	3.00	2.10	0.74	1.09	0.93	0.30	0.80	0.10
0.48	SPEED	317.92	317.68	317.80	316.61	318.73	312.29	314.15	314.58	314.27	316.15	317.23	317.43	316.40
	POWER	1.55	0.60	0.10	2.36	0.49	3.00	2.10	0.74	1.09	0.93	0.30	0.80	0.10
0.50	SPEED	317.99	317.76	317.93	316.17	318.44	312.05	316.45	314.17	313.90	316.46	317.09	317.50	316.73
	POWER	1.55	0.60	0.10	2.36	0.49	3.00	2.10	0.74	1.09	0.93	0.30	0.80	0.10
0.52	SPEED	318.03	317.80	318.03	315.70	318.07	311.97	319.63	313.78	313.57	316.77	316.92	317.52	317.06
	POWER	1.55	0.60	0.10	2.36	0.49	3.00	2.10	0.74	1.09	0.93	0.30	0.80	0.10
0.54	SPEED	318.03	317.82	318.11	315.21	317.63	312.17	321.52	313.45	313.31	317.08	316.71	317.51	317.38
	POWER	1.55	0.60	0.10	2.36	0.49	3.00	2.10	0.74	1.09	0.93	0.30	0.80	0.10
0.56	SPEED	318.00	317.83	318.13	314.72	317.12	312.36	321.97	313.17	313.13	317.39	316.50	317.46	317.69
	POWER	1.55	0.60	0.10	2.36	0.49	3.00	2.10	0.74	1.09	0.93	0.30	0.80	0.10
0.58	SPEED	317.93	317.76	318.13	314.35	316.56	312.86	322.84	312.98	313.05	317.72	316.28	317.38	317.97
	POWER	1.55	0.60	0.10	2.36	0.49	3.00	2.10	0.74	1.09	0.93	0.30	0.80	0.10
0.60	SPEED	317.96	317.84	318.21	314.39	316.33	313.63	324.02	313.45	313.61	317.68	315.91	317.12	318.08
	POWER	1.55	0.60	0.10	2.36	0.49	3.00	2.10	0.74	1.09	0.93	0.30	0.80	0.10
0.62	SPEED	317.97	317.91	318.25	314.53	316.19	314.42	325.11	313.94	314.19	317.65	315.57	316.85	318.17
	POWER	1.55	0.60	0.10	2.36	0.49	3.00	2.10	0.74	1.09	0.93	0.30	0.80	0.10
0.64	SPEED	317.96	317.97	318.28	314.69	315.98	315.24	326.13	314.45	314.79	317.63	315.25	316.59	318.23
	POWER	1.55	0.60	0.10	2.36	0.49	3.00	2.10	0.74	1.09	0.93	0.30	0.80	0.10
0.66	SPEED	317.94	318.00	318.25	314.87	315.76	316.07	327.08	314.97	315.41	317.59	314.97	316.33	318.25
	POWER	1.55	0.60	0.10	2.36	0.49	3.00	2.10	0.74	1.09	0.93	0.30	0.80	0.10
0.68	SPEED	317.91	318.02	318.27	315.07	315.54	316.91	327.97	315.51	316.04	317.54	314.72	316.07	318.22
	POWER	1.55	0.60	0.10	2.36	0.49	3.00	2.10	0.74	1.09	0.93	0.30	0.80	0.10
0.70	SPEED	317.87	318.03	318.23	315.29	315.33	317.75	328.81	316.06	316.67	317.48	314.52	315.82	318.14
	POWER	1.55	0.60	0.10	2.36	0.49	3.00	2.10	0.74	1.09	0.93	0.30	0.80	0.10
0.72	SPEED	317.82	318.02	318.19	315.54	315.13	318.58	329.64	316.62	317.30	317.41	314.35	315.57	318.01
	POWER	1.55	0.60	0.10	2.36	0.49	3.00	2.10	0.74	1.09	0.93	0.30	0.80	0.10

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0.74  SPEED  317.76   318.00   318.11   315.80   314.94   319.39   337.48   317.18   317.92   317.33   314.23   315.33   317.82
      POWER    1.55     0.60     0.10     2.36     0.49     3.00     2.10     0.74     1.09     0.93     0.30     0.80     0.10
0.76  SPEED  317.59   317.81   317.91   315.91   314.58   320.44   329.33   317.65   318.42   317.46   314.60   315.31   317.60
      POWER    1.55     0.60     0.10     2.36     0.49     3.00     2.10     0.74     1.09     0.93     0.30     0.80     0.10
0.78  SPEED  317.41   317.63   317.71   316.07   314.29   321.33   326.64   318.12   318.89   317.56   315.01   315.31   317.31
      POWER    1.55     0.60     0.10     2.36     0.49     3.00     2.10     0.74     1.09     0.93     0.30     0.80     0.10
0.80  SPEED  317.23   317.44   317.50   316.27   314.07   322.04   325.43   318.57   319.30   317.63   315.45   315.32   316.97
      POWER    1.55     0.60     0.10     2.36     0.49     3.00     2.10     0.74     1.09     0.93     0.30     0.80     0.10
0.82  SPEED  317.07   317.26   317.30   316.51   313.94   322.56   324.64   318.99   319.65   317.67   315.91   315.36   316.61
      POWER    1.55     0.60     0.10     2.36     0.49     3.00     2.10     0.74     1.09     0.93     0.30     0.80     0.10
0.84  SPEED  316.92   317.08   317.10   316.79   313.88   322.99   324.25   319.38   319.93   317.70   316.39   315.43   316.23
      POWER    1.55     0.60     0.10     2.36     0.49     3.00     2.10     0.74     1.09     0.93     0.30     0.80     0.10
0.86  SPEED  316.78   316.92   316.91   317.09   313.92   323.05   324.23   319.73   320.16   317.70   316.87   315.52   315.84
      POWER    1.55     0.60     0.10     2.36     0.49     3.00     2.10     0.74     1.09     0.93     0.30     0.80     0.10
0.88  SPEED  316.66   316.76   316.73   317.43   314.05   323.05   324.56   320.04   320.33   317.68   317.33   315.64   315.47
      POWER    1.55     0.60     0.10     2.36     0.49     3.00     2.10     0.74     1.09     0.93     0.30     0.80     0.10
0.90  SPEED  316.56   316.62   316.56   317.78   314.27   322.92   325.25   320.30   320.43   317.65   317.76   315.79   315.13
      POWER    1.55     0.60     0.10     2.36     0.49     3.00     2.10     0.74     1.09     0.93     0.30     0.80     0.10
0.92  SPEED  316.48   316.51   316.41   318.13   314.57   322.67   326.34   320.51   320.48   317.61   318.16   315.96   314.82
      POWER    1.55     0.60     0.10     2.36     0.49     3.00     2.10     0.74     1.09     0.93     0.30     0.80     0.10
0.94  SPEED  316.41   316.41   316.29   318.49   314.93   322.31   327.88   320.67   320.47   317.55   318.49   316.14   314.56
      POWER    1.55     0.60     0.10     2.36     0.49     3.00     2.10     0.74     1.09     0.93     0.30     0.80     0.10
0.96  SPEED  316.36   316.32   316.16   318.81   315.34   321.87   329.93   320.75   320.39   317.49   318.76   316.34   314.35
      POWER    1.55     0.60     0.10     2.36     0.49     3.00     2.10     0.74     1.09     0.93     0.30     0.80     0.10
0.98  SPEED  316.32   316.25   316.06   319.10   315.79   321.32   332.57   320.75   320.23   317.42   318.96   316.55   314.21
      POWER    1.55     0.60     0.10     2.36     0.49     3.00     2.10     0.74     1.09     0.93     0.30     0.80     0.10
1.00  SPEED  316.26   316.19   315.99   319.34   316.27   320.56   335.63   320.57   319.98   317.34   319.09   316.78   314.14
      POWER    1.55     0.60     0.10     2.36     0.49     3.00     2.10     0.74     1.09     0.93     0.30     0.80     0.10
1.02  SPEED  316.25   316.14   315.91   319.50   316.76   319.84   339.64   320.47   319.62   317.27   319.17   317.03   314.17
      POWER    1.55     0.60     0.10     2.36     0.49     3.00     2.10     0.74     1.09     0.93     0.30     0.80     0.10
1.04  SPEED  316.22   316.10   315.85   319.60   317.32   318.92   343.75   320.14   319.14   317.23   319.21   317.32   314.32
      POWER    1.55     0.60     0.10     2.36     0.49     3.00     2.10     0.74     1.09     0.93     0.30     0.80     0.10
1.06  SPEED  316.21   316.08   315.82   319.64   317.91   317.56   347.59   319.70   318.54   317.22   319.27   317.69   314.61
      POWER    1.55     0.60     0.10     2.36     0.49     3.00     2.10     0.74     1.09     0.93     0.30     0.80     0.10
1.08  SPEED  316.24   316.10   315.84   319.67   318.58   316.11   350.36   319.18   317.90   317.26   319.40   318.16   315.07
      POWER    1.55     0.60     0.10     2.36     0.49     3.00     2.10     0.74     1.09     0.93     0.30     0.80     0.10
1.10  SPEED  316.33   316.19   315.92   319.76   319.36   314.69   351.34   318.69   317.32   317.35   319.60   318.70   315.69
      POWER    1.55     0.60     0.10     2.36     0.49     3.00     2.10     0.74     1.09     0.93     0.30     0.80     0.10
1.12  SPEED  316.49   316.37   316.07   319.92   320.21   313.57   350.49   318.30   316.94   317.47   319.84   319.28   316.42
      POWER    1.55     0.60     0.10     2.36     0.49     3.00     2.10     0.74     1.09     0.93     0.30     0.80     0.10
1.14  SPEED  316.70   316.61   316.29   320.16   321.06   312.95   348.59   318.09   316.82   317.60   320.06   319.83   317.21
      POWER    1.55     0.60     0.10     2.36     0.49     3.00     2.10     0.74     1.09     0.93     0.30     0.80     0.10
1.16  SPEED  316.93   316.88   316.53   320.39   321.85   312.78   346.87   318.00   316.84   317.71   320.15   320.28   318.01
      POWER    1.55     0.60     0.10     2.36     0.49     3.00     2.10     0.74     1.09     0.93     0.30     0.80     0.10
1.18  SPEED  317.15   317.14   316.77   320.52   322.51   312.86   346.40   317.93   316.94   317.80   320.10   320.62   318.80
      POWER    1.55     0.60     0.10     2.36     0.49     3.00     2.10     0.74     1.09     0.93     0.30     0.80     0.10
1.20  SPEED  317.34   317.36   317.00   320.51   323.00   312.93   347.82   317.75   316.96   317.87   319.87   320.84   319.59
      POWER    1.55     0.60     0.10     2.36     0.49     3.00     2.10     0.74     1.09     0.93     0.30     0.80     0.10
1.22  SPEED  317.48   317.53   317.21   320.31   323.30   312.82   351.17   317.49   316.83   317.95   319.51   320.96   320.37
      POWER    1.55     0.60     0.10     2.36     0.49     3.00     2.10     0.74     1.09     0.93     0.30     0.80     0.10
1.24  SPEED  317.59   317.66   317.39   319.95   323.41   312.47   355.70   316.99   316.48   318.06   319.06   321.02   321.15
      POWER    1.55     0.60     0.10     2.36     0.49     3.00     2.10     0.74     1.09     0.93     0.30     0.80     0.10
1.26  SPEED  317.69   317.77   317.56   319.37   323.35   312.07   359.70   316.30   315.96   318.22   318.62   321.05   321.94
      POWER    1.55     0.60     0.10     2.35     0.49     3.00     2.10     0.74     1.09     0.93     0.30     0.80     0.10
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DATA FOR TIME VS. ANGLE(DEG)PLOTTING

TIME	KAPTAI	SIKALBAHA	HALISAHAR	ASUGANG -132-	SHAHJIBAZAR	ASUGANG -230-	GHORASAL -230-	SIDDHIRGANG	GHORASAL-132	GOALPARA	BHERAMARA	BOGRA	SAIDPUR
0.	1.00	3.21	1.57	7.35	1.83	10.63	11.64	5.00	7.36	-22.47	-16.58	-16.62	-14.89
0.020	1.06	3.25	1.60	7.49	1.87	10.92	12.29	5.24	7.61	-23.55	-16.64	-16.67	-14.88
0.040	1.75	3.39	1.69	7.91	2.00	11.85	14.24	5.96	8.36	-23.79	-16.80	-16.83	-14.83
0.060	1.91	3.61	1.84	8.61	2.2	13.37	17.43	7.15	9.61	-24.19	-17.06	-17.10	-14.75
0.080	2.12	3.92	2.00	9.59	2.50	15.49	21.98	8.82	11.34	-24.74	-17.44	-17.47	-14.66
0.100	2.40	4.33	2.35	10.84	2.91	18.20	27.73	10.94	13.55	-25.45	-17.92	-17.95	-14.55
0.120	2.77	4.83	2.71	12.38	3.43	21.49	34.69	13.52	15.22	-26.32	-19.51	-18.53	-14.46
0.140	3.22	5.43	3.15	14.20	4.09	25.35	42.82	16.54	19.35	-27.33	-19.20	-19.22	-14.38
0.160	3.76	6.13	3.68	16.32	4.91	29.78	52.10	19.99	22.91	-28.50	-20.01	-20.01	-14.35
0.180	4.42	6.94	4.30	18.73	5.91	34.75	62.47	23.85	26.89	-29.82	-20.93	-20.91	-14.36
0.200	5.22	7.88	5.06	21.40	7.19	39.86	72.20	27.91	31.04	-31.14	-21.73	-21.73	-14.44
0.220	6.22	8.98	5.98	24.29	9.85	44.67	79.43	31.92	35.11	-32.33	-22.12	-22.24	-14.48
0.240	7.44	10.27	7.09	27.43	10.94	49.17	84.09	35.97	39.10	-33.37	-22.07	-22.43	-14.49
0.260	8.92	11.78	8.42	30.85	13.50	53.22	86.18	39.84	43.00	-34.23	-21.56	-22.26	-14.46
0.280	10.66	13.52	9.98	34.52	16.54	57.11	85.79	43.71	46.80	-34.92	-20.59	-21.72	-14.37
0.300	12.69	15.51	11.79	38.44	20.36	60.49	83.07	47.49	50.46	-35.40	-19.15	-20.80	-14.19
0.320	15.01	17.75	13.87	42.57	24.35	63.40	78.28	51.14	53.94	-35.67	-17.27	-19.49	-13.97
0.340	17.62	20.26	16.23	46.86	28.49	65.79	71.77	54.62	57.22	-35.70	-14.97	-17.82	-13.47
0.360	20.55	23.03	18.86	51.23	33.33	67.60	64.06	57.95	60.18	-35.48	-12.28	-15.73	-12.85
0.380	23.70	26.06	21.78	55.60	38.49	68.79	55.76	60.80	62.62	-34.97	-9.26	-13.31	-12.02
0.400	27.23	29.33	24.96	59.99	43.91	69.30	47.59	63.38	65.06	-34.18	-5.97	-10.52	-10.93
0.420	30.94	32.82	28.41	63.99	49.48	69.13	40.28	65.54	66.86	-33.07	-2.48	-7.45	-9.55
0.440	34.37	36.50	32.39	67.82	55.69	68.29	34.49	67.24	68.18	-31.64	1.12	-4.11	-7.86
0.460	38.90	40.35	35.95	71.29	60.63	66.80	30.77	68.45	69.02	-29.86	4.74	-0.57	-5.83
0.480	43.24	44.34	40.39	74.33	65.99	64.93	29.48	69.18	69.38	-27.77	8.31	3.13	-3.44
0.500	47.59	48.43	44.34	76.89	71.08	62.64	30.79	69.43	69.29	-25.31	11.76	6.92	-0.67
0.520	52.01	52.59	48.73	79.93	75.78	60.16	34.69	69.21	68.83	-22.50	15.03	10.77	2.47
0.540	56.46	56.78	53.22	80.41	80.02	57.70	41.93	68.59	67.97	-19.33	18.09	14.63	5.98
0.560	60.88	60.98	57.76	81.34	83.70	55.46	49.10	67.61	66.89	-15.81	20.90	18.45	9.86
0.580	65.24	65.14	62.32	81.72	86.77	53.69	58.6	66.36	65.67	-11.93	23.46	22.19	14.07
0.600	69.58	69.32	66.93	81.90	89.43	52.64	69.22	65.26	64.71	-7.88	25.68	25.74	18.51
0.620	73.94	73.59	71.60	82.24	91.87	52.48	81.15	64.74	64.42	-3.86	27.50	28.98	23.00
0.640	78.31	77.93	76.32	82.76	94.07	53.25	94.29	64.78	64.80	0.13	28.93	31.92	27.7
0.660	82.66	82.33	81.05	83.48	96.04	54.96	108.55	65.41	65.88	4.08	30.02	34.56	32.38
0.680	86.98	86.75	85.78	84.42	97.75	57.63	123.87	66.65	67.68	7.99	30.81	36.89	37.05
0.700	91.26	91.19	90.48	85.59	99.22	61.27	140.17	68.52	70.20	11.83	31.33	38.94	41.66
0.720	95.48	95.53	95.12	87.02	100.44	65.86	157.43	71.02	73.44	15.60	31.65	40.70	46.16
0.740	99.64	100.05	99.69	88.76	101.45	71.39	175.64	74.17	77.39	19.28	31.80	42.18	50.47
0.760	103.67	104.35	104.12	90.70	102.14	78.00	193.05	77.91	82.00	22.99	32.09	43.51	54.55
0.780	107.50	108.44	108.31	92.80	102.46	85.72	208.25	82.19	87.17	26.83	32.83	44.84	58.33
0.800	111.12	112.32	112.27	95.10	102.49	94.35	221.78	87.00	92.83	30.77	34.06	46.16	61.75
0.820	114.55	115.99	115.99	97.66	102.30	103.69	234.19	92.31	98.93	34.77	35.80	47.52	64.77
0.840	117.91	119.45	119.48	100.52	102.02	113.52	245.9	98.08	105.40	38.82	38.09	48.94	67.36
0.860	120.96	122.71	122.75	103.71	101.72	123.63	257.38	104.27	112.15	42.87	40.93	50.45	69.52
0.880	123.84	125.79	125.00	107.27	101.53	133.83	269.03	110.94	119.14	46.92	44.30	52.08	71.24
0.900	126.65	128.70	128.66	111.22	101.53	143.96	281.26	117.74	126.28	50.95	48.19	53.86	72.55
0.920	129.36	131.46	131.32	115.57	101.93	153.85	294.51	124.91	133.51	54.93	52.55	55.83	73.48
0.940	131.98	134.10	133.93	120.32	102.51	163.40	309.26	132.29	140.76	58.85	57.34	58.00	74.09
0.960	134.53	136.63	136.20	125.48	103.63	172.49	320.07	139.81	147.95	62.70	62.47	60.40	74.42
0.980	137.03	139.07	138.44	130.99	105.24	181.01	345.56	147.38	155.00	66.48	67.86	63.02	74.56
1.000	139.49	141.45	140.58	136.79	107.39	188.83	368.42	154.91	161.82	70.17	73.45	65.89	74.57
1.020	141.90	143.75	142.63	142.83	110.11	195.81	395.36	162.27	168.30	73.78	79.16	69.04	74.57
1.040	144.29	146.01	144.61	149.01	113.42	201.73	425.89	169.32	174.29	77.32	84.94	72.50	74.67
1.060	146.65	148.23	146.54	155.28	117.38	206.34	463.05	175.93	179.66	80.83	90.78	76.34	75.02
1.080	149.02	150.44	148.40	161.59	122.07	209.41	503.10	181.98	184.32	84.30	96.72	80.66	75.80
1.100	151.46	152.72	150.43	167.96	127.59	210.83	545.33	187.46	188.25	87.97	102.85	85.56	77.2
1.120	154.04	155.16	152.54	174.48	134.04	210.80	597.59	192.43	191.69	91.70	109.24	91.11	79.38
1.140	156.03	157.34	154.86	181.24	141.47	209.76	628.16	197.07	194.80	95.57	115.88	97.30	82.42
1.160	159.88	160.81	157.44	188.25	149.84	208.27	666.52	201.53	197.86	99.56	122.71	104.07	86.28
1.180	163.19	164.09	160.31	195.47	159.04	206.74	703.54	205.89	201.00	103.69	129.56	111.29	91.25
1.200	166.73	167.64	163.44	202.77	168.97	205.20	741.07	210.13	204.21	107.91	136.25	118.82	97.04
1.220	170.46	171.42	166.81	209.94	179.22	203.81	781.37	214.12	207.35	112.21	142.60	126.56	103.77
1.240	174.33	175.36	170.41	216.76	189.77	202.07	826.31	217.65	210.21	116.61	148.49	134.40	111.30
1.260	178.33	179.45	174.21	223.00	200.35	199.90	876.35	220.51	212.57	121.18	153.87	142.29	119.79

GRAPH FOR SUSTAINED FAULT CLEARED AT 3 CYCLES LATER,RECLOSES AFTER 28 CYCLES & THEN OPEN AFTER 36 CYCLES

REFFERENCE MACHINE 9 IS GHORASAL-132

3-PHASE FAULT BETWEEN TONGI-230 & ISHURDI-230 LINE AT TONGI-230 END FAULT TYPE = 2

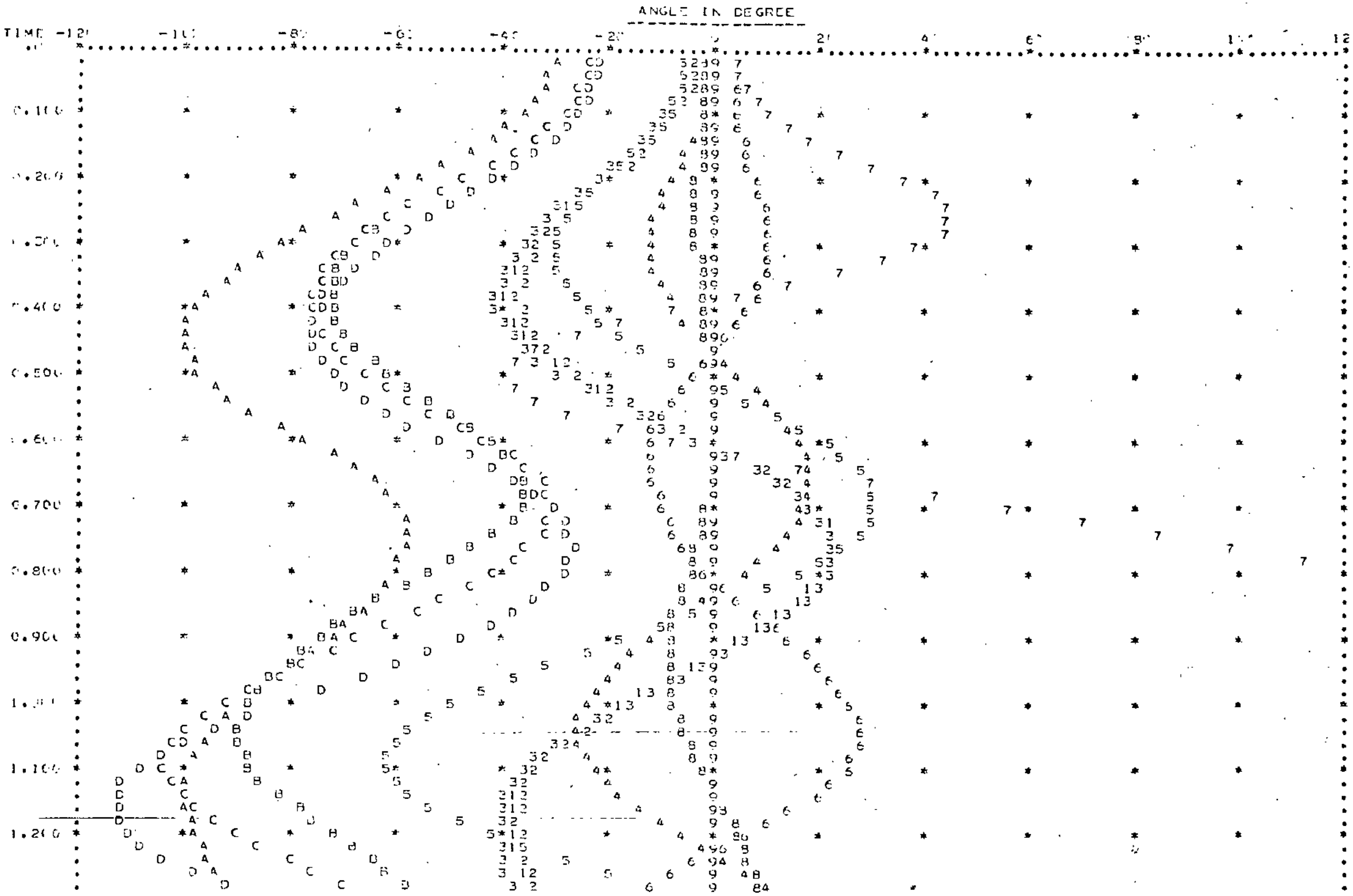

Fig. 6.3 (Without Governor)

* * * MEANING OF THE CODES * * *

1=KAPTAI 2=SIKALBAHA 3=HALISHAHAR 4=ASHUGANG-132 5=SHAHJIBAZAR 6=ASHUGANG-230 7=GHORASAL-230

8=SIDDIRGANG 9=GHORASAL-132 A=GOALPARA B=BHERAMARA C=BOGRA D=SAIDPUR

DATA FOR TIME VS. ANGLE(DEG)PLOTTING

TIME	KAPTAI	SIKALDAHA	HALISAHAR	ASUGANG -132-	SHAHJIBAZAR	ASUGANG -230-	GHURASAL -230-	SIDDIRGANG	GHORASAL-132	GOALPARA	BHERAMARA	BOGRA	SAIDPUR
0.0	1.63	3.21	1.57	7.35	1.83	10.62	11.64	5.00	7.36	-23.47	-16.58	-16.62	-14.89
0.020	1.66	3.25	1.60	7.49	1.87	10.92	12.29	5.24	7.61	-23.55	-16.64	-16.67	-14.88
0.040	1.75	3.39	1.69	7.91	2.00	11.85	14.24	5.96	8.36	-23.79	-16.80	-16.83	-14.83
0.060	1.90	3.61	1.84	8.61	2.20	13.27	17.47	7.15	9.61	-24.18	-17.06	-17.09	-14.75
0.080	2.12	3.92	2.06	9.59	2.52	15.49	21.92	8.82	11.34	-24.73	-17.43	-17.46	-14.67
0.100	2.40	4.32	2.34	10.84	2.91	18.20	27.54	10.94	13.54	-25.43	-17.90	-17.91	-14.58
0.120	2.75	4.81	2.70	12.38	3.43	21.48	34.25	13.52	16.21	-26.28	-18.47	-18.46	-14.52
0.140	3.19	5.36	3.13	14.20	4.09	25.33	41.98	16.54	19.31	-27.27	-19.13	-19.10	-14.50
0.160	3.72	6.32	3.65	16.31	4.90	29.73	50.62	19.99	22.84	-28.39	-19.89	-19.82	-14.53
0.180	4.35	6.76	4.25	18.71	5.90	34.66	60.12	23.85	26.77	-29.65	-20.74	-20.62	-14.64
0.200	5.11	7.61	4.97	21.36	7.17	39.70	69.72	27.89	30.84	-30.91	-21.44	-21.31	-14.78
0.220	[illegible]	8.58	5.62	24.22	8.81	44.38	74.59	31.89	34.77	-32.01	-21.71	-21.69	-14.88
0.240	7.21	9.71	6.95	27.31	10.88	48.68	77.60	35.82	38.56	-32.95	-21.52	-21.72	-14.94
0.260	8.60	11.22	8.05	30.63	13.40	52.56	78.05	39.64	42.19	-33.70	-20.86	-21.41	-14.94
0.280	10.22	12.52	9.44	34.16	16.38	55.96	75.98	43.38	45.62	-34.25	-19.74	-20.75	-14.85
0.300	12.10	14.22	11.04	37.92	19.32	58.83	71.78	46.96	48.81	-34.60	-18.19	-19.74	-14.64
0.320	14.23	16.12	12.85	41.81	23.69	61.10	65.88	50.35	51.72	-34.71	-16.23	-18.40	-14.31
0.340	16.67	18.23	14.86	45.78	27.97	62.73	58.81	53.47	54.29	-34.59	-13.94	-16.74	-13.83
0.360	19.21	20.54	17.07	49.75	32.58	63.65	51.16	56.25	55.47	-34.21	-11.36	-14.79	-13.20
0.380	22.03	23.02	19.47	53.63	37.46	63.84	43.59	58.67	56.22	-33.55	-8.58	-12.57	-12.43
0.400	25.06	25.67	22.03	57.33	42.50	63.30	36.77	60.62	59.48	-32.62	-5.67	-10.14	-11.51
0.420	28.23	28.44	24.75	60.76	47.62	62.04	31.31	62.08	60.25	-31.40	-2.73	-7.53	-10.48
0.440	31.53	31.32	27.58	63.83	52.69	60.15	27.71	63.01	60.51	-29.90	0.16	-4.80	-9.23
0.460	34.92	34.29	30.52	66.47	57.62	57.75	25.30	63.41	60.29	-28.10	2.93	-2.00	-8.09
0.480	38.37	37.30	33.54	68.62	62.29	54.90	27.23	63.27	59.63	-26.02	5.52	0.84	-6.77
0.500	41.83	40.33	36.60	70.24	66.61	51.99	30.46	62.63	58.59	-23.65	7.87	3.66	-5.37
0.520	45.26	43.35	39.68	71.29	70.48	49.04	35.75	61.52	57.23	-21.00	9.97	6.42	-3.91
0.540	48.64	46.35	42.75	71.76	73.81	46.31	42.64	59.99	55.65	-18.07	11.80	9.10	-2.38
0.560	51.91	49.28	45.78	71.66	76.54	44.05	50.54	58.14	53.97	-14.89	13.38	11.69	-0.80
0.580	55.05	52.13	48.75	71.03	78.62	42.46	58.74	56.05	52.30	-11.46	14.74	14.12	0.85
0.600	58.03	54.38	51.62	69.89	80.00	41.72	66.57	53.86	50.75	-7.82	15.92	16.42	2.54
0.620	60.91	57.51	54.36	68.32	80.65	41.96	73.41	51.67	49.46	-3.97	16.96	18.58	4.28
0.640	63.38	59.99	56.94	66.42	80.50	43.25	78.78	49.61	48.52	0.03	17.93	20.58	6.05
0.660	65.70	62.31	59.34	64.26	79.83	45.59	82.37	47.79	48.02	4.17	18.89	22.43	7.84
0.680	67.70	64.45	61.52	61.93	78.37	48.91	84.[illegible]	46.32	45.02	8.41	19.88	24.13	9.63
0.700	69.55	66.39	63.46	59.55	76.25	53.05	83.67	45.29	48.54	12.71	20.96	25.69	11.41
0.720	71.04	68.12	65.13	57.21	73.53	57.82	81.49	44.75	49.60	17.03	22.19	27.14	13.18
0.740	72.23	69.61	66.51	55.02	70.29	62.96	77.74	44.78	51.15	21.32	23.60	28.48	14.92
0.760	73.12	70.36	67.59	53.07	66.60	68.19	72.81	45.37	53.14	25.56	25.21	29.75	16.62
0.780	73.69	71.35	68.33	51.44	62.57	73.20	67.17	46.53	55.50	29.70	27.04	30.95	18.28
0.800	73.96	72.58	68.74	50.21	59.31	77.70	61.36	48.20	58.10	33.69	29.07	32.12	19.9[illegible]
0.820	73.93	73.04	68.82	49.42	53.95	81.42	53.94	50.35	60.84	37.51	31.29	33.26	21.47
0.840	73.61	73.24	68.57	49.11	49.61	84.16	51.45	52.88	63.57	41.10	33.65	34.39	23.[illegible]
0.860	73.02	73.17	68.00	49.30	45.42	85.76	48.35	55.71	66.19	44.44	36.10	35.54	24.50
0.880	72.18	72.86	67.14	49.96	41.51	86.14	46.96	58.72	68.56	47.50	38.60	36.70	25.95
0.900	71.11	72.30	66.02	51.09	38.00	85.29	47.45	61.82	70.61	50.25	41.08	37.90	27.39
0.920	69.85	71.52	64.67	52.65	34.98	83.25	49.83	64.89	72.22	52.67	43.56	39.14	28.8
0.940	68.41	70.53	63.12	54.68	32.57	80.15	53.93	67.82	73.36	54.76	45.79	40.42	30.21
0.960	66.83	69.35	61.44	56.83	30.84	76.17	59.39	70.53	73.99	56.50	47.92	41.77	31.62
0.980	65.15	67.99	59.64	59.31	29.87	71.55	65.75	72.91	74.10	57.92	49.85	43.16	33.04
1.000	63.29	66.47	57.77	61.94	29.69	66.62	72.26	74.90	73.70	58.94	51.53	44.61	34.46
1.020	61.60	64.82	55.98	64.63	30.34	61.71	78.46	76.43	72.84	59.64	52.95	46.08	35.91
1.040	59.81	63.06	54.00	67.29	31.81	57.17	83.73	77.45	71.58	60.01	54.09	47.57	37.34
1.060	58.05	61.23	52.17	69.92	34.18	53.32	87.60	77.95	70.[illegible]	60.[illegible]	54.92	49.04	38.75
1.080	56.34	59.36	50.43	72.16	37.09	50.43	89.79	77.92	68.20	59.79	55.45	50.45	40.12
1.100	54.72	57.49	48.81	74.20	40.78	49.69	90.13	77.35	65.28	59.23	55.07	51.77	41.43
1.120	53.20	55.65	47.33	75.89	45.04	48.23	88.64	76.28	64.34	58.38	55.59	52.95	42.65
1.140	51.91	53.38	46.02	77.16	49.77	49.09	85.46	74.74	62.49	57.28	55.22	53.96	43.77
1.160	50.36	52.21	44.88	77.98	54.84	51.23	80.87	72.77	60.87	55.94	54.58	54.75	44.77
1.180	49.46	50.69	43.94	78.32	60.11	54.52	75.22	70.44	59.37	54.37	53.71	55.29	45.65
1.200	48.52	49.34	43.2	78.20	65.45	58.74	69.[illegible]	67.94	58.26	52.61	52.62	55.56	46.38
1.220	47.70	48.19	42.67	77.60	70.63	63.64	62.76	65.05	57.53	50.68	51.37	55.52	46.97
1.240	47.17	47.27	42.34	76.57	75.67	68.89	57.09	62.19	57.22	48.59	49.97	55.16	47.42
1.260	46.70	46.61	42.23	75.18	80.20	74.17	52.57	59.37	57.34	46.39	48.49	54.49	47.72

GRAPH FOR UNSUSTAINED FAULT WITHOUT AUTORECLOSER

REFERENCE MACHINE 9 IS GHORASAL-132

3-PHASE FAULT BETWEEN TONGI-230 & ISHURDI-230 LINE AT TONGI-230 END   FAULT TYPE = 2

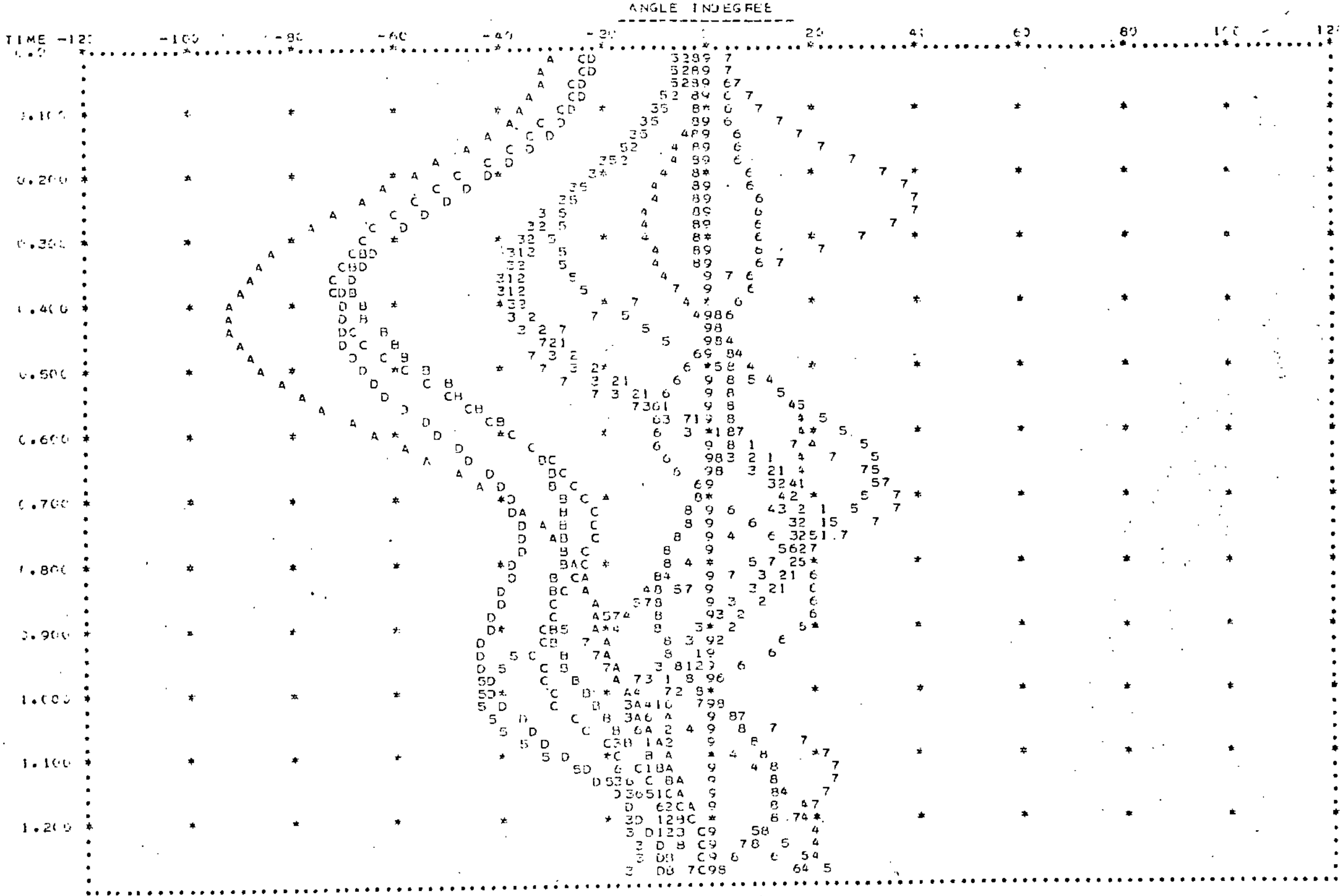

Fig. 6.4 (With Governor)

* * * MEANING OF THE CODES * * *

1=KAPTAI   2=SIKALBAHA   3=HALISHAHAR   4=ASHUGANG-132   5=SHAHJIBAZAR   6=ASHUGANG-230   7=GHORASAL-230

8=SIDDIRGANG   9=GHORASAL-132   A=GOALPARA   B=BHERAMARA   C=BOGRA   D=SAIDPUR

DATA FOR TIME VS. ANGLE(DEG)PLOTTING

TIME	KAPTAI	SIKALBAHA	HALISAHAR	ASUGANG -132-	SHAHJIBAZAR	ASUGANG -33 -	GHORASAL -230-	SIDDIRGANG	GHORASAL-132	GOALPARA	BHERAMARA	BOGRA	SAIDPUR
0.0	1.63	3.21	1.57	7.35	1.83	10.63	11.64	5.00	7.36	-23.47	-16.56	-16.62	-14.89
0.020	1.66	3.25	1.60	7.49	1.87	10.93	12.29	5.24	7.61	-23.55	-16.64	-16.67	-14.86
0.040	1.75	3.39	1.69	7.91	2.00	11.65	14.24	5.96	8.36	-23.79	-16.80	-16.83	-14.83
0.060	1.90	3.61	1.84	8.61	2.2[illegible]	13.27	17.47	7.15	9.61	-24.18	-17.06	-17.09	-14.75
0.080	2.12	3.92	2.06	9.59	2.5[illegible]	15.49	21.92	8.82	11.34	-24.73	-17.43	-17.46	-14.67
0.100	2.40	4.32	2.34	10.84	2.91	18.20	27.54	10.94	13.54	-25.43	-17.90	-17.91	-14.58
0.120	2.75	4.8[illegible]	2.70	12.39	3.43	21.48	34.25	13.52	16.21	-26.28	-18.47	-18.46	-14.52
0.140	3.19	5.36	3.12	14.20	4.09	25.33	41.99	16.54	19.31	-27.27	-19.13	-19.1[illegible]	-14.50
0.160	3.72	6.02	3.65	16.31	4.90	29.73	50.62	19.99	22.84	-28.39	-19.89	-19.82	-14.53
0.180	4.35	6.76	4.25	18.71	5.9[illegible]	34.66	60.12	23.85	26.77	-29.65	-20.74	-20.62	-14.64
0.200	5.11	7.61	4.97	21.36	7.17	39.70	68.72	27.89	30.64	-30.91	-21.44	-21.31	-14.78
0.220	6.06	8.58	5.82	24.22	8.31	44.38	74.59	31.83	34.77	-32.01	-21.71	-21.69	-14.88
0.240	7.21	9.71	6.85	27.31	10.88	48.60	77.66	35.83	38.56	-32.95	-21.52	-21.72	-14.94
0.260	8.5[illegible]	11.02	8.05	30.62	13.40	52.50	78.05	39.64	42.19	-33.71	-20.86	-21.41	-14.94
0.280	10.22	12.52	9.44	34.18	16.35	55.96	75.98	43.38	45.62	-34.25	-19.74	-20.75	-14.85
0.300	12.10	14.22	11.04	37.92	19.82	58.83	71.78	46.96	49.81	-34.63	-18.19	-19.74	-14.64
0.320	14.23	16.12	12.85	41.81	23.69	61.10	65.88	50.35	51.72	-34.71	-16.23	-18.4[illegible]	-14.21
0.340	16.6[illegible]	18.23	14.86	45.78	27.97	62.73	58.81	53.47	54.29	-34.59	-13.94	-16.74	-13.83
0.360	19.21	20.54	17.07	49.75	32.58	63.65	51.14	56.25	56.47	-34.20	-11.36	-14.79	-13.2[illegible]
0.380	22.03	23.02	19.47	53.63	37.46	63.84	43.59	58.67	58.22	-33.55	-8.58	-12.57	-12.43
0.400	25.05	25.67	22.03	57.33	42.50	63.30	36.77	60.62	59.46	-32.62	-5.67	-10.14	-11.51
0.420	28.23	28.44	24.75	60.70	47.52	62.04	31.31	62.08	60.25	-31.40	-2.73	-7.53	-10.48
0.440	31.53	31.32	27.58	63.83	52.69	60.15	27.71	63.01	60.51	-29.90	0.16	-4.8[illegible]	-9.33
0.460	34.92	34.29	30.52	66.47	57.62	57.75	26.30	63.41	60.29	-28.10	2.93	-2.00	-8.09
0.480	38.37	37.30	33.54	68.62	62.29	54.96	27.23	63.27	59.63	-26.02	5.52	0.84	-6.77
0.500	41.53	40.32	36.60	70.24	66.61	51.99	30.46	62.63	58.59	-23.65	7.87	3.66	-5.37
0.520	45.26	43.35	39.68	71.29	70.48	49.04	35.75	61.52	57.23	-21.[illegible]	9.97	6.42	-3.91
0.540	48.64	46.35	42.75	71.76	73.81	46.31	42.64	59.99	55.65	-18.07	11.80	9.10	-2.36
0.560	51.91	49.28	45.78	71.66	76.54	44.05	50.54	58.14	53.97	-14.99	13.38	11.68	-0.90
0.580	55.05	52.13	48.75	71.03	78.62	42.46	58.74	56.05	52.37	-11.46	14.74	14.12	0.85
0.600	58.05	54.90	51.72	69.89	79.99	41.68	66.64	53.84	50.75	-7.76	16.08	16.56	2.80
0.620	60.89	57.80	54.76	68.34	80.64	41.91	73.65	51.59	49.44	-3.77	17.66	19.06	5.47
0.640	63.50	60.57	57.83	66.43	80.54	42.92	79.21	49.42	48.46	0.44	19.29	21.56	8.51
0.660	65.87	63.21	60.87	64.26	79.73	45.03	82.92	47.47	47.93	4.87	21.17	24.05	11.84
0.680	67.97	65.67	63.84	61.93	78.2[illegible]	48.06	84.57	45.84	47.87	9.46	23.25	26.52	15.32
0.700	69.80	67.89	66.67	59.53	75.[illegible]1	51.91	84.14	44.62	48.32	14.18	25.5[illegible]	28.95	18.84
0.720	71.32	69.34	69.29	57.17	73.21	56.38	81.74	43.89	49.26	18.95	27.94	31.34	22.31
0.740	72.55	71.49	71.65	54.93	69.87	61.25	77.65	43.70	50.73	23.85	30.54	33.69	25.63
0.760	73.47	72.82	73.69	52.93	66.18	66.23	72.27	44.08	52.61	28.71	33.26	35.95	28.75
0.780	74.09	73.31	75.35	51.24	61.93	71.04	66.11	45.04	54.83	33.53	36.07	38.15	31.59
0.800	74.40	74.40	76.58	49.92	57.55	75.40	59.74	46.54	57.31	38.25	38.92	40.26	34.10
0.820	74.41	74.77	77.34	49.04	53.[illegible]6	79.04	53.79	48.53	59.92	42.92	41.74	42.29	36.26
0.840	74.13	74.70	77.60	48.63	48.6[illegible]	81.75	49.87	50.94	62.53	47.2[illegible]	44.48	44.18	38.12
0.860	73.59	74.44	77.35	48.7[illegible]	44.29	83.38	45.46	53.69	65.02	51.33	47.07	45.97	39.40
0.880	72.79	73.95	76.58	49.24	40.26	83.80	43.93	56.65	67.29	55.18	49.46	47.63	40.4[illegible]
0.900	71.70	72.99	75.32	50.26	36.63	83.16	44.48	59.76	69.24	58.70	51.61	49.16	41.10
0.920	70.52	71.92	73.59	51.70	33.53	81.34	47.12	62.88	70.79	61.86	53.51	50.57	41.60
0.940	69.10	70.63	71.44	53.53	31.04	78.51	51.66	65.91	71.95	64.64	55.12	51.85	42.03
0.960	67.53	69.17	68.92	55.69	29.26	74.86	57.73	68.75	72.54	67.02	56.45	53.01	42.48
0.980	65.84	67.56	66.10	58.12	28.26	70.63	64.76	71.34	72.69	68.97	57.50	54.06	43.15
1.000	64.06	65.82	63.06	60.72	28.08	66.13	72.11	73.57	72.40	70.5[illegible]	58.30	55.01	43.82
1.020	62.24	63.99	59.87	63.43	28.77	61.68	79.09	75.38	71.69	71.59	58.86	55.86	44.87
1.040	60.39	62.11	56.61	66.15	30.31	57.62	85.[illegible]9	76.74	70.64	72.24	59.22	56.62	45.99
1.060	58.50	60.22	53.39	68.8[illegible]	32.69	54.27	89.63	77.61	69.34	72.47	59.39	57.28	47.34
1.080	56.78	58.34	50.27	71.3[illegible]	35.84	51.86	92.36	77.97	67.87	72.28	59.41	57.85	48.78
1.100	55.07	56.52	47.34	73.57	39.72	50.59	93.13	77.84	66.34	71.69	59.30	58.32	50.24
1.120	53.47	54.75	44.68	75.52	44.22	50.56	91.92	77.21	64.84	70.70	59.07	58.67	51.62
1.140	51.98	53.18	42.33	77.14	49.23	51.81	88.89	76.14	63.45	69.35	58.75	58.9[illegible]	52.84
1.160	50.65	51.72	40.37	78.35	54.64	54.27	84.31	74.64	62.27	67.66	58.33	58.99	53.84
1.180	49.47	50.44	38.84	79.14	60.3[illegible]	57.81	78.57	72.78	61.36	65.64	57.82	58.95	54.59
1.200	48.47	49.37	37.75	79.48	65.05	62.22	72.17	70.63	60.77	63.35	57.23	58.74	55.06
1.220	47.67	48.51	37.15	79.38	71.75	67.23	65.68	68.26	60.55	60.85	56.57	58.38	55.27
1.240	47.07	47.90	37.03	78.88	77.24	72.52	59.73	65.79	60.71	58.[illegible]4	55.83	57.86	55.24
1.260	46.63	47.34	37.38	78.01	82.37	77.77	54.92	63.32	61.27	55.11	55.02	57.18	55.02

GRAPH FOR FAULT CLEARED AT 3 CYCLES LATER & RECLOSE AFTER 28 CYCLES

REFERENCE MACHINE 9 IS GHORASAL-132

3-PHASE FAULT BETWEEN TONGI-230 & ISHURDI-230 LINE AT TONGI-230 END FAULT TYPE = 2

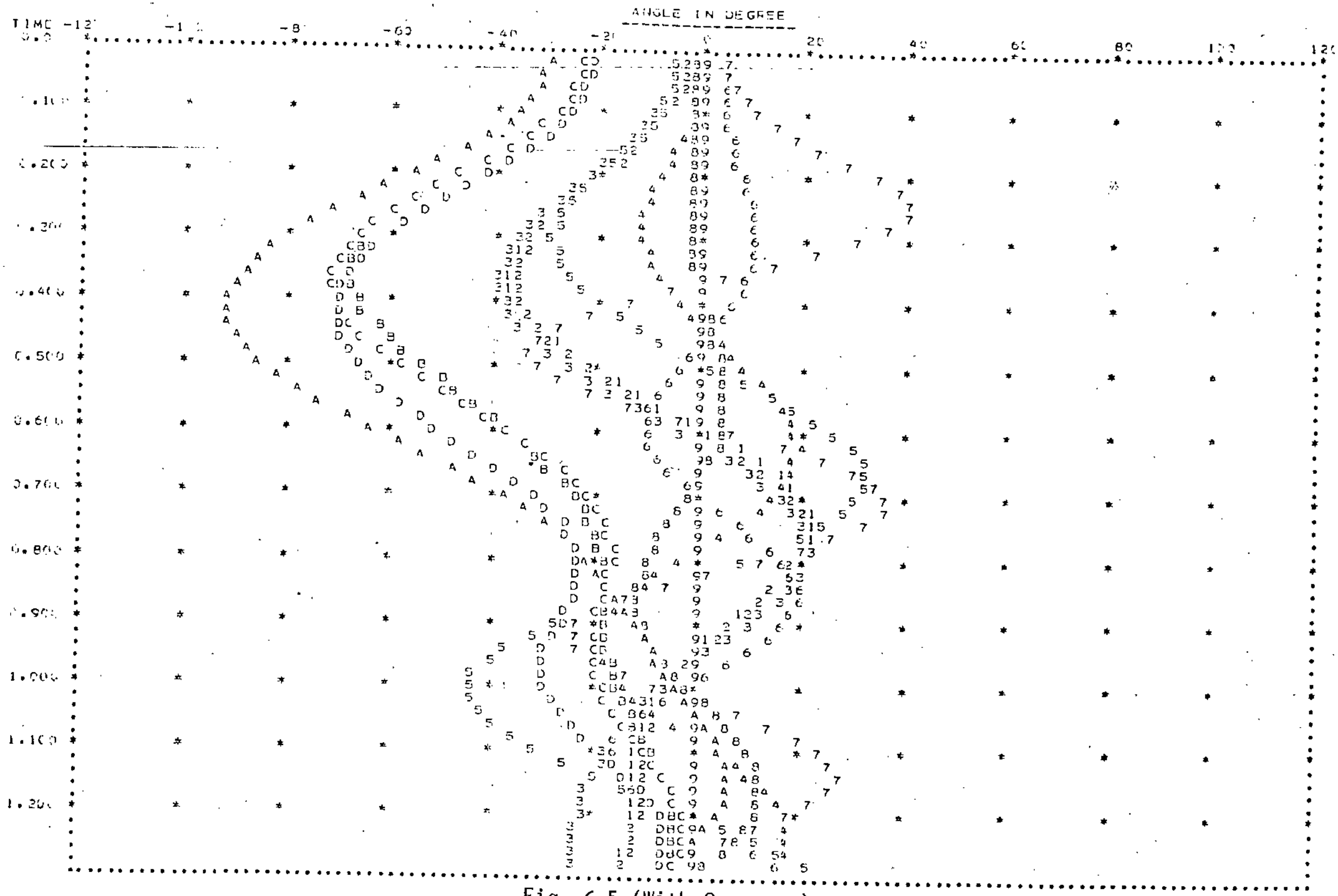

Fig. 6.5 (With Governor)

* * * MEANING OF THE CODES * * *

1=KAPTAI 2=SIKALBARA 3=HALISHAHAR 4=ASHUGANG-132 5=SHAHJIBAZAR 6=ASHUGANG-230 7=GHORASAL-23

8=SIDDIRGANG 9=GHORASAL-132 A=GOALPARA B=BHERAMARA C=BOGRA D=SAIDPUR

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TIME          KAPTAI   SIKAL-   HALI-    ASUGANG  SHAHJI-  ASUGANG  GHORASAL SIDDIR-  GHORA-   GOAL-    BHERA-   BOGRA    SAIDPUR
                       BAHA     SAHAR    -132-    BAZAR    -230-    -230-    GANG     SAL-132  PARA     MARA

0.0   SPEED   314.16   314.16   314.16   314.16   314.16   314.16   314.16   314.15   314.16   314.15   314.16   314.16   314.16
      POWER     1.55     0.60     0.10     2.36     0.49     3.00     2.10     0.74     1.09     0.93     0.30     0.80     0.10
0.02  SPEED   314.21   314.24   314.21   314.41   314.22   314.69   315.30   314.58   314.60   314.02   314.07   314.07   314.19
      POWER     1.55     0.60     0.10     2.36     0.49     3.00     2.10     0.74     1.09     0.93     0.30     0.82     0.10
0.04  SPEED   314.26   314.32   314.27   314.65   314.30   315.22   316.43   315.00   315.03   313.88   313.97   313.97   314.21
      POWER     1.55     0.60     0.10     2.36     0.49     3.01     2.07     0.74     1.09     0.94     0.30     0.81     0.10
0.06  SPEED   314.32   314.39   314.32   314.89   314.39   315.75   317.52   315.41   315.46   313.75   313.88   313.89   314.23
      POWER     1.54     0.61     0.10     2.35     0.49     3.01     2.02     0.74     1.09     0.95     0.31     0.81     0.10
0.08  SPEED   314.38   314.47   314.38   315.13   314.46   316.27   318.57   315.81   315.88   313.61   313.79   313.80   314.24
      POWER     1.54     0.59     0.10     2.36     0.49     2.99     1.96     0.74     1.08     0.96     0.31     0.82     0.10
0.10  SPEED   314.44   314.54   314.44   315.38   314.55   316.78   319.56   316.21   316.29   313.48   313.71   313.72   314.23
      POWER     1.54     0.59     0.10     2.35     0.49     2.98     1.95     0.74     1.08     0.97     0.31     0.83     0.10
0.12  SPEED   314.51   314.62   314.50   315.62   314.67   317.27   320.47   316.60   316.68   313.36   313.62   313.64   314.25
      POWER     1.53     0.58     0.11     2.35     0.49     2.97     1.92     0.74     1.07     0.98     0.32     0.83     0.11
0.14  SPEED   314.58   314.69   314.57   315.87   314.8    317.76   321.32   316.98   317.06   313.24   313.54   313.57   314.16
      POWER     1.53     0.58     0.11     2.35     0.49     2.96     1.76     0.74     1.06     0.99     0.32     0.84     0.11
0.16  SPEED   314.66   314.77   314.65   316.13   314.94   318.23   322.09   317.35   317.42   313.12   313.46   313.50   314.10
      POWER     1.52     0.57     0.10     2.35     0.49     2.95     1.70     0.74     1.05     0.99     0.33     0.84     0.10
0.18  SPEED   314.75   314.84   314.73   316.39   315.11   318.69   322.80   317.70   317.76   313.00   313.38   313.42   314.03
      POWER     1.52     0.57     0.10     2.34     0.49     2.93     1.64     0.74     1.04     1.00     0.33     0.85     0.12
0.20  SPEED   314.91   314.94   314.84   316.55   315.42   318.40   320.48   317.65   317.64   313.13   313.73   313.69   314.05
      POWER     1.51     0.56     0.09     2.33     0.49     2.91     1.56     0.74     1.02     1.00     0.34     0.85     0.10
0.22  SPEED   315.07   315.07   314.97   316.75   315.77   318.08   319.04   317.60   317.52   313.27   314.12   313.99   314.08
      POWER     1.50     0.56     0.09     2.32     0.49     2.89     1.60     0.74     1.00     0.99     0.33     0.82     0.10
0.24  SPEED   315.26   315.22   315.12   316.95   316.15   317.73   315.63   317.54   317.39   313.42   314.53   314.28   314.13
      POWER     1.49     0.55     0.09     2.32     0.49     2.86     1.70     0.74     0.99     0.98     0.32     0.80     0.11
0.26  SPEED   315.47   315.38   315.29   317.16   316.55   317.34   313.36   317.47   317.24   313.59   314.94   314.58   314.21
      POWER     1.48     0.54     0.09     2.31     0.48     2.85     1.83     0.74     0.98     0.97     0.30     0.78     0.12
0.28  SPEED   315.68   315.55   315.46   317.34   316.96   316.90   311.34   317.36   317.05   313.75   315.33   314.89   314.28
      POWER     1.47     0.54     0.09     2.30     0.49     2.84     1.98     0.74     0.97     0.96     0.28     0.76     0.11
0.30  SPEED   315.90   315.73   315.64   317.49   317.35   316.41   309.67   317.21   316.82   313.95   315.79   315.19   314.39
      POWER     1.45     0.53     0.09     2.29     0.48     2.83     2.05     0.74     0.96     0.95     0.26     0.74     0.11
0.32  SPEED   316.12   315.91   315.82   317.63   317.72   315.87   308.40   317.01   316.56   314.16   316.02   315.47   314.51
      POWER     1.44     0.52     0.08     2.29     0.48     2.83     2.08     0.74     0.96     0.94     0.24     0.72     0.10
0.34  SPEED   316.33   316.08   316.00   317.64   318.04   315.28   307.63   316.75   316.24   314.38   316.30   315.74   314.64
      POWER     1.43     0.51     0.08     2.28     0.48     2.82     2.09     0.74     0.95     0.92     0.22     0.71     0.09
0.36  SPEED   316.53   316.25   316.17   317.67   318.31   314.65   307.40   316.44   315.88   314.61   316.51   315.98   314.77
      POWER     1.41     0.50     0.08     2.27     0.48     2.83     2.10     0.74     0.95     0.91     0.20     0.69     0.09
0.38  SPEED   316.71   316.40   316.32   317.48   318.5    314.00   307.77   316.07   315.48   314.85   316.65   316.19   314.9
      POWER     1.40     0.48     0.07     2.26     0.48     2.83     2.10     0.74     0.94     0.90     0.19     0.67     0.08
0.40  SPEED   316.86   316.52   316.46   317.28   318.61   313.36   308.71   315.65   315.05   315.09   316.72   316.36   315.01
      POWER     1.39     0.47     0.07     2.25     0.48     2.84     2.10     0.74     0.95     0.88     0.18     0.66     0.08
0.42  SPEED   316.99   316.63   316.59   317.01   318.62   312.77   310.14   315.25   314.61   315.25   316.72   316.50   315.11
      POWER     1.38     0.46     0.07     2.24     0.48     2.86     2.10     0.74     0.95     0.85     0.17     0.65     0.07
0.44  SPEED   317.09   316.71   316.68   316.66   318.54   312.26   311.93   314.74   314.17   315.60   316.64   316.58   315.20
      POWER     1.37     0.45     0.07     2.24     0.48     2.87     2.17     0.74     0.95     0.85     0.16     0.64     0.06
0.46  SPEED   317.15   316.76   316.76   316.26   318.35   311.87   313.94   314.27   313.77   315.85   316.50   316.63   315.26
      POWER     1.36     0.45     0.06     2.23     0.49     2.89     2.10     0.74     0.96     0.83     0.16     0.64     0.06
0.48  SPEED   317.18   316.79   316.81   315.81   318.10   311.61   315.99   313.81   313.40   316.11   316.31   316.63   315.34
      POWER     1.35     0.44     0.06     2.23     0.48     2.90     2.10     0.74     0.97     0.82     0.17     0.64     0.05
0.50  SPEED   317.17   316.80   316.84   315.33   317.74   311.53   317.93   313.38   313.09   316.35   316.10   316.60   315.40
      POWER     1.35     0.43     0.06     2.22     0.48     2.91     2.05     0.74     0.98     0.83     0.17     0.64     0.05
0.52  SPEED   317.13   316.78   316.84   314.92   317.31   311.64   319.56   313.00   312.86   316.59   315.87   316.54   315.46
      POWER     1.35     0.43     0.05     2.22     0.48     2.92     1.97     0.74     0.99     0.78     0.18     0.64     0.04
0.54  SPEED   317.06   316.74   316.82   314.32   316.82   311.94   320.72   312.67   312.72   316.83   315.64   316.45   315.51
      POWER     1.35     0.43     0.05     2.22     0.48     2.93     1.87     0.74     1.00     0.77     0.19     0.64     0.04
0.56  SPEED   316.96   316.68   316.78   313.83   316.20   312.44   321.30   312.42   312.67   317.05   315.43   316.35   315.56
      POWER     1.36     0.43     0.05     2.22     0.48     2.94     1.77     0.74     1.01     0.75     0.20     0.65     0.03
0.58  SPEED   316.83   316.6    316.7    313.29   315.67   313.11   321.26   312.27   312.73   317.25   315.25   316.23   315.61
      POWER     1.36     0.43     0.05     2.23     0.46     2.95     1.70     0.74     1.02     0.74     0.22     0.66     0.03
0.60  SPEED   316.85   316.77   316.87   313.52   315.48   313.90   322.36   312.74   313.34   317.19   314.96   316.00   315.90
      POWER     1.41     0.56     0.12     2.36     0.43     3.01     1.92     0.74     1.09     0.62     0.28     0.59     0.09
0.62  SPEED   316.81   316.90   317.02   313.69   315.26   314.70   323.29   312.23   313.96   317.06   314.69   315.66   316.75
      POWER     1.29     0.51     0.09     2.36     0.49     3.03     1.75     0.74     1.09     0.79     0.27     0.72     0.06
0.64  SPEED   316.75   316.96   317.13   313.86   315.12   315.51   324.16   313.74   314.61   316.95   314.44   315.39   316.07
      POWER     1.38     0.48     0.09     2.36     0.49     3.06     1.63     0.74     1.09     0.73     0.27     0.70     0.04
0.66  SPEED   316.67   316.98   317.21   314.06   314.8    316.32   324.69   314.26   315.24   316.83   314.22   315.12   [illegible]
      POWER     1.38     0.46     0.09     2.36     0.49   [illegible] 1.54     0.74     1.09     0.75     0.27     0.73     0.03
0.68  SPEED   316.59   316.96   317.25   314.29   314.57   317.13   325.23   314.80   315.89   316.72   314.05   314.98   315.85
      POWER     1.38     0.44     0.09     2.37     0.49     2.99     1.47     0.74     1.09     0.76     0.28     0.74     0.02
0.70  SPEED   316.51   316.90   317.25   314.52   314.34   317.92   325.69   315.35   316.52   316.55   313.92   314.65   315.64
      POWER     1.39     0.43     0.08     2.37     0.49     2.98     1.42     0.74     1.09     0.77     0.29     0.76     0.02
0.72  SPEED   316.43   316.82   317.22   314.81   314.14   318.69   326.11   315.91   317.15   316.41   313.63   314.44   315.30
      POWER     1.39     0.42     0.08     2.37     0.49     2.96     1.39     0.74     1.08     0.78     0.30     0.77     0.02
0.74  SPEED   316.34   316.72   317.16   315.09   313.95   319.44   326.49   315.47   317.75   316.24   313.79   314.25   315.47
      POWER     1.40     0.42     0.07     2.37     0.49     2.95     1.35     0.74     1.07     0.79     0.31     0.79     0.02
0.76  SPEED   316.17   316.50   316.97   315.27   313.61   320.22   323.53   316.99   318.22   316.27   314.28   314.37   315.13
      POWER     1.40     0.43     0.07     2.36     0.49     2.90     1.30     0.74     1.04     0.80     0.32     0.79     0.03
0.78  SPEED [illegible] 316.29  316.75   315.51   313.36 [illegible] [illegible] 317.52 318.68   316.29 [illegible] 314.57 [illegible]
```

```
0.80  SPEED  315.68  316.09  316.51  315.81  313.19  321.23  318.14  318.04  319.01  316.28  315.37  314.69  315.01
      POWER    1.42    0.44    0.06    2.36    0.49    2.85    1.49    0.74    1.01    0.79    0.29    0.77    0.04
0.82  SPEED  315.77  315.90  316.25  316.15  313.13  321.64  315.64  318.55  319.31  316.27  315.93  314.89  315.04
      POWER    1.43    0.45    0.06    2.35    0.49    2.83    1.64    0.74    1.00    0.80    0.27    0.76    0.04
0.84  SPEED  315.68  315.75  316.01  316.53  313.17  321.78  313.18  319.03  319.54  316.25  316.48  315.13  315.10
      POWER    1.44    0.46    0.06    2.35    0.49    2.80    1.80    0.74    0.98    0.80    0.24    0.75    0.04
0.86  SPEED  315.62  315.63  315.75  316.96  313.33  321.76  310.72  319.49  319.70  316.25  317.03  315.40  315.21
      POWER    1.45    0.47    0.05    2.34    0.49    2.77    1.97    0.74    0.96    0.82    0.21    0.73    0.04
0.88  SPEED  315.59  315.55  315.51  317.42  313.61  321.57  308.26  319.90  319.80  316.25  317.55  315.71  315.34
      POWER    1.45    0.48    0.05    2.33    0.49    2.74    2.05    0.74    0.94    0.81    0.18    0.71    0.04
0.90  SPEED  315.58  315.51  315.28  317.89  313.99  321.21  305.86  320.25  319.80  316.25  318.03  316.05  315.50
      POWER    1.45    0.49    0.05    2.33    0.44    2.72    2.06    0.74    0.92    0.81    0.15    0.69    0.04
0.92  SPEED  315.60  315.50  315.07  318.36  314.49  320.63  303.67  320.51  319.71  316.29  318.48  316.42  315.69
      POWER    1.46    0.50    0.05    2.32    0.49    2.70    2.09    0.74    0.91    0.80    0.12    0.67    0.03
0.94  SPEED  315.64  315.53  314.97  318.79  315.05  319.84  301.98  320.65  319.49  316.34  318.87  316.82  315.88
      POWER    1.45    0.50    0.05    2.31    0.49    2.68    2.10    0.74    0.89    0.79    0.09    0.64    0.03
0.96  SPEED  315.70  315.58  314.76  319.15  315.64  318.83  301.08  320.62  319.13  316.40  319.19  317.22  316.08
      POWER    1.45    0.51    0.05    2.29    0.49    2.66    2.10    0.74    0.87    0.79    0.07    0.61    0.02
0.98  SPEED  315.76  315.65  314.65  319.41  316.33  317.61  301.21  320.43  318.63  316.48  319.39  317.61  316.29
      POWER    1.45    0.51    0.05    2.28    0.48    2.66    2.10    0.74    0.86    0.79    0.05    0.59    0.01
1.00  SPEED  315.82  315.72  314.59  319.54  316.99  316.26  302.44  320.06  317.99  316.57  319.47  317.96  316.49
      POWER    1.45    0.50    0.05    2.27    0.48    2.65    2.10    0.74    0.85    0.78    0.03    0.56    0.01
1.02  SPEED  315.88  315.80  314.57  319.55  317.63  314.85  304.66  319.55  317.27  316.65  319.40  318.27  316.70
      POWER    1.44    0.50    0.05    2.25    0.48    2.66    2.10    0.74    0.84    0.77    0.02    0.54    0.01
1.04  SPEED  315.94  315.89  314.60  319.43  318.23  313.45  307.63  318.94  316.50  316.75  319.20  318.51  316.92
      POWER    1.44    0.50    0.05    2.24    0.48    2.67    2.10    0.74    0.84    0.77    0.02    0.52    0.01
1.06  SPEED  316.00  315.96  314.66  319.21  318.79  312.14  311.11  318.25  315.73  316.85  318.87  318.69  317.15
      POWER    1.43    0.49    0.05    2.23    0.48    2.69    2.10    0.74    0.84    0.76    0.02    0.51    0.00
1.08  SPEED  316.06  316.03  314.81  318.89  319.28  310.95  314.87  317.51  314.96  316.95  318.46  318.80  317.39
      POWER    1.43    0.49    0.05    2.21    0.48    2.72    2.10    0.74    0.84    0.76    0.03    0.50    0.00
1.10  SPEED  316.12  316.11  314.99  318.47  319.70  309.95  318.71  316.71  314.23  317.07  317.99  318.87  317.65
      POWER    1.43    0.49    0.05    2.20    0.47    2.75    2.08    0.74    0.85    0.75    0.04    0.49    0.00
1.12  SPEED  316.18  316.17  315.21  317.96  320.04  309.17  322.43  315.85  313.54  317.19  317.49  318.87  317.92
      POWER    1.42    0.48    0.05    2.19    0.47    2.78    1.97    0.74    0.86    0.74    0.06    0.49    0.00
1.14  SPEED  316.23  316.23  315.47  317.36  320.27  308.68  325.67  314.93  312.91  317.32  316.99  318.83  318.21
      POWER    1.42    0.48    0.05    2.18    0.47    2.81    1.79    0.74    0.88    0.73    0.09    0.49    0.00
1.16  SPEED  316.27  316.28  315.75  316.69  320.38  308.57  328.10  314.07  312.37  317.45  316.51  318.74  318.48
      POWER    1.41    0.47    0.05    2.17    0.47    2.83    1.59    0.74    0.89    0.73    0.11    0.49    0.00
1.18  SPEED  316.31  316.31  316.04  315.97  320.37  308.89  329.37  313.19  311.96  317.59  316.08  318.60  318.75
      POWER    1.41    0.47    0.05    2.16    0.47    2.85    1.40    0.74    0.91    0.72    0.14    0.50    0.00
1.20  SPEED  316.34  316.34  316.34  315.24  320.24  309.68  329.34  312.35  311.73  317.72  315.72  318.41  318.98
      POWER    1.41    0.46    0.05    2.16    0.47    2.87    1.25    0.74    0.93    0.71    0.16    0.51    0.00
1.22  SPEED  316.37  316.36  316.63  314.54  319.98  310.91  328.12  311.64  311.72  317.84  315.44  318.19  319.15
      POWER    1.41    0.46    0.04    2.16    0.47    2.89    1.17    0.74    0.95    0.70    0.19    0.52    0.00
1.24  SPEED  316.39  316.37  316.90  313.90  319.62  312.46  326.00  311.09  311.92  317.94  315.25  317.92  319.26
      POWER    1.40    0.46    0.04    2.16    0.47    2.90    1.16    0.74    0.97    0.69    0.21    0.54    0.00
1.26  SPEED  316.40  316.37  317.13  313.34  319.16  314.22  323.33  310.72  312.31  318.01  315.15  317.61  319.29
      POWER    1.40    0.46    0.04    2.17    0.47    2.91    1.22    0.74    0.98    0.69    0.22    0.56    0.00
```

DATA FOR TIME VS. ANGLE(DEG) PLOTTING

TIME	KAPTAI	SIKAL-BAHA	HALI-SAHAR	ASUGANG -132-	SHAHJI-BAZAR	ASUGANG -230-	GHORASAL -230-	SIDDIR-GANG	GHORA-SAL-132	GOAL-PARA	BHERA-MARA	BOGRA	SAIDPUR
0.0	1.53	3.21	1.57	7.35	1.93	10.63	11.64	5.00	7.36	-23.47	-16.58	-16.62	-14.89
0.020	1.60	3.25	1.60	7.49	1.87	10.92	12.29	5.24	7.61	-23.55	-16.64	-16.67	-14.88
0.040	1.75	3.39	1.69	7.91	2.09	11.85	14.24	5.95	8.30	-23.79	-16.80	-16.83	-14.82
0.060	1.90	3.61	1.84	8.61	2.20	13.37	17.47	7.15	9.61	-24.18	-17.06	-17.09	-14.75
0.080	2.12	3.92	2.06	9.59	2.51	15.49	21.92	8.62	11.34	-24.73	-17.43	-17.46	-14.67
0.100	2.42	4.32	2.34	10.84	2.91	18.2	27.54	10.94	13.54	-25.43	-17.90	-17.91	-14.59
0.120	2.75	4.80	2.70	12.39	3.43	21.48	34.25	13.52	16.21	-26.28	-18.47	-18.46	-14.52
0.140	3.19	5.30	3.13	14.20	4.09	25.32	41.98	16.54	19.31	-27.27	-19.13	-19.10	-14.50
0.160	3.72	6.02	3.65	16.31	4.90	29.73	50.62	19.09	22.84	-28.39	-19.89	-19.82	-14.53
0.180	4.35	6.76	4.25	18.71	5.90	34.66	60.12	22.85	26.77	-29.65	-20.74	-20.62	-14.64
0.200	5.11	7.61	4.97	21.36	7.17	39.70	68.72	27.99	30.84	-30.91	-21.44	-21.31	-14.78
0.220	6.06	8.58	5.82	24.22	8.81	44.38	74.59	31.35	34.77	-32.01	-21.71	-21.69	-14.88
0.240	7.21	9.71	6.85	27.31	10.98	48.60	77.66	35.80	38.56	-32.95	-21.52	-21.72	-14.94
0.260	8.60	11.12	8.05	30.63	13.40	52.50	78.05	39.64	42.19	-33.70	-20.86	-21.41	-14.94
0.280	10.22	12.52	9.44	34.18	16.38	55.96	75.98	43.38	45.62	-34.25	-19.74	-20.75	-14.85
0.300	12.10	14.22	11.04	37.92	19.82	58.63	71.78	46.95	48.81	-34.60	-18.15	-19.74	-14.64
0.320	14.23	16.12	12.85	41.81	23.69	61.10	65.88	50.35	51.72	-34.71	-16.23	-18.42	-14.31
0.340	16.60	18.23	14.86	45.78	27.97	62.73	58.81	53.47	54.29	-34.59	-13.94	-16.74	-13.83
0.360	19.21	20.54	17.07	49.75	32.58	63.65	51.16	56.25	56.47	-34.20	-11.36	-14.79	-13.20
0.380	22.03	23.02	19.47	53.63	37.46	63.84	43.59	58.67	58.22	-33.55	-8.58	-12.57	-12.43
0.400	25.05	25.67	22.03	57.33	42.50	63.30	36.77	60.62	59.48	-32.62	-5.67	-10.14	-11.51
0.420	28.23	28.44	24.75	60.70	47.62	62.04	31.31	62.08	60.25	-31.40	-2.73	-7.53	-10.48
0.440	31.53	31.32	27.58	63.83	52.69	60.15	27.71	63.01	60.51	-29.90	0.16	-4.80	-9.33
0.460	34.92	34.29	30.52	66.47	57.62	57.75	26.30	63.41	60.29	-28.10	2.93	-2.00	-8.09
0.480	38.37	37.30	33.54	68.52	62.29	54.96	27.23	63.27	59.63	-26.02	5.52	0.84	-6.77
0.500	41.82	40.33	36.60	70.24	66.61	51.99	30.46	62.63	58.59	-23.65	7.87	3.66	-5.37
0.520	45.26	43.35	39.68	71.29	70.48	49.04	35.75	61.52	57.23	-21.00	9.97	6.42	-3.91
0.540	48.64	46.35	42.75	71.76	73.81	46.31	42.64	59.99	55.65	-18.07	11.80	9.10	-2.38
0.560	51.91	49.28	45.78	71.66	76.54	44.05	50.54	58.14	53.97	-14.89	13.38	11.68	-0.8
0.580	55.05	52.13	48.75	71.03	78.62	42.46	58.74	56.05	52.30	-11.46	14.74	14.12	0.85
0.600	58.12	55.04	51.77	70.21	80.24	41.71	67.51	54.15	51.01	-7.96	15.83	16.36	2.68
0.620	61.18	58.11	54.96	69.57	81.62	41.87	77.45	52.81	50.43	-4.55	16.59	18.28	4.77
0.640	64.19	61.29	58.31	69.12	82.75	42.95	88.36	52.04	50.57	-1.29	17.06	19.85	6.95
0.660	67.11	64.52	61.76	68.90	83.62	44.96	100.06	51.85	51.44	1.85	17.25	21.11	9.11
0.680	69.95	67.74	65.29	68.92	84.22	47.90	112.44	52.29	53.05	4.84	17.22	22.07	11.14
0.700	72.69	70.92	68.84	69.21	84.56	51.76	125.39	53.34	55.40	7.66	17.02	22.76	12.96
0.720	75.34	74.03	72.38	69.79	84.65	56.51	138.64	55.03	58.47	10.32	16.70	23.2	14.5
0.740	77.89	77.03	75.86	70.69	84.52	62.14	152.75	57.35	62.23	12.8	16.30	23.40	15.71
0.760	80.30	79.84	79.19	71.86	84.09	68.65	165.16	60.30	66.03	15.2	16.15	23.58	15.73
0.780	82.52	82.41	82.30	73.28	83.31	75.98	174.28	63.85	71.54	17.62	16.60	23.9	17.72
0.800	84.58	84.74	85.14	75.00	82.30	83.94	180.32	68.02	75.90	20.06	17.67	24.42	18.69
0.820	86.49	86.85	87.70	77.09	81.15	92.35	183.44	72.77	82.64	22.48	19.38	25.14	19.68
0.840	88.28	88.70	89.97	79.59	79.99	101.02	183.73	78.19	88.68	24.89	21.72	26.12	20.73
0.860	89.99	90.52	91.95	82.50	78.95	109.76	181.21	83.95	94.96	27.29	24.71	27.39	21.87
0.880	91.65	92.16	93.63	86.04	78.16	118.38	175.87	90.30	101.38	29.68	28.30	28.99	23.15
0.900	93.28	93.73	95.05	90.05	77.74	126.07	167.73	97.10	107.86	32.08	32.47	30.96	24.6
0.920	94.93	95.28	96.22	94.60	77.83	134.43	155.96	104.25	114.29	34.50	37.17	33.35	26.24
0.940	96.51	96.84	97.17	99.67	78.53	141.41	143.93	111.62	120.54	36.97	42.36	36.17	29.11
0.960	98.34	98.45	97.94	105.19	79.91	147.35	129.40	119.05	126.46	39.50	47.96	39.45	30.21
0.980	100.14	100.12	98.56	111.07	82.03	152.01	114.42	126.37	131.89	42.12	53.85	43.19	32.53
1.000	102.01	101.88	99.09	117.18	84.90	155.20	100.21	133.35	136.65	44.83	59.90	47.35	35.09
1.020	103.96	103.72	99.58	123.30	88.52	156.80	88.00	139.85	140.04	47.65	65.96	51.89	37.89
1.040	105.97	105.65	100.06	129.49	92.84	156.79	78.77	145.69	143.78	50.57	71.66	56.74	40.93
1.060	108.05	107.67	100.62	135.40	97.83	155.22	73.26	150.75	146.02	53.61	77.47	61.84	44.23
1.080	110.20	109.78	101.29	141.01	103.42	152.22	71.92	155.05	147.38	56.76	82.65	67.10	47.8
1.100	112.41	111.98	102.14	146.19	109.54	147.97	74.94	158.44	147.89	60.04	87.32	72.47	51.67
1.120	114.70	114.25	103.22	150.85	116.10	142.68	82.32	160.88	147.57	63.45	91.44	77.89	55.83
1.140	117.04	116.60	104.58	154.86	122.98	136.67	93.70	162.33	146.55	67.00	94.98	83.27	60.32
1.160	119.43	119.01	106.24	158.15	130.06	130.31	108.36	162.75	144.75	70.70	97.96	88.58	65.13
1.180	121.68	121.46	108.23	160.64	137.20	124.07	125.16	162.14	142.46	74.56	100.42	93.76	70.25
1.200	124.30	123.95	110.56	162.29	144.26	118.47	142.67	160.54	139.80	78.56	102.42	98.75	75.65
1.220	126.88	126.47	113.24	163.13	151.09	114.03	159.45	159.05	137.05	82.72	104.05	103.50	81.29
1.240	129.43	129.00	116.23	163.20	157.56	111.19	174.29	154.84	134.31	86.99	105.42	107.97	87.09
1.260	132.00	131.54	119.50	162.58	163.57	110.25	186.36	151.10	131.96	91.37	106.02	112.11	92.97

GRAPH FOR SUSTAINED FAULT CLEARED AT 3 CYCLES LATER,RECLOSES AFTER 28 CYCLES & THEN OPEN AFTER 36 CYCLES

REFFERENCE MACHINE 9 IS GHORASAL-132

3-PHASE FAULT BETWEEN TONGI-230 & ISHURDI-230 LINE AT TONGI-230 END   FAULT TYPE = 2

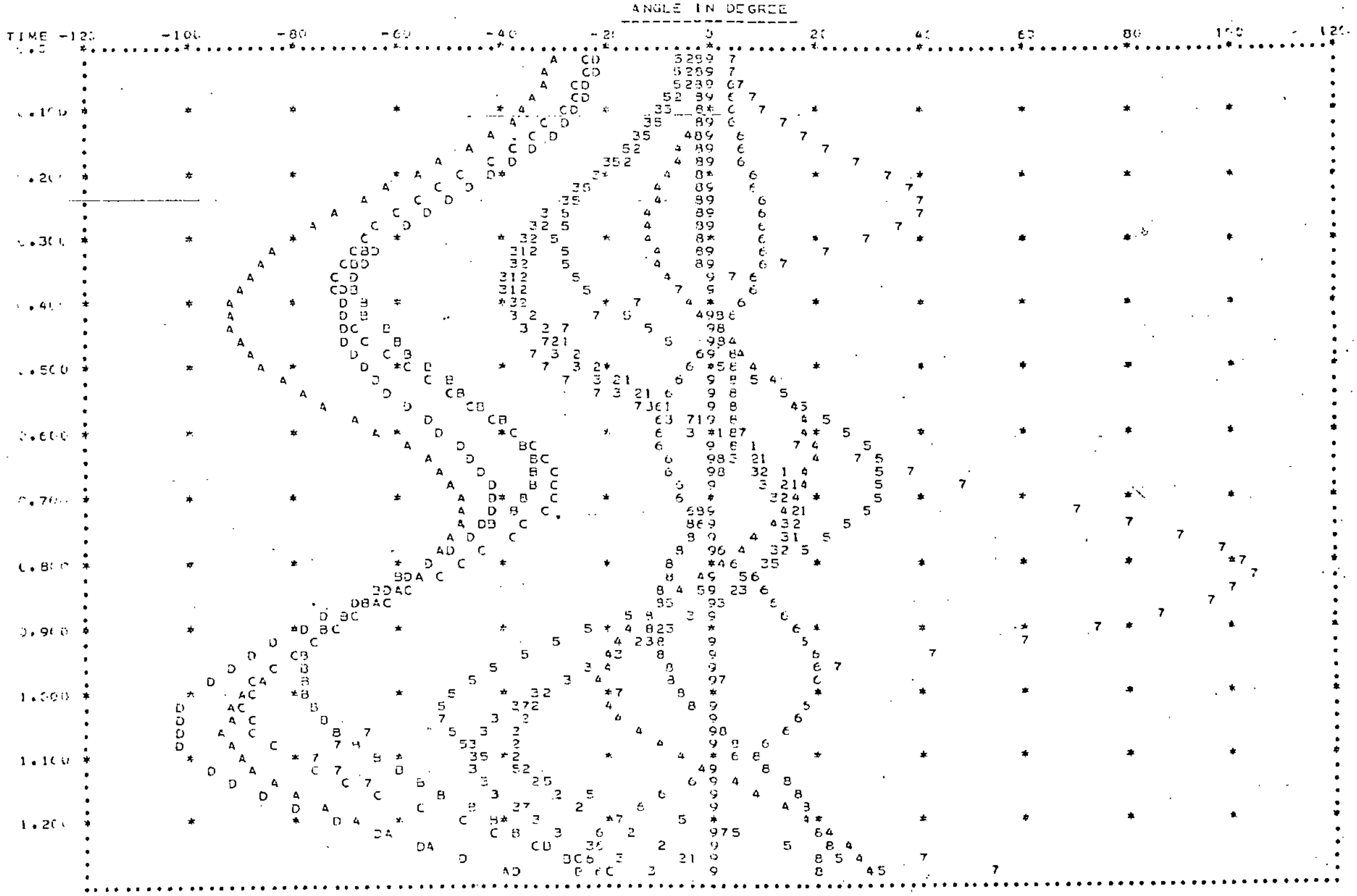

Fig.6.6 (With Governor)

* * * MEANING OF THE CODES * * *

1=KAPTAI , 2=SIKALBAHA 3=HALISHAHAR 4=ASHUGANG-132 5=SHAHJIBAZAR 6=ASHUGANG-230 7=GHORASAL-230

8=SIDDIRGANG 9=GHORASAL-132 A=GOALPARA B=BHERAMARA C=BOGRA D=SAIDPUR

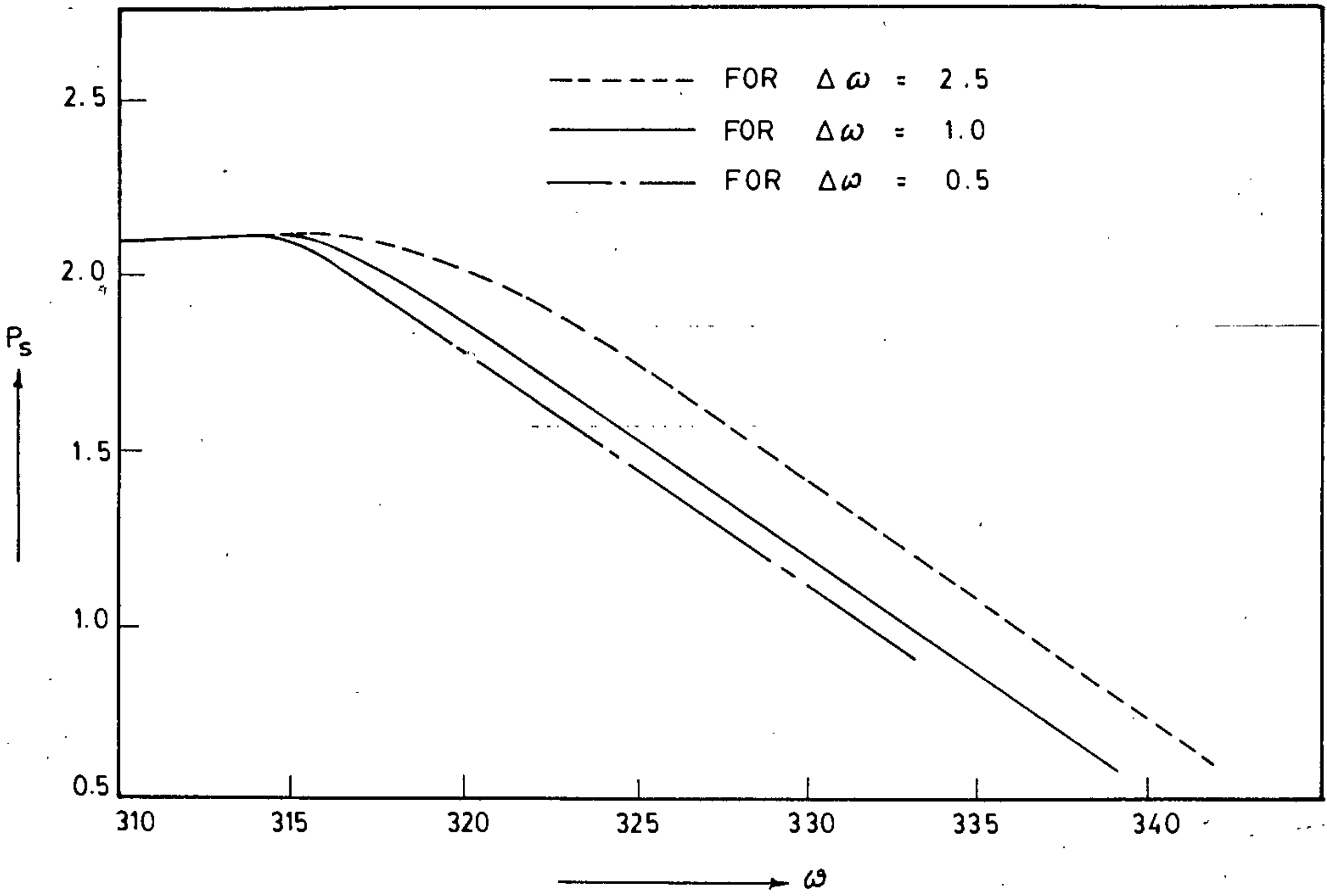

FIG. 6.7 CURVE FOR SHAFT POWER VS. ROTOR SPEED OF GHORASAL-230 GENERATOR.

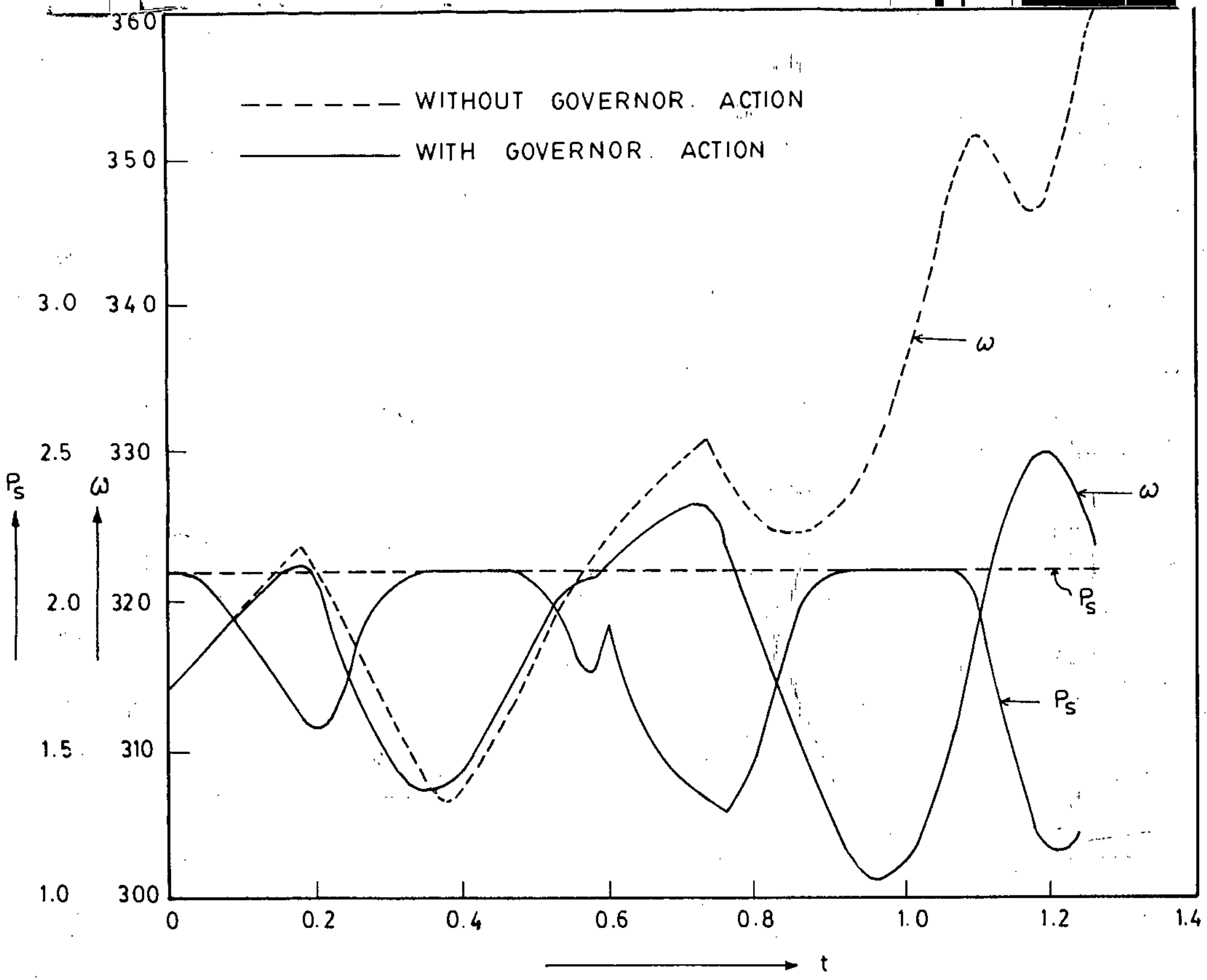

FIG. 6.8 : VARIATION OF SHAFT POWER AND ROTOR SPEED WITH TIME (GHORASAL – 230 GENERATOR).

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                                                      YBUS DURING FAULT
                                                      -----------------
                            FAULTED BUS IS SIDDIRGANG                                                    FAULT TYPE = 3
                            -------------------------                                                    --------------
             MAG    ANGLE                 MAG    ANGLE                 MAG    ANGLE                 MAG    ANGLE                 MAG    ANGLE
----------------------------------------------------------------------------------------------------------------------------------------------
 Y( 1, 1)=   3.52  -79.97 Y( 1, 2)=      0.82   78.55 Y( 1, 3)=      0.16   78.28 Y( 1, 4)=      0.22   80.88 Y( 1, 5)=      0.09   83.29
 Y( 1, 6)=   0.09   78.62 Y( 1, 7)=      0.04   80.01 Y( 1, 8)=      0.04   82.03 Y( 1, 9)=      0.01   82.05 Y( 1,10)=      0.01   75.61
 Y( 1,11)=   0.01   76.82 Y( 1,12)=      0.00   71.34 Y( 1,13)=      0.15   79.01 Y( 2, 1)=      0.82   78.55 Y( 2, 2)=      1.80  -87.25
 Y( 2, 3)=   0.06   76.29 Y( 2, 4)=      0.08   79.01 Y( 2, 5)=      0.03   81.41 Y( 2, 6)=      0.03   76.74 Y( 2, 7)=      0.02   78.14
 Y( 2, 8)=   0.01   80.15 Y( 2, 9)=      0.00   80.18 Y( 2,10)=      0.00   73.74 Y( 2,11)=      0.00   74.95 Y( 2,12)=      0.00   69.46
 Y( 2,13)=   0.04   77.86 Y( 3, 1)=      0.16   78.28 Y( 3, 2)=      0.06   76.29 Y( 3, 3)=      0.40  -89.42 Y( 3, 4)=      0.02   78.80
 Y( 3, 5)=   0.01   81.20 Y( 3, 6)=      0.01   76.53 Y( 3, 7)=      0.00   77.93 Y( 3, 8)=      0.00   79.94 Y( 3, 9)=      0.00   79.96
 Y( 3,10)=   0.00   73.52 Y( 3,11)=      0.00   74.74 Y( 3,12)=      0.00   69.25 Y( 3,13)=      0.01   77.62 Y( 4, 1)=      0.22   80.88
 Y( 4, 2)=   0.08   79.01 Y( 4, 3)=      0.02   78.80 Y( 4, 4)=      7.54  -87.56 Y( 4, 5)=      0.88   84.39 Y( 4, 6)=      0.96   79.72
 Y( 4, 7)=   0.45   81.12 Y( 4, 8)=      0.40   83.14 Y( 4, 9)=      0.12   83.16 Y( 4,10)=      0.09   75.72 Y( 4,11)=      0.10   77.93
 Y( 4,12)=   0.01   72.44 Y( 4,13)=      0.01   80.18 Y( 5, 1)=      0.09   83.29 Y( 5, 2)=      0.03   81.41 Y( 5, 3)=      0.01   81.20
 Y( 5, 4)=   0.88   84.39 Y( 5, 5)=      3.52  -85.84 Y( 5, 6)=      0.37   82.13 Y( 5, 7)=      0.17   83.52 Y( 5, 8)=      0.16   85.54
 Y( 5, 9)=   0.05   85.56 Y( 5,10)=      0.04   79.12 Y( 5,11)=      0.04   80.33 Y( 5,12)=      0.00   74.85 Y( 5,13)=      0.00   82.59
 Y( 6, 1)=   0.09   78.62 Y( 6, 2)=      0.03   76.74 Y( 6, 3)=      0.01   76.53 Y( 6, 4)=      0.96   79.72 Y( 6, 5)=      0.37   82.13
 Y( 6, 6)=   7.55  -88.36 Y( 6, 7)=      0.97   86.87 Y( 6, 8)=      0.32   79.77 Y( 6, 9)=      0.27   88.91 Y( 6,10)=      0.20   82.47
 Y( 6,11)=   0.22   83.69 Y( 6,12)=      0.01   78.20 Y( 6,13)=      0.00   77.92 Y( 7, 1)=      0.04   80.01 Y( 7, 2)=      0.02   78.14
 Y( 7, 3)=   0.00   77.93 Y( 7, 4)=      0.45   81.12 Y( 7, 5)=      0.17   83.52 Y( 7, 6)=      0.97   86.87 Y( 7, 7)=      5.26  -89.20
 Y( 7, 8)=   0.21   77.78 Y( 7, 9)=      0.21   86.77 Y( 7,10)=      0.16   80.33 Y( 7,11)=      0.17   81.54 Y( 7,12)=      0.01   76.05
 Y( 7,13)=   0.00   79.31 Y( 8, 1)=      0.04   82.03 Y( 8, 2)=      0.01   80.15 Y( 8, 3)=      0.00   79.94 Y( 8, 4)=      0.40   83.14
 Y( 8, 5)=   0.16   85.54 Y( 8, 6)=      0.32   79.77 Y( 8, 7)=      0.21   77.78 Y( 8, 8)=      2.13  -89.13 Y( 8, 9)=      0.06   79.82
 Y( 8,10)=   0.04   73.38 Y( 8,11)=      0.05   74.59 Y( 8,12)=      0.00   69.11 Y( 8,13)=      0.00   81.33 Y( 9, 1)=      0.01   82.05
 Y( 9, 2)=   0.00   80.18 Y( 9, 3)=      0.00   79.96 Y( 9, 4)=      0.12   83.16 Y( 9, 5)=      0.05   85.56 Y( 9, 6)=      0.27   88.91
 Y( 9, 7)=   0.21   86.77 Y( 9, 8)=      0.06   79.82 Y( 9, 9)=      2.98   66.78 Y( 9,10)=      0.55   83.21 Y( 9,11)=      0.48   85.64
 Y( 9,12)=   0.03   80.15 Y( 9,13)=      0.00   81.35 Y(10, 1)=      0.01   75.61 Y(10, 2)=      0.00   73.74 Y(10, 3)=      0.00   73.52
 Y(10, 4)=   0.09   76.72 Y(10, 5)=      0.04   79.12 Y(10, 6)=      0.20   82.47 Y(10, 7)=      0.16   80.33 Y(10, 8)=      0.04   73.38
 Y(10, 9)=   0.55   83.21 Y(10,10)=     10.19  -89.44 Y(10,11)=      0.36   79.20 Y(10,12)=      0.02   73.71 Y(10,13)=      0.00   74.91
 Y(11, 1)=   0.01   76.82 Y(11, 2)=      0.00   74.95 Y(11, 3)=      0.00   74.74 Y(11, 4)=      0.10   77.93 Y(11, 5)=      0.04   80.33
 Y(11, 6)=   0.22   83.69 Y(11, 7)=      0.17   81.54 Y(11, 8)=      0.05   74.59 Y(11, 9)=      0.48   85.64 Y(11,10)=      0.36   79.20
 Y(11,11)=   1.02  -59.24 Y(11,12)=      0.13   68.96 Y(11,13)=      0.00   76.12 Y(12, 1)=      0.00   71.34 Y(12, 2)=      0.00   69.46
 Y(12, 3)=   0.00   69.25 Y(12, 4)=      0.01   72.44 Y(12, 5)=      0.00   74.85 Y(12, 6)=      0.01   78.20 Y(12, 7)=      0.01   76.05
 Y(12, 8)=   0.00   69.11 Y(12, 9)=      0.03   80.15 Y(12,10)=      0.02   73.71 Y(12,11)=      0.13   68.96 Y(12,12)=      4.55  -89.83
 Y(12,13)=   0.00   70.64 Y(13, 1)=      0.15   79.01 Y(13, 2)=      0.04   77.86 Y(13, 3)=      0.01   77.62 Y(13, 4)=      0.01   80.18
 Y(13, 5)=   0.00   82.59 Y(13, 6)=      0.00   77.92 Y(13, 7)=      0.00   79.31 Y(13, 8)=      0.00   81.33 Y(13, 9)=      0.00   81.35
 Y(13,10)=   0.00   74.91 Y(13,11)=      0.00   76.12 Y(13,12)=      0.00   70.64 Y(13,13)=      0.32  -89.64 Y(
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                                          YBUS AFTER CLEARING THE FAULT
                                          -----------------------------
                     FAULTED BUS IS SIDDIRGANG                                                       FAULT TYPE = 3
                     -------------------------                                                       --------------
           MAG    ANGLE                  MAG    ANGLE                   MAG    ANGLE                  MAG    ANGLE                   MAG    ANGLE
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Y( 1, 1)=  3.37  -79.03 Y( 1, 2)=        0.88   78.51 Y( 1, 3)=         0.17   78.25 Y( 1, 4)=        0.48   81.42 Y( 1, 5)=         0.19   83.82
Y( 1, 6)=  0.26   78.83 Y( 1, 7)=        0.14   78.40 Y( 1, 8)=         0.14   82.91 Y( 1, 9)=        0.04   79.50 Y( 1,10)=         0.03   73.06
Y( 1,11)=  0.03   74.27 Y( 1,12)=        0.00   68.78 Y( 1,13)=         0.16   79.02 Y( 2, 1)=        0.88   78.51 Y( 2, 2)=         1.78  -87.06
Y( 2, 3)=  0.07   76.27 Y( 2, 4)=        0.17   79.54 Y( 2, 5)=         0.07   81.94 Y( 2, 6)=        0.09   76.95 Y( 2, 7)=         0.05   76.53
Y( 2, 8)=  0.05   81.03 Y( 2, 9)=        0.02   77.62 Y( 2,10)=         0.01   71.18 Y( 2,11)=        0.01   72.39 Y( 2,12)=         0.00   66.91
Y( 2,13)=  0.04   77.82 Y( 3, 1)=        0.17   78.25 Y( 3, 2)=         0.07   76.27 Y( 3, 3)=        0.40  -89.39 Y( 3, 4)=         0.03   79.33
Y( 3, 5)=  0.01   81.73 Y( 3, 6)=        0.02   76.74 Y( 3, 7)=         0.01   76.31 Y( 3, 8)=        0.01   80.82 Y( 3, 9)=         0.00   77.41
Y( 3,10)=  0.00   70.97 Y( 3,11)=        0.00   72.18 Y( 3,12)=         0.00   66.70 Y( 3,13)=        0.01   77.58 Y( 4, 1)=         0.48   81.42
Y( 4, 2)=  0.17   79.54 Y( 4, 3)=        0.03   79.33 Y( 4, 4)=         6.81  -86.74 Y( 4, 5)=        1.17   85.08 Y( 4, 6)=         1.62   80.09
Y( 4, 7)=  0.89   79.66 Y( 4, 8)=        0.87   84.17 Y( 4, 9)=         0.26   80.76 Y( 4,10)=        0.19   74.32 Y( 4,11)=         0.21   75.53
Y( 4,12)=  0.01   70.04 Y( 4,13)=        0.02   80.71 Y( 5, 1)=         0.19   83.82 Y( 5, 2)=        0.07   81.94 Y( 5, 3)=         0.01   81.73
Y( 5, 4)=  1.17   85.08 Y( 5, 5)=        3.41  -85.70 Y( 5, 6)=         0.63   82.49 Y( 5, 7)=        0.35   82.06 Y( 5, 8)=         0.34   86.57
Y( 5, 9)=  0.10   83.16 Y( 5,10)=        0.08   76.72 Y( 5,11)=         0.08   77.93 Y( 5,12)=        0.01   72.44 Y( 5,13)=         0.01   83.12
Y( 6, 1)=  0.26   78.83 Y( 6, 2)=        0.09   76.95 Y( 6, 3)=         0.02   76.74 Y( 6, 4)=        1.62   80.09 Y( 6, 5)=         0.63   82.49
Y( 6, 6)=  6.83  -86.91 Y( 6, 7)=        1.50   82.95 Y( 6, 8)=         0.75   80.05 Y( 6, 9)=        0.44   84.05 Y( 6,10)=         0.33   77.61
Y( 6,11)=  0.36   78.82 Y( 6,12)=        0.02   73.33 Y( 6,13)=         0.01   78.13 Y( 7, 1)=        0.14   78.40 Y( 7, 2)=         0.05   76.53
Y( 7, 3)=  0.01   76.31 Y( 7, 4)=        0.89   79.66 Y( 7, 5)=         0.35   82.06 Y( 7, 6)=        1.50   82.95 Y( 7, 7)=         4.90  -87.85
Y( 7, 8)=  0.50   77.66 Y( 7, 9)=        0.34   82.03 Y( 7,10)=         0.25   75.59 Y( 7,11)=        0.27   76.80 Y( 7,12)=         0.02   71.32
Y( 7,13)=  0.01   77.70 Y( 8, 1)=        0.14   82.91 Y( 8, 2)=         0.05   81.03 Y( 8, 3)=        0.01   80.82 Y( 8, 4)=         0.87   84.17
Y( 8, 5)=  0.34   86.57 Y( 8, 6)=        0.75   80.05 Y( 8, 7)=         0.50   77.66 Y( 8, 8)=        1.78  -86.52 Y( 8, 9)=         0.15   78.76
Y( 8,10)=  0.11   72.32 Y( 8,11)=        0.12   73.53 Y( 8,12)=         0.01   68.04 Y( 8,13)=        0.01   82.21 Y( 9, 1)=         0.04   79.50
Y( 9, 2)=  0.02   77.62 Y( 9, 3)=        0.00   77.41 Y( 9, 4)=         0.26   80.76 Y( 9, 5)=        0.10   83.16 Y( 9, 6)=         0.44   84.05
Y( 9, 7)=  0.34   82.03 Y( 9, 8)=        0.15   78.76 Y( 9, 9)=         3.03   66.89 Y( 9,10)=        0.58   82.41 Y( 9,11)=         0.51   84.58
Y( 9,12)=  0.03   79.10 Y( 9,13)=        0.00   78.79 Y(10, 1)=         0.03   73.06 Y(10, 2)=        0.01   71.18 Y(10, 3)=         0.00   70.97
Y(10, 4)=  0.19   74.32 Y(10, 5)=        0.08   76.72 Y(10, 6)=         0.33   77.61 Y(10, 7)=        0.25   75.59 Y(10, 8)=         0.11   72.32
Y(10, 9)=  0.58   82.41 Y(10,10)=       10.17  -89.38 Y(10,11)=         0.38   78.14 Y(10,12)=        0.02   72.66 Y(10,13)=         0.00   72.35
Y(11, 1)=  0.03   74.27 Y(11, 2)=        0.01   72.39 Y(11, 3)=         0.00   72.18 Y(11, 4)=        0.21   75.53 Y(11, 5)=         0.08   77.93
Y(11, 6)=  0.36   78.82 Y(11, 7)=        0.27   76.80 Y(11, 8)=         0.12   73.53 Y(11, 9)=        0.51   84.58 Y(11,10)=         0.38   78.14
Y(11,11)=  1.00  -57.95 Y(11,12)=        0.13   68.82 Y(11,13)=         0.00   73.57 Y(12, 1)=        0.00   68.78 Y(12, 2)=         0.00   66.91
Y(12, 3)=  0.00   66.70 Y(12, 4)=        0.01   70.04 Y(12, 5)=         0.01   72.44 Y(12, 6)=        0.02   73.33 Y(12, 7)=         0.02   71.32
Y(12, 8)=  0.01   68.04 Y(12, 9)=        0.03   79.10 Y(12,10)=         0.02   72.66 Y(12,11)=        0.13   68.82 Y(12,12)=         4.55  -89.83
Y(12,13)=  0.00   68.08 Y(13, 1)=        0.16   79.02 Y(13, 2)=         0.04   77.82 Y(13, 3)=        0.01   77.58 Y(13, 4)=         0.02   80.71
Y(13, 5)=  0.01   83.12 Y(13, 6)=        0.01   78.13 Y(13, 7)=         0.01   77.70 Y(13, 8)=        0.01   82.21 Y(13, 9)=         0.00   78.79
Y(13,10)=  0.00   72.35 Y(13,11)=        0.00   73.57 Y(13,12)=         0.00   68.08 Y(13,13)=        0.32  -89.62 Y(
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DATA FOR TIME VS. ANGLE(DEG)PLOTTING

TIME	KAPTAI	SIKALBAHA	HAJISAHAR	ASJGANG -132-	SHAHJIBAZAR	ASUGANG -230-	GHORASAL -230-	SIDDIRGANG	GHORASAL-132	GOALPARA	BHERAMARA	BOGRA	SAIDPUR
0.0	1.63	3.21	1.57	7.35	1.83	10.63	11.64	5.00	7.36	-23.47	-16.58	-16.62	-14.89
0.020	1.54	3.24	1.58	7.45	1.86	10.84	12.03	5.15	6.96	-23.31	-16.73	-16.38	-14.43
0.040	1.67	3.33	1.64	7.75	1.93	11.45	13.19	5.59	5.77	-22.84	-17.17	-15.69	-13.07
0.060	1.73	3.47	1.73	8.25	2.06	12.47	15.08	6.33	3.83	-22.07	-17.88	-14.54	-10.86
0.080	1.81	3.68	1.86	8.95	2.25	13.88	17.62	7.35	1.18	-21.00	-18.83	-12.94	-7.89
0.100	1.93	3.95	2.03	9.84	2.51	15.65	20.75	8.65	-2.07	-19.64	-19.99	-10.90	-4.25
0.120	2.09	4.28	2.25	10.94	2.86	17.78	24.35	10.24	-5.85	-18.01	-21.31	-8.42	-0.08
0.140	2.30	4.68	2.53	12.25	3.30	20.23	28.33	12.09	-10.02	-16.14	-22.73	-5.51	4.46
0.160	2.58	5.15	2.86	13.76	3.86	22.99	32.56	14.19	-14.46	-14.05	-24.21	-2.19	9.22
0.180	2.93	5.70	3.26	15.48	4.55	26.02	36.95	16.55	-19.02	-11.76	-25.68	1.53	14.03
0.200	3.38	6.30	3.72	17.34	5.43	29.01	40.70	18.93	-23.45	-9.29	-26.93	5.64	18.69
0.220	3.94	6.96	4.26	19.26	6.54	31.62	43.04	21.11	-27.47	-6.65	-27.74	10.11	22.99
0.240	4.63	7.67	4.89	21.25	7.90	33.82	43.94	23.07	-30.92	-3.89	-28.03	14.93	26.77
0.260	5.47	8.47	5.63	23.29	9.53	35.60	43.46	24.79	-33.63	-1.02	-27.78	20.10	29.93
0.280	6.47	9.36	6.47	25.36	11.42	36.91	41.76	26.25	-35.50	1.93	-26.95	25.59	32.37
0.300	7.64	10.36	7.45	27.43	13.55	37.75	39.02	27.45	-36.45	4.92	-25.55	31.41	34.04
0.320	8.97	11.45	8.55	29.47	15.91	38.09	35.53	28.37	-36.39	7.94	-23.59	37.53	34.92
0.340	10.46	12.66	9.78	31.43	18.45	37.95	31.59	28.97	-35.30	10.95	-21.12	43.94	35.01
0.360	12.10	13.98	11.14	33.27	21.12	37.33	27.56	29.27	-33.17	13.94	-18.19	50.65	34.37
0.380	13.88	15.41	12.63	34.93	23.86	36.25	23.78	29.25	-30.00	16.87	-14.88	57.64	33.07
0.400	15.76	16.94	14.24	36.38	26.62	34.78	20.58	28.93	-25.85	19.74	-11.28	64.91	31.21
0.420	17.73	18.56	15.95	37.56	29.32	32.99	18.25	28.35	-20.78	22.51	-7.48	72.44	28.94
0.440	19.77	20.26	17.77	38.44	31.89	30.97	17.00	27.54	-14.91	25.18	-3.59	80.24	26.42
0.460	21.84	22.02	19.66	39.00	34.28	28.84	16.96	26.58	-8.38	27.73	0.29	88.30	23.82
0.480	23.91	23.84	21.61	39.23	36.41	26.74	18.15	25.53	-1.35	30.16	4.08	96.63	21.34
0.500	25.96	25.69	23.61	39.14	38.23	24.83	20.50	24.51	5.98	32.46	7.68	105.23	19.17
0.520	27.95	27.54	25.63	38.73	39.70	23.27	23.84	23.61	13.40	34.64	11.05	114.10	17.48
0.540	29.87	29.40	27.66	38.04	40.79	22.20	27.94	22.93	20.70	36.70	14.13	123.25	16.43
0.560	31.69	31.23	29.56	37.13	41.48	21.76	32.50	22.57	27.68	38.65	16.90	132.70	16.14
0.580	33.40	33.01	31.63	36.04	41.75	22.07	37.20	22.64	34.13	40.49	19.35	142.46	16.70
0.600	34.97	34.74	33.54	34.86	41.63	23.18	41.73	23.18	39.88	42.25	21.49	152.55	18.15
0.620	36.41	36.38	35.36	33.67	41.13	25.14	45.83	24.26	44.80	43.93	23.34	163.00	20.50
0.640	37.69	37.94	37.09	32.56	40.29	27.92	49.28	25.87	48.76	45.55	24.91	173.84	23.68
0.660	38.83	39.38	38.70	31.60	39.16	31.45	51.91	28.00	51.70	47.12	26.23	185.11	27.63
0.680	39.83	40.72	40.18	30.90	37.80	35.62	53.67	30.59	53.57	48.63	27.31	196.84	32.20
0.700	40.69	41.93	41.52	30.52	36.28	40.27	54.55	33.57	54.36	50.10	28.19	209.08	37.23
0.720	41.43	43.01	42.72	30.54	34.69	45.21	54.63	36.81	54.09	51.53	28.87	221.88	42.54
0.740	42.06	43.96	43.76	31.02	33.11	50.25	54.07	40.20	52.84	52.91	29.35	235.27	47.93
0.760	42.59	44.79	44.64	31.99	31.63	55.15	53.07	43.60	50.67	54.23	29.63	249.31	53.19
0.780	43.05	45.49	45.38	33.47	30.33	59.72	51.86	46.86	47.73	55.49	29.70	264.04	58.12
0.800	43.46	46.09	45.96	35.46	29.31	63.77	50.72	49.87	44.13	56.68	29.55	279.50	62.55
0.820	43.84	46.58	46.42	37.94	28.63	67.13	49.87	52.52	40.06	57.78	29.18	295.69	66.32
0.840	44.20	47.00	46.75	40.86	28.36	69.69	49.53	54.70	35.68	58.77	28.56	312.62	69.32
0.860	44.57	47.34	46.97	44.17	28.55	71.35	49.84	56.37	31.19	59.64	27.71	330.28	71.44
0.880	44.96	47.64	47.11	47.79	29.25	72.09	50.88	57.50	26.76	60.38	26.66	348.62	72.64
0.900	45.38	47.91	47.18	51.63	30.47	71.92	52.65	58.11	22.58	60.97	25.46	367.59	72.89
0.920	45.86	48.17	47.22	55.59	32.25	70.90	55.08	58.24	18.81	61.40	24.18	387.10	72.21
0.940	46.40	48.44	47.23	59.56	34.56	69.14	58.02	57.95	15.61	61.66	22.92	407.07	70.65
0.960	47.00	48.75	47.26	63.43	37.38	66.79	61.26	57.37	13.08	61.75	21.78	427.42	68.30
0.980	47.67	49.11	47.32	67.11	40.69	64.04	64.58	56.60	11.34	61.67	20.87	448.10	65.29
1.000	48.42	49.55	47.45	70.49	44.41	61.10	67.73	55.77	10.44	61.42	20.28	469.05	61.77
1.020	49.24	50.06	47.65	73.49	48.48	58.20	70.46	55.00	10.41	61.01	20.08	490.28	57.92
1.040	50.13	50.68	47.96	76.02	52.82	55.56	72.58	54.41	11.26	60.44	20.31	511.80	53.96
1.060	51.07	51.39	48.40	78.04	57.31	53.39	73.91	54.10	12.97	59.72	20.95	533.67	50.09
1.080	52.07	52.21	48.96	79.49	61.87	51.86	74.38	54.14	15.47	58.88	21.99	555.95	46.53
1.100	53.11	53.14	49.67	80.37	66.37	51.10	73.96	54.57	19.69	57.91	23.36	578.74	43.50
1.120	54.18	54.17	50.53	80.66	70.71	51.18	72.70	55.40	22.54	56.84	24.96	602.12	41.18
1.140	55.27	55.29	51.53	80.39	74.78	52.14	70.73	56.61	26.88	55.68	26.72	626.17	39.72
1.160	56.38	56.50	52.69	79.58	78.49	53.94	68.23	58.16	31.58	54.46	28.52	650.93	39.23
1.180	57.50	57.78	53.98	78.29	81.73	56.51	65.46	59.98	36.49	53.21	30.30	676.43	39.78
1.200	58.62	59.12	55.39	76.58	84.43	59.73	62.71	61.97	41.45	51.95	31.99	702.65	41.40
1.220	59.73	60.50	56.92	74.55	86.53	63.43	60.31	64.04	46.30	50.72	33.57	729.53	44.05
1.240	60.83	61.91	58.53	72.29	87.96	67.43	58.58	66.09	50.89	49.54	35.06	756.97	47.67
1.260	61.92	63.31	60.22	69.92	88.71	71.52	57.77	68.02	55.07	48.47	36.50	784.87	52.12

GRAPH FOR UNSUSTAINED FAULT WITHOUT AUTORECLOSER

REFFERENCE MACHINE 9 IS GHORASAL-132

3-PHASE FAULT AT SIDDIRGANG.

FAULT TYPE = 3

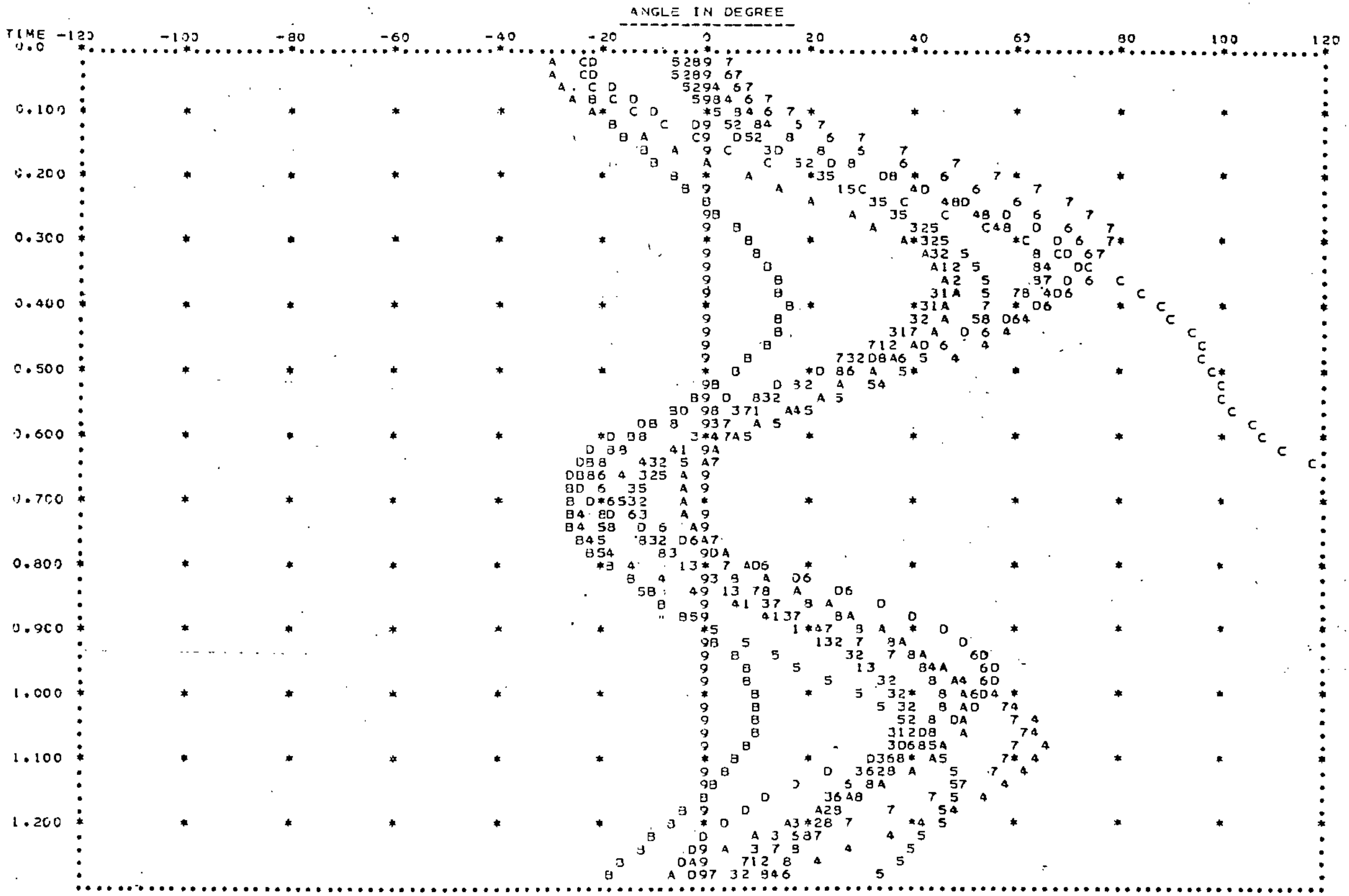

Fig. 6.9 (Without Governor)

* * * MEANING OF THE CODES * * *

1=KAPTAI 2=SIKALBAHA 3=HALISHAHAR 4=ASHUGANG-132 5=SHAHJIBAZAR 6=ASHUGANG-230 7=GHORASAL-230

8=SIDDIRGANG 9=GHORASAL-132 A=GOALPARA B=BHERAMARA C=BOGRA D=SAIDPUR

DATA FOR SPEED VS. POWER(PU) FOR GOVERNOR ACTION

TIME		KAPTAI	SIKAL-BAHA	HALI-SAHAR	ASUGANG -132-	SHAHJI-BAZAR	ASUGANG -230-	GHORASAL -230-	SIDDIR-GANG	GHORA-SAL-132	GDAL-PARA	BHERA-MARA	BOGRA	SAIDPUR
0.0	SPEED	314.16	314.16	314.16	314.15	314.16	314.16	314.16	314.15	314.16	314.16	314.16	314.16	314.15
	POWER	1.55	0.60	0.10	2.36	0.49	3.00	2.10	0.74	1.09	0.93	0.30	0.80	0.10
0.02	SPEED	314.18	314.21	314.19	314.33	314.20	314.52	314.84	314.42	313.46	314.43	313.90	314.56	314.96
	POWER	1.55	0.60	0.10	2.36	0.49	3.00	2.10	0.74	1.09	0.93	0.30	0.80	0.10
0.04	SPEED	314.20	314.26	314.22	314.51	314.25	314.87	315.50	314.53	312.78	314.70	313.66	314.96	315.73
	POWER	1.55	0.60	0.10	2.36	0.49	3.00	2.10	0.74	1.09	0.93	0.30	0.80	0.10
0.06	SPEED	314.22	314.31	314.26	314.60	314.30	315.22	316.10	314.93	312.15	314.97	313.43	315.36	316.44
	POWER	1.55	0.60	0.10	2.36	0.49	3.00	2.10	0.74	1.09	0.93	0.30	0.80	0.10
0.08	SPEED	314.24	314.37	314.29	314.85	314.35	315.55	316.65	315.18	311.57	315.22	313.23	315.75	317.06
	POWER	1.55	0.60	0.10	2.36	0.49	3.00	2.10	0.74	1.09	0.93	0.30	0.80	0.10
0.10	SPEED	314.28	314.42	314.33	315.03	314.42	315.86	317.11	315.42	311.07	315.46	313.07	316.14	317.58
	POWER	1.55	0.60	0.10	2.36	0.49	3.00	2.10	0.74	1.09	0.93	0.30	0.80	0.10
0.12	SPEED	314.32	314.48	314.37	315.21	314.50	316.16	317.48	315.65	310.67	315.69	312.95	316.51	317.98
	POWER	1.55	0.60	0.10	2.36	0.49	3.00	2.10	0.74	1.09	0.93	0.30	0.80	0.10
0.14	SPEED	314.37	314.54	314.42	315.39	314.59	316.43	317.75	315.89	310.38	315.89	312.88	316.88	318.24
	POWER	1.55	0.60	0.10	2.36	0.49	3.00	2.10	0.74	1.09	0.93	0.30	0.80	0.10
0.16	SPEED	314.43	314.60	314.48	315.57	314.70	316.69	317.93	316.10	310.21	316.09	312.86	317.23	318.36
	POWER	1.55	0.60	0.10	2.36	0.49	3.00	2.10	0.74	1.09	0.93	0.30	0.80	0.10
0.18	SPEED	314.51	314.67	314.54	315.75	314.83	316.91	318.02	316.32	310.16	316.24	312.90	317.58	318.34
	POWER	1.55	0.60	0.10	2.36	0.49	3.00	2.10	0.74	1.09	0.93	0.30	0.80	0.10
0.20	SPEED	314.59	314.70	314.59	315.81	315.02	316.60	316.82	316.14	310.44	316.39	313.25	317.90	318.09
	POWER	1.55	0.60	0.10	2.36	0.49	3.00	2.10	0.74	1.09	0.93	0.30	0.80	0.10
0.22	SPEED	314.70	314.75	314.66	315.86	315.23	316.26	315.56	315.96	310.88	316.52	313.67	318.22	317.70
	POWER	1.55	0.60	0.10	2.36	0.49	3.00	2.10	0.74	1.09	0.93	0.30	0.80	0.10
0.24	SPEED	314.82	314.82	314.75	315.92	315.46	315.90	314.32	315.76	311.45	316.62	314.13	318.52	317.20
	POWER	1.55	0.60	0.10	2.36	0.49	3.00	2.10	0.74	1.09	0.93	0.30	0.80	0.10
0.26	SPEED	314.96	314.89	314.84	315.95	315.69	315.51	313.17	315.55	312.14	316.70	314.63	318.81	316.61
	POWER	1.55	0.60	0.10	2.36	0.49	3.00	2.10	0.74	1.09	0.93	0.30	0.80	0.10
0.28	SPEED	315.10	314.98	314.95	315.97	315.92	315.10	312.18	315.32	312.92	316.76	315.13	319.10	315.96
	POWER	1.55	0.60	0.10	2.36	0.49	3.00	2.10	0.74	1.09	0.93	0.30	0.80	0.10
0.30	SPEED	315.25	315.07	315.06	315.96	316.12	314.68	311.39	315.08	313.76	316.79	315.63	319.37	315.27
	POWER	1.55	0.60	0.10	2.36	0.49	3.00	2.10	0.74	1.09	0.93	0.30	0.80	0.10
0.32	SPEED	315.39	315.16	315.17	315.91	316.30	314.25	310.86	314.82	314.65	316.79	316.10	319.63	314.58
	POWER	1.55	0.60	0.10	2.36	0.49	3.00	2.10	0.74	1.09	0.93	0.30	0.80	0.10
0.34	SPEED	315.53	315.26	315.29	315.82	316.44	313.82	310.62	314.55	315.56	316.78	316.52	319.89	313.91
	POWER	1.55	0.60	0.10	2.36	0.49	3.00	2.10	0.74	1.09	0.93	0.30	0.80	0.10
0.36	SPEED	315.65	315.36	315.40	315.69	316.53	313.41	310.69	314.28	316.48	316.75	316.89	320.14	313.29
	POWER	1.55	0.60	0.10	2.36	0.49	3.00	2.10	0.74	1.09	0.93	0.30	0.80	0.10
0.38	SPEED	315.76	315.45	315.51	315.52	316.57	313.04	311.06	314.01	317.36	316.69	317.19	320.38	312.76
	POWER	1.55	0.60	0.10	2.36	0.49	3.00	2.10	0.74	1.09	0.93	0.30	0.80	0.10
0.40	SPEED	315.85	315.53	315.61	315.31	316.55	312.72	311.71	313.75	318.20	316.62	317.40	320.62	312.33
	POWER	1.55	0.60	0.10	2.35	0.49	3.00	2.10	0.74	1.09	0.93	0.30	0.80	0.10
0.42	SPEED	315.91	315.61	315.70	315.06	316.47	312.47	312.57	313.54	318.95	316.54	317.52	320.85	312.04
	POWER	1.55	0.60	0.10	2.36	0.49	3.00	2.10	0.74	1.09	0.93	0.30	0.80	0.10
0.44	SPEED	315.95	315.67	315.77	314.79	316.33	312.33	313.58	313.37	319.59	316.44	317.56	321.08	311.89
	POWER	1.55	0.60	0.10	2.36	0.49	3.00	2.10	0.74	1.09	0.93	0.30	0.80	0.10
0.46	SPEED	315.97	315.72	315.84	314.51	316.14	312.29	314.66	313.27	320.10	316.33	317.51	321.31	311.91
	POWER	1.55	0.60	0.10	2.36	0.49	3.00	2.10	0.74	1.09	0.93	0.30	0.80	0.10
0.48	SPEED	315.96	315.76	315.88	314.22	315.89	312.38	315.72	313.24	320.45	316.22	317.39	321.55	312.10
	POWER	1.55	0.60	0.10	2.36	0.49	3.00	2.10	0.74	1.09	0.93	0.30	0.80	0.10
0.50	SPEED	315.93	315.78	315.91	313.93	315.60	312.61	316.67	313.33	320.63	316.11	317.20	321.78	312.44
	POWER	1.55	0.60	0.10	2.36	0.49	3.00	2.10	0.74	1.09	0.93	0.30	0.80	0.10
0.52	SPEED	315.87	315.78	315.92	313.67	315.28	312.98	317.44	313.45	320.61	316.00	316.97	322.02	312.94
	POWER	1.55	0.60	0.10	2.36	0.49	3.00	2.10	0.74	1.09	0.93	0.30	0.80	0.10
0.54	SPEED	315.79	315.77	315.92	313.45	314.94	313.48	317.98	313.69	320.42	315.90	316.71	322.28	313.55
	POWER	1.55	0.60	0.10	2.36	0.49	3.00	2.10	0.74	1.09	0.93	0.30	0.80	0.10
0.56	SPEED	315.70	315.74	315.89	313.27	314.58	314.08	318.24	314.02	320.04	315.81	316.43	322.54	314.26
	POWER	1.55	0.60	0.10	2.36	0.49	3.00	2.10	0.74	1.09	0.93	0.30	0.80	0.10
0.58	SPEED	315.59	315.69	315.85	313.16	314.22	314.77	318.23	314.41	319.51	315.73	316.15	322.82	315.02
	POWER	1.55	0.60	0.10	2.36	0.49	3.00	2.10	0.74	1.09	0.93	0.30	0.80	0.10
0.60	SPEED	315.51	315.66	315.81	313.16	313.92	315.60	318.27	314.78	319.45	315.46	316.54	322.26	315.62
	POWER	1.55	0.60	0.10	2.36	0.49	3.00	2.10	0.74	1.09	0.93	0.30	0.80	0.10
0.62	SPEED	315.42	315.63	315.76	313.25	313.65	316.44	318.09	315.19	319.22	315.20	316.89	321.78	316.22
	POWER	1.55	0.60	0.10	2.36	0.49	3.00	2.10	0.74	1.09	0.93	0.30	0.80	0.10
0.64	SPEED	315.34	315.59	315.71	313.42	313.43	317.25	317.74	315.63	318.84	314.95	317.19	321.38	316.81
	POWER	1.55	0.60	0.10	2.36	0.49	3.00	2.10	0.74	1.09	0.93	0.30	0.80	0.10
0.66	SPEED	315.27	315.54	315.64	313.68	313.26	317.99	317.26	316.07	318.32	314.70	317.43	321.06	317.41
	POWER	1.55	0.60	0.10	2.36	0.49	3.00	2.10	0.74	1.09	0.93	0.30	0.80	0.10
0.68	SPEED	315.20	315.50	315.57	314.01	313.16	318.62	316.70	316.52	317.72	314.47	317.60	320.82	318.00
	POWER	1.55	0.60	0.10	2.36	0.49	3.00	2.10	0.74	1.09	0.93	0.30	0.80	0.10
0.70	SPEED	315.14	315.45	315.55	314.41	313.12	319.11	316.11	316.95	317.04	314.26	317.69	320.66	318.60
	POWER	1.55	0.60	0.10	2.36	0.49	3.00	2.10	0.74	1.09	0.93	0.30	0.80	0.10
0.72	SPEED	315.10	315.40	315.42	314.87	313.16	319.45	315.56	317.35	316.33	314.07	317.72	320.57	319.19
	POWER	1.55	0.60	0.10	2.36	0.49	3.00	2.10	0.74	1.09	0.93	0.30	0.80	0.10
0.74	SPEED	315.07	315.36	315.35	315.38	313.28	319.60	315.08	317.71	315.62	313.90	317.66	320.57	319.79
	POWER	1.55	0.60	0.10	2.36	0.49	3.00	2.10	0.74	1.09	0.93	0.30	0.80	0.10

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0.76  SPEED  315.06  315.32  315.20  315.91  313.48  319.58  314.72  318.01  314.93  313.75  317.53  320.64  320.38
      POWER    1.55    0.60    0.10    2.36    0.49    3.00    2.10    0.74    1.09    0.93    0.30    0.80    0.10
0.78  SPEED  315.06  315.28  315.21  316.45  313.75  319.38  314.50  318.24  314.29  313.62  317.32  320.81  320.98
      POWER    1.55    0.60    0.10    2.36    0.49    3.00    2.10    0.74    1.09    0.93    0.30    0.80    0.10
0.80  SPEED  315.08  315.26  315.16  316.98  314.09  319.01  314.45  318.40  313.73  313.52  317.03  321.06  321.57
      POWER    1.55    0.60    0.10    2.36    0.49    3.00    2.10    0.74    1.09    0.93    0.30    0.80    0.10
0.82  SPEED  315.12  315.24  315.11  317.48  314.49  318.50  314.55  318.45  313.28  313.44  316.68  321.41  322.17
      POWER    1.55    0.60    0.10    2.36    0.49    3.00    2.10    0.74    1.09    0.93    0.30    0.80    0.10
0.84  SPEED  315.17  315.24  315.08  317.94  314.94  317.87  314.80  318.45  312.95  313.37  316.27  321.87  322.76
      POWER    1.55    0.60    0.10    2.36    0.49    3.00    2.10    0.74    1.09    0.93    0.30    0.80    0.10
0.86  SPEED  315.24  315.25  315.07  318.33  315.43  317.15  315.17  318.34  312.76  313.33  315.81  322.43  323.35
      POWER    1.55    0.60    0.10    2.36    0.49    3.00    2.10    0.74    1.09    0.93    0.30    0.80    0.10
0.88  SPEED  315.32  315.27  315.07  318.65  315.94  316.38  315.61  318.15  312.72  313.30  315.29  323.11  323.95
      POWER    1.55    0.60    0.10    2.36    0.49    3.00    2.10    0.74    1.09    0.93    0.30    0.80    0.10
0.90  SPEED  315.41  315.30  315.09  318.89  316.48  315.58  316.08  317.88  312.83  313.28  314.74  323.91  324.54
      POWER    1.55    0.60    0.10    2.36    0.49    3.00    2.10    0.74    1.09    0.93    0.30    0.80    0.10
0.92  SPEED  315.51  315.36  315.13  319.01  317.01  314.80  316.54  317.54  313.09  313.28  314.17  324.83  325.14
      POWER    1.55    0.60    0.10    2.36    0.49    3.00    2.10    0.74    1.09    0.93    0.30    0.90    0.10
0.94  SPEED  315.63  315.42  315.19  319.04  317.54  314.06  316.93  317.15  313.49  313.29  313.58  325.85  325.73
      POWER    1.55    0.60    0.10    2.36    0.49    3.00    2.10    0.74    1.09    0.93    0.30    0.80    0.10
0.96  SPEED  315.74  315.51  315.27  318.96  318.04  313.40  317.22  316.71  314.01  313.32  312.99  326.95  326.33
      POWER    1.55    0.60    0.10    2.36    0.49    3.00    2.10    0.74    1.09    0.93    0.30    0.80    0.10
0.98  SPEED  315.86  315.60  315.37  318.79  318.50  312.85  317.36  316.23  314.62  313.36  312.43  328.10  326.92
      POWER    1.55    0.60    0.10    2.36    0.49    3.00    2.10    0.74    1.09    0.93    0.30    0.80    0.10
1.00  SPEED  315.98  315.71  315.49  318.51  318.90  312.45  317.34  315.74  315.29  313.43  311.92  329.22  327.52
      POWER    1.55    0.60    0.10    2.36    0.49    3.00    2.10    0.74    1.09    0.93    0.30    0.80    0.10
1.02  SPEED  316.11  315.83  315.62  318.15  319.24  312.22  317.15  315.24  315.99  313.51  311.51  330.26  328.11
      POWER    1.55    0.60    0.10    2.36    0.49    3.00    2.10    0.74    1.09    0.93    0.30    0.80    0.10
1.04  SPEED  316.22  315.96  315.77  317.71  319.49  312.18  316.81  314.76  316.69  313.62  311.23  331.12  328.71
      POWER    1.55    0.60    0.10    2.36    0.49    3.00    2.10    0.74    1.09    0.93    0.30    0.80    0.10
1.06  SPEED  316.34  316.09  315.93  317.22  319.65  312.34  316.33  314.31  317.36  313.76  311.13  331.72  329.30
      POWER    1.55    0.60    0.10    2.36    0.49    3.00    2.10    0.74    1.09    0.93    0.30    0.80    0.10
1.08  SPEED  316.44  316.22  316.09  316.68  319.71  312.70  315.78  313.91  317.95  313.93  311.23  332.01  329.90
      POWER    1.55    0.60    0.10    2.36    0.49    3.00    2.10    0.74    1.09    0.93    0.30    0.80    0.10
1.10  SPEED  316.54  316.36  316.27  316.13  319.67  313.24  315.20  313.58  318.45  314.13  311.55  331.99  330.49
      POWER    1.55    0.60    0.10    2.36    0.49    3.00    2.10    0.74    1.09    0.93    0.30    0.80    0.10
1.12  SPEED  316.63  316.49  316.44  315.57  319.53  313.93  314.65  313.34  318.84  314.35  312.08  331.70  331.09
      POWER    1.55    0.60    0.10    2.36    0.49    3.00    2.10    0.74    1.09    0.93    0.30    0.80    0.10
1.14  SPEED  316.71  316.62  316.61  315.03  319.29  314.74  314.18  313.20  319.09  314.58  312.77  331.19  331.68
      POWER    1.55    0.60    0.10    2.36    0.49    3.00    2.10    0.74    1.09    0.93    0.30    0.80    0.10
1.16  SPEED  316.77  316.74  316.77  314.54  318.96  315.61  313.85  313.15  319.20  314.81  313.57  330.57  332.28
      POWER    1.55    0.60    0.10    2.36    0.49    3.00    2.10    0.74    1.09    0.93    0.30    0.80    0.10
1.18  SPEED  316.83  316.84  316.93  314.09  318.55  316.50  313.68  313.23  319.16  315.03  314.43  329.93  332.87
      POWER    1.55    0.60    0.10    2.36    0.49    3.00    2.10    0.74    1.09    0.93    0.30    0.80    0.10
1.20  SPEED  316.87  316.93  317.06  313.71  318.07  317.35  313.70  313.41  318.98  315.25  315.31  329.34  333.47
      POWER    1.55    0.60    0.10    2.36    0.49    3.00    2.10    0.74    1.09    0.93    0.30    0.80    0.10
1.22  SPEED  316.90  317.01  317.18  313.41  317.52  318.11  313.90  313.68  318.67  315.44  316.16  328.87  334.06
      POWER    1.55    0.60    0.10    2.36    0.49    3.00    2.10    0.74    1.09    0.93    0.30    0.80    0.10
1.24  SPEED  316.91  317.06  317.27  313.20  316.93  318.74  314.27  314.04  318.25  315.62  316.94  328.55  334.65
      POWER    1.55    0.60    0.10    2.36    0.49    3.00    2.10    0.74    1.09    0.93    0.30    0.80    0.10
1.26  SPEED  316.92  317.09  317.34  313.09  316.31  319.22  314.80  314.48  317.73  315.79  317.65  328.41  335.25
      POWER    1.55    0.60    0.10    2.36    0.49    3.00    2.10    0.74    1.09    0.93    0.30    0.80    0.10
```

DATA FOR TIME VS. ANGLE(DEG) PLOTTING

TIME	KAPTAI	SIKAL-BAHA	HALI-SAHAR	ASUGANG -132-	SHAHJI-BAZAR	ASUGANG -230-	GHORASAL -230-	SIDDIR-GANG	GHORA-SAL-132	GOAL-PARA	BHERA-MARA	BOGRA	SAIDPUR
0.0	1.63	3.21	1.57	7.35	1.83	10.63	11.64	5.00	7.36	-23.47	-16.58	-16.62	-14.89
0.020	1.64	3.24	1.58	7.45	1.86	10.84	12.03	5.15	5.96	-23.31	-16.73	-16.38	-14.43
0.040	1.67	3.33	1.64	7.75	1.93	11.45	13.19	5.59	5.77	-22.84	-17.17	-15.69	-13.07
0.060	1.72	3.47	1.73	8.25	2.06	12.47	15.08	6.33	3.83	-22.07	-17.88	-14.54	-10.86
0.080	1.81	3.68	1.86	8.95	2.25	13.88	17.62	7.35	1.18	-21.03	-18.83	-12.94	-7.89
0.100	1.93	3.95	2.03	9.84	2.51	15.65	20.75	8.65	-2.07	-19.64	-19.99	-10.90	-4.25
0.120	2.09	4.28	2.25	10.94	2.86	17.78	24.35	10.24	-5.85	-18.01	-21.31	-8.42	-0.08
0.140	2.30	4.68	2.53	12.25	3.30	20.23	28.33	12.09	-10.02	-16.14	-22.73	-5.51	4.46
0.160	2.58	5.15	2.86	13.76	3.86	22.99	32.56	14.19	-14.46	-14.05	-24.21	-2.19	9.22
0.180	2.93	5.70	3.26	15.48	4.55	26.02	36.95	16.55	-19.02	-11.76	-25.68	1.53	14.03
0.200	3.38	6.30	3.72	17.34	5.43	29.01	40.70	18.93	-23.45	-9.29	-26.93	5.64	18.69
0.220	3.94	6.96	4.26	19.26	6.54	31.62	43.54	21.11	-27.47	-6.65	-27.74	10.11	22.99
0.240	4.63	7.67	4.89	21.25	7.90	33.82	43.94	23.07	-30.92	-3.89	-28.03	14.93	26.77
0.260	5.47	8.47	5.63	23.29	9.53	35.60	43.46	24.79	-33.63	-1.02	-27.78	20.10	29.93
0.280	6.47	9.36	6.47	25.36	11.42	36.91	41.76	26.25	-35.50	1.93	-26.95	25.59	32.37
0.300	7.64	10.36	7.45	27.43	13.55	37.75	39.02	27.45	-36.45	4.92	-25.55	31.41	34.04
0.320	8.97	11.45	8.55	29.47	15.91	38.09	35.53	28.37	-36.39	7.94	-23.59	37.53	34.92
0.340	10.46	12.66	9.78	31.43	18.45	37.95	31.59	28.97	-35.30	10.95	-21.12	43.94	35.01
0.360	12.10	13.98	11.14	33.27	21.12	37.33	27.56	29.27	-33.17	13.94	-18.19	50.65	34.37
0.380	13.88	15.41	12.63	34.93	23.86	36.25	23.78	29.25	-30.00	16.87	-14.88	57.64	33.07
0.400	15.76	16.94	14.24	36.38	26.62	34.78	20.58	28.93	-25.85	19.74	-11.28	64.91	31.21
0.420	17.73	18.56	15.95	37.56	29.32	32.99	18.25	28.35	-20.78	22.51	-7.48	72.44	28.94
0.440	19.77	20.26	17.77	38.44	31.89	30.97	17.00	27.54	-14.91	25.18	-3.59	80.24	26.42
0.460	21.84	22.02	19.66	39.00	34.28	28.84	16.96	26.58	-8.38	27.73	0.29	88.30	23.82
0.480	23.91	23.84	21.61	39.23	36.41	26.74	18.15	25.53	-1.35	30.16	4.08	96.63	21.34
0.500	25.96	25.69	23.61	39.14	38.23	24.83	20.50	24.51	5.98	32.46	7.68	105.23	19.17
0.520	27.95	27.54	25.63	38.73	39.70	23.27	23.84	23.61	13.40	34.64	11.05	114.10	17.48
0.540	29.67	29.40	27.66	38.04	40.79	22.20	27.94	22.93	20.70	36.70	14.13	123.25	16.43
0.560	31.69	31.23	29.66	37.13	41.48	21.76	32.50	22.57	27.68	38.65	16.90	132.70	15.14
0.580	33.40	33.01	31.63	36.04	41.75	22.07	37.20	22.64	34.13	40.49	19.35	142.46	16.70
0.600	34.99	34.75	33.55	34.89	41.65	23.24	41.91	23.14	40.24	42.14	21.86	152.05	18.04
0.620	36.49	36.46	35.42	33.89	41.23	25.38	46.54	24.09	45.19	43.49	24.80	161.05	20.26
0.640	37.89	38.12	37.23	32.85	40.52	28.47	50.86	25.53	51.78	44.54	28.11	169.54	22.76
0.660	39.21	39.74	38.97	32.15	39.58	32.45	54.70	27.47	56.86	45.30	31.72	177.62	26.14
0.680	40.44	41.30	40.63	31.78	38.49	37.22	57.95	29.92	61.30	45.79	35.57	185.38	30.20
0.700	41.60	42.81	42.21	31.84	37.32	42.63	60.53	32.89	65.05	46.03	39.57	192.91	34.94
0.720	42.70	44.26	43.70	32.39	36.16	48.51	62.46	36.32	67.90	46.03	43.65	200.30	40.36
0.740	43.76	45.66	45.11	33.50	35.09	54.68	63.80	40.19	69.99	45.83	47.70	207.63	46.47
0.760	44.80	47.01	46.44	35.21	34.19	60.92	64.65	44.44	71.27	45.44	51.64	215.00	53.26
0.780	45.84	48.32	47.68	37.52	33.57	67.03	65.17	49.00	71.79	44.90	55.39	222.51	60.72
0.800	46.89	49.60	48.86	40.46	33.29	72.82	65.53	53.78	71.62	44.22	58.85	230.26	68.87
0.820	47.97	50.85	49.99	43.99	33.44	78.10	65.92	58.69	70.87	43.44	61.95	238.35	77.70
0.840	49.10	52.09	51.07	48.07	34.08	82.72	66.52	63.62	69.68	42.57	64.62	246.91	87.21
0.860	50.30	53.34	52.12	52.63	35.25	86.57	67.47	68.48	68.18	41.64	66.77	256.04	97.41
0.880	51.59	54.60	53.16	57.61	37.00	89.56	68.88	73.17	66.55	40.67	68.37	265.90	108.28
0.900	52.97	55.90	54.22	62.90	39.35	91.65	70.83	77.60	64.96	39.68	69.36	276.60	119.83
0.920	54.47	57.24	55.31	68.39	42.32	92.83	73.31	81.68	63.59	38.68	69.70	288.28	132.07
0.940	56.09	58.66	56.46	73.98	45.90	93.14	76.28	85.34	62.59	37.68	69.37	301.08	144.99
0.960	57.84	60.16	57.69	79.54	50.06	92.65	79.64	88.52	62.13	36.70	68.37	315.09	158.59
0.980	59.72	61.76	59.02	84.95	54.78	91.46	83.25	91.17	62.37	35.77	66.71	330.40	172.87
1.000	61.75	63.48	60.48	90.11	59.99	89.73	86.93	93.25	63.21	34.89	64.43	347.01	187.83
1.020	63.91	65.33	62.08	94.90	65.63	87.63	90.48	94.79	64.92	34.10	61.62	364.88	203.47
1.040	66.21	67.32	63.84	99.23	71.61	85.38	93.73	95.75	67.43	33.42	58.42	383.83	219.79
1.060	68.65	69.46	65.78	103.02	77.82	83.19	96.51	96.19	70.72	32.88	54.99	403.63	236.80
1.080	71.21	71.75	67.91	106.23	84.16	81.30	98.69	96.14	74.74	32.53	51.56	423.94	254.48
1.100	73.88	74.20	70.24	108.81	90.51	79.93	100.22	95.65	79.39	32.38	48.38	444.41	272.85
1.120	76.67	76.81	72.76	110.75	96.76	79.27	101.10	94.86	84.54	32.48	45.69	464.69	291.90
1.140	79.55	79.56	75.47	112.06	102.78	79.48	101.40	93.84	90.06	32.83	43.69	484.51	311.63
1.160	82.51	82.46	78.38	112.78	108.43	80.65	101.24	92.71	95.79	33.44	42.55	503.67	332.04
1.180	85.54	85.48	81.48	112.95	113.76	82.83	100.78	91.67	101.56	34.21	42.37	522.11	353.13
1.200	88.63	88.62	84.73	112.66	118.52	86.01	100.24	90.64	107.20	35.43	43.19	539.83	374.91
1.220	91.76	91.85	88.13	111.97	122.69	90.12	99.82	89.93	112.56	36.79	44.99	556.94	397.30
1.240	94.91	95.15	91.66	110.99	126.21	95.02	99.74	89.59	117.49	38.36	47.74	573.59	420.50
1.260	98.07	98.50	95.28	109.82	129.04	100.57	100.17	89.73	121.89	40.14	51.34	589.97	444.31

GRAPH FOR FAULT CLEARED AT 8 CYCLES LATER & RECLOSE AFTER 28 CYCLES

REFFERENCE MACHINE 9 IS GHORASAL-132

3-PHASE FAULT AT SIDDIRGANG

FAULT TYPE = 3

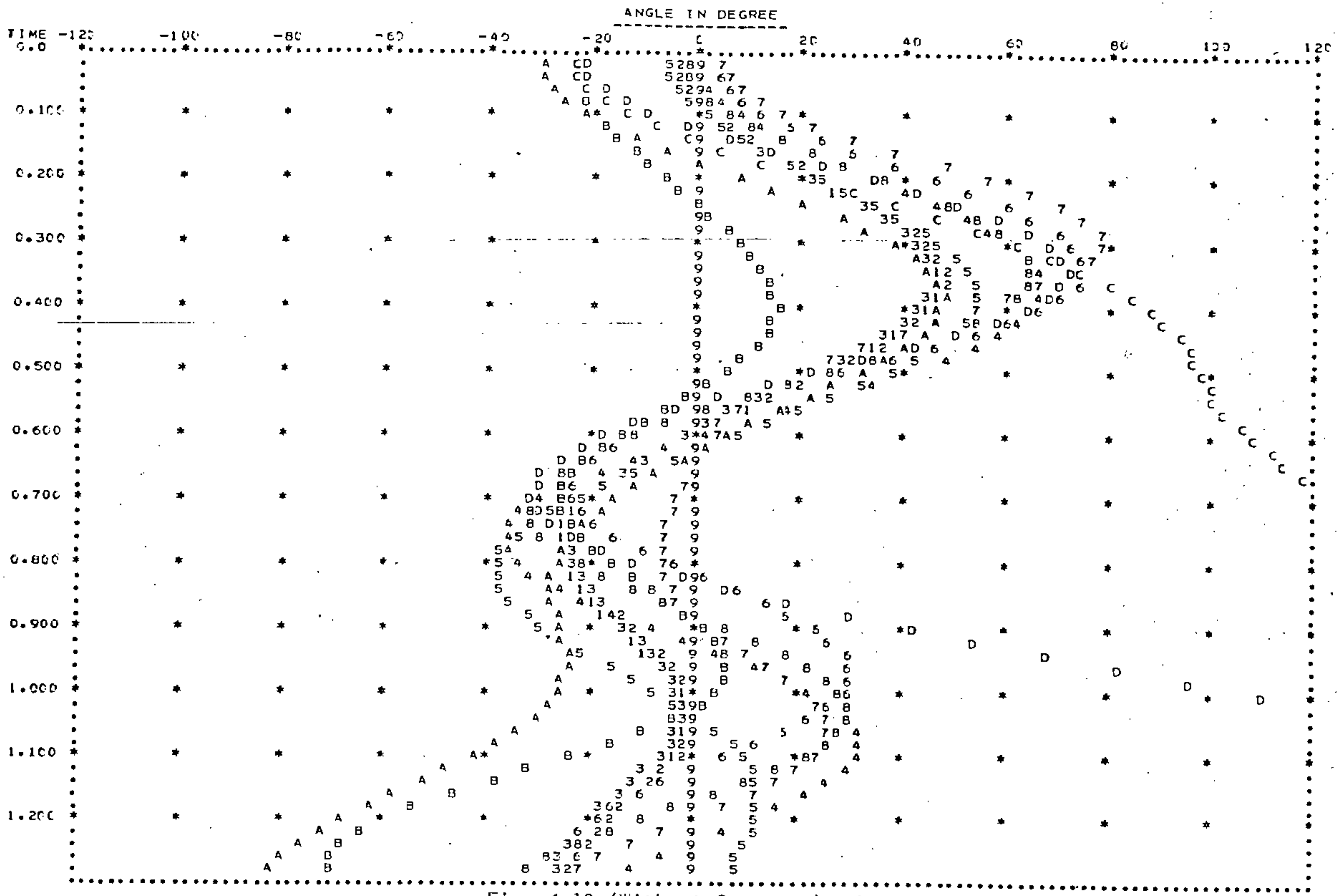

Fig. 6.10 (Without Governor)

* * * MEANING OF THE CODES * * *

1=KAPTAI 2=SIKALBAHA 3=HALISHAHAR 4=ASHUGANG-132 5=SHAHJIBAZAR 6=ASHUGANG-230 7=GHORASAL-230

8=SIDDIRGANG 9=GHORASAL-132 A=GOALPARA B=BHERAMARA C=BOGRA D=SAIDPUR

DATA FOR TIME VS. ANGLE(DEG) PLOTTING

TIME	KAPTAI	SIKAL-BAHA	HALI-SAHAR	ASUGANG -132-	SHAHJI-BAZAR	ASUGANG -230-	GHORASAL -230-	SIDDIR-GANG	GHORA-SAL-132	GOAL-PARA	BHERA-MARA	BOGRA	SAIDPUR
0.0	1.63	3.21	1.57	7.35	1.83	10.63	11.64	5.00	7.36	-23.47	-16.58	-16.62	-14.89
0.020	1.64	3.24	1.58	7.45	1.86	10.84	12.03	5.15	6.96	-23.31	-16.73	-16.38	-14.43
0.040	1.67	3.33	1.64	7.75	1.93	11.45	13.19	5.59	5.77	-22.84	-17.17	-15.69	-13.07
0.060	1.73	3.47	1.73	8.25	2.06	12.47	15.08	6.33	3.83	-22.07	-17.88	-14.54	-10.86
0.080	1.81	3.68	1.86	8.95	2.25	13.88	17.62	7.35	1.18	-21.00	-18.83	-12.94	-7.89
0.100	1.93	3.95	2.03	9.84	2.51	15.65	20.75	8.65	-2.07	-19.64	-19.99	-10.90	-4.25
0.120	2.09	4.28	2.25	10.94	2.86	17.78	24.35	10.24	-5.85	-18.01	-21.31	-8.42	-0.08
0.140	2.30	4.68	2.53	12.25	3.30	20.23	28.33	12.09	-10.02	-16.14	-22.73	-5.51	4.46
0.160	2.58	5.15	2.86	13.76	3.86	22.99	32.56	14.19	-14.46	-14.05	-24.21	-2.19	9.22
0.180	2.93	5.70	3.26	15.48	4.55	26.02	36.95	16.55	-19.02	-11.76	-25.68	1.53	14.03
0.200	3.38	6.30	3.72	17.34	5.43	29.01	40.70	18.93	-23.45	-9.29	-26.93	5.64	18.69
0.220	3.94	6.96	4.26	19.26	6.54	31.62	43.04	21.11	-27.47	-6.65	-27.74	10.11	22.99
0.240	4.63	7.67	4.89	21.25	7.90	33.82	43.94	23.07	-30.92	-3.89	-28.03	14.93	26.77
0.260	5.47	8.47	5.63	23.29	9.53	35.60	43.46	24.79	-33.63	-1.02	-27.78	20.10	29.93
0.280	6.47	9.36	6.47	25.36	11.42	36.91	41.76	26.25	-35.50	1.93	-26.95	25.59	32.37
0.300	7.64	10.36	7.45	27.43	13.55	37.75	39.02	27.45	-36.45	4.92	-25.55	31.41	34.04
0.320	8.97	11.45	8.55	29.47	15.91	38.09	35.53	28.37	-36.39	7.94	-23.59	37.53	34.92
0.340	10.46	12.66	9.78	31.43	18.45	37.95	31.59	28.97	-35.30	10.95	-21.12	43.94	35.01
0.360	12.10	13.98	11.14	33.27	21.12	37.33	27.56	29.27	-33.17	13.94	-18.19	50.65	34.37
0.380	13.88	15.41	12.63	34.93	23.86	36.25	23.78	29.25	-30.00	16.87	-14.88	57.64	33.07
0.400	15.76	16.94	14.24	36.38	26.62	34.78	20.58	28.93	-25.85	19.74	-11.28	64.91	31.21
0.420	17.73	18.56	15.95	37.56	29.32	32.99	18.25	28.35	-20.78	22.51	-7.48	72.44	28.94
0.440	19.77	20.26	17.77	38.44	31.89	30.97	17.00	27.54	-14.91	25.18	-3.59	80.24	26.42
0.460	21.84	22.02	19.66	39.00	34.28	28.84	16.96	26.58	-8.38	27.73	0.29	88.30	23.82
0.480	23.91	23.84	21.61	39.23	36.41	26.74	18.15	25.53	-1.35	30.16	4.08	96.63	21.34
0.500	25.96	25.69	23.61	39.14	38.23	24.83	20.50	24.51	5.98	32.46	7.68	105.23	19.17
0.520	27.95	27.54	25.63	38.73	39.70	23.27	23.84	23.61	13.40	34.64	11.05	114.10	17.48
0.540	29.87	29.40	27.66	38.04	40.79	22.20	27.94	22.93	20.70	36.70	14.13	123.25	16.43
0.560	31.69	31.23	29.66	37.13	41.48	21.76	32.50	22.57	27.68	38.65	16.90	132.70	16.14
0.580	33.40	33.01	31.63	36.04	41.75	22.07	37.20	22.64	34.13	40.49	19.35	142.46	16.70
0.600	35.02	34.80	33.58	34.97	41.73	23.23	42.19	23.19	39.98	42.30	21.55	152.56	18.14
0.620	36.62	36.65	35.55	34.09	41.50	25.33	47.70	24.29	45.22	44.12	23.58	163.04	20.43
0.640	38.18	38.55	37.53	33.43	41.10	28.36	53.58	25.94	49.76	45.97	25.47	173.93	23.56
0.660	39.70	40.48	39.50	33.05	40.55	32.30	59.65	28.14	53.56	47.86	27.24	185.25	27.46
0.680	41.20	42.44	41.45	32.99	39.87	37.09	65.76	30.89	55.56	49.81	28.93	197.04	32.05
0.700	42.68	44.41	43.38	33.30	39.12	42.69	71.78	34.17	58.77	51.81	30.56	209.33	37.20
0.720	44.15	46.39	45.28	34.02	38.34	48.59	77.61	37.97	60.19	53.88	32.15	222.15	42.78
0.740	45.61	48.37	47.14	35.20	37.59	55.91	83.15	42.26	60.85	56.02	33.71	235.55	48.65
0.760	47.06	50.28	48.93	36.93	36.96	63.09	87.51	46.97	60.70	58.20	35.25	249.57	54.58
0.780	48.47	52.06	50.60	39.28	36.59	70.13	89.82	51.95	59.73	60.38	36.76	264.25	60.35
0.800	49.87	53.72	52.16	42.30	36.57	76.83	90.17	57.13	58.05	62.56	38.20	279.63	65.79
0.820	51.29	55.28	53.63	45.99	37.00	82.99	88.78	62.33	55.84	64.74	39.75	295.73	70.75
0.840	52.76	56.75	55.04	50.33	37.94	88.42	85.98	67.41	53.24	66.91	41.21	312.58	75.09
0.860	54.30	58.16	56.40	55.25	39.47	92.96	82.18	72.22	50.43	69.06	42.61	330.16	78.72
0.880	55.93	59.54	57.72	60.68	41.62	96.48	77.89	76.60	47.58	71.16	43.92	348.45	81.57
0.900	57.65	60.91	59.05	66.50	44.41	98.87	73.61	80.41	44.83	73.21	45.12	367.42	83.60
0.920	59.49	62.29	60.39	72.60	47.85	100.09	69.89	83.55	42.36	75.18	46.18	387.01	84.80
0.940	61.45	63.73	61.77	78.82	51.92	100.13	67.21	85.95	40.28	77.06	47.12	407.15	85.20
0.960	63.54	65.24	63.22	85.01	56.59	99.06	65.92	87.57	38.72	78.83	47.94	427.75	84.88
0.980	65.74	66.85	64.76	91.03	61.81	97.00	66.27	88.44	37.78	80.49	48.70	448.75	83.92
1.000	68.07	68.58	66.41	96.73	67.48	94.13	68.34	88.63	37.53	82.02	49.44	470.06	82.45
1.020	70.51	70.46	68.19	101.97	73.54	90.67	72.06	88.24	38.03	83.41	50.23	491.66	80.63
1.040	73.04	72.50	70.11	106.65	79.86	86.93	77.20	87.43	39.31	84.67	51.12	513.53	78.64
1.060	75.66	74.72	72.19	110.66	86.33	83.20	83.41	86.37	41.36	85.80	52.17	535.68	76.67
1.080	78.36	77.10	74.43	113.93	92.81	79.84	90.22	85.25	44.16	86.80	53.39	558.16	74.92
1.100	81.11	79.66	76.84	116.43	99.19	77.15	97.14	84.29	47.65	87.67	54.78	581.04	73.58
1.120	83.89	82.39	79.42	118.14	105.33	75.43	103.71	83.66	51.77	88.42	56.35	604.39	72.83
1.140	86.71	85.27	82.16	119.07	111.11	74.90	109.50	83.55	56.42	89.08	58.04	628.32	72.82
1.160	89.52	88.28	85.06	119.27	116.44	75.71	114.18	84.09	61.47	89.65	59.83	652.89	73.68
1.180	92.34	91.41	88.09	118.78	121.21	77.95	117.55	85.37	66.82	90.15	61.66	678.16	75.47
1.200	95.14	94.62	91.24	117.70	125.34	81.62	119.48	87.44	72.33	90.61	63.53	704.17	78.24
1.220	97.91	97.88	94.50	116.12	128.75	86.62	119.97	90.29	77.86	91.03	65.42	730.91	81.99
1.240	100.64	101.16	97.82	114.14	131.40	92.80	119.11	93.85	83.30	91.46	67.37	758.32	86.66
1.260	103.32	104.43	101.19	111.92	133.24	99.91	117.14	98.02	88.51	91.92	69.42	786.32	92.15

GRAPH FOR SUSTAINED FAULT CLEARED AT 8 CYCLES LATER,RECLOSES AFTER 28 CYCLES & THEN OPEN AFTER 36 CYCLES

REFFERENCE MACHINE 9 IS GHORASAL-132

3-PHASE FAULT AT SIDDIRGANG

FAULT TYPE = 3

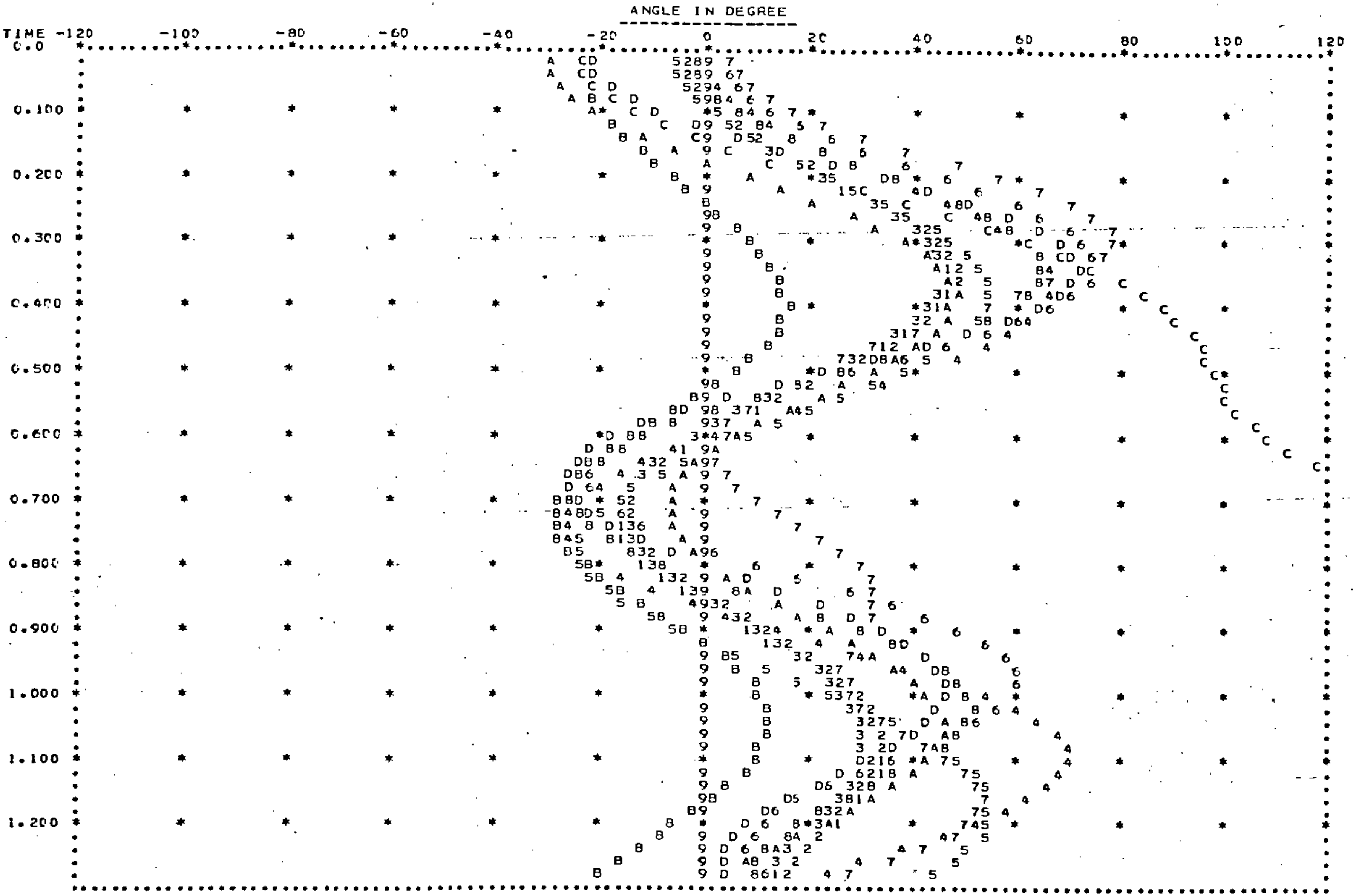

Fig. 6.11 (Without Governor)

* * * MEANING OF THE CODES * * *

1=KAPTAI
2=SIKALBAHA
3=HALISHAHAR
4=ASHUGANG-132
5=SHAHJIBAZAR
6=ASHUGANG-230
7=GHORASAL-230
8=SIDDIRGANG
9=GHORASAL-132
A=GOALPARA
B=BHERAMARA
C=BOGRA
D=SAIDPUR

DATA FOR TIME VS. ANGLE(DEG)PLOTTING

TIME	KAPTAI	SIKAL-BAHA	HALI-SAHAR	ASUGANG -132-	SHAHJI-BAZAR	ASUGANG -230-	GHORASAL -230-	SIDDIR-GANG	GHORA-SAL-132	GOAL-PARA	BHERA-MARA	BOGRA	SAIDPUR
0.0	1.63	3.21	1.57	7.35	1.83	10.63	11.64	5.00	7.36	-23.47	-16.58	-16.62	-14.89
0.020	1.64	3.24	1.58	7.45	1.86	10.84	12.03	5.15	6.96	-23.31	-16.73	-16.38	-14.43
0.040	1.67	3.33	1.64	7.75	1.93	11.45	13.19	5.59	5.77	-22.84	-17.17	-15.69	-13.07
0.060	1.73	3.47	1.73	8.25	2.06	12.47	15.07	6.33	3.83	-22.07	-17.87	-14.56	-11.13
0.080	1.81	3.68	1.86	8.95	2.25	13.88	17.59	7.35	1.19	-21.01	-18.81	-13.00	-9.03
0.100	1.92	3.94	2.03	9.84	2.51	15.65	20.64	8.65	-2.07	-19.67	-19.95	-11.05	-6.94
0.120	2.08	4.26	2.25	10.94	2.86	17.77	24.11	10.24	-5.84	-18.09	-21.21	-8.73	-4.91
0.140	2.28	4.63	2.51	12.24	3.30	20.22	27.86	12.03	-10.01	-16.27	-22.56	-6.06	-3.01
0.160	2.53	5.06	2.82	13.75	3.85	22.95	31.77	14.19	-14.44	-14.25	-23.92	-3.06	-1.31
0.180	2.85	5.59	3.19	15.46	4.54	25.95	35.74	16.54	-18.99	-12.06	-25.25	0.23	0.18
0.200	3.24	6.04	3.61	17.30	5.41	28.88	38.98	18.90	-23.42	-9.71	-26.33	3.80	1.53
0.220	3.71	6.57	4.07	19.20	6.51	31.40	40.75	21.05	-27.44	-7.23	-26.95	7.60	2.78
0.240	4.29	7.12	4.59	21.14	7.85	33.48	41.07	22.94	-30.88	-4.64	-27.07	11.64	3.91
0.260	4.97	7.70	5.17	23.11	9.44	35.08	40.06	24.57	-33.60	-1.97	-26.67	15.88	4.97
0.280	5.78	8.34	5.83	25.09	11.27	36.16	37.93	25.91	-35.48	0.75	-25.75	20.31	5.97
0.300	6.70	9.04	6.56	27.04	13.33	36.72	34.95	26.93	-36.44	3.49	-24.34	24.90	6.94
0.320	7.74	9.80	7.37	28.92	15.59	36.74	31.43	27.62	-36.41	6.22	-22.49	29.65	7.88
0.340	8.89	10.63	8.26	30.69	18.01	36.22	27.67	27.97	-35.36	8.92	-20.27	34.54	8.80
0.360	10.14	11.54	9.21	32.30	20.53	35.20	24.02	27.97	-33.28	11.56	-17.76	39.55	9.72
0.380	11.48	12.52	10.24	33.69	23.09	33.71	20.77	27.63	-30.20	14.14	-15.04	44.68	10.64
0.400	12.88	13.57	11.32	34.83	25.63	31.83	18.19	26.97	-26.17	16.62	-12.20	49.90	11.57
0.420	14.33	14.67	12.45	35.68	28.09	29.65	16.52	26.03	-21.29	18.99	-9.33	55.21	12.51
0.440	15.82	15.84	13.63	36.20	30.38	27.29	15.87	24.87	-15.66	21.24	-6.50	60.60	13.47
0.460	17.32	17.05	14.82	36.37	32.46	24.87	16.29	23.55	-9.46	23.36	-3.80	66.07	14.44
0.480	18.80	18.29	16.04	36.20	34.24	22.54	17.76	22.19	-2.86	25.35	-1.26	71.59	15.42
0.500	20.25	19.55	17.25	35.67	35.70	20.47	20.13	20.87	3.92	27.20	1.06	77.17	16.43
0.520	21.66	20.81	18.44	34.83	36.77	18.81	23.18	19.69	10.66	28.92	3.22	82.81	17.45
0.540	22.99	22.07	19.61	33.70	37.44	17.69	26.65	18.75	17.15	30.51	5.14	88.49	18.48
0.560	24.25	23.29	20.73	32.33	37.68	17.24	30.23	18.15	23.17	31.99	6.88	94.22	19.51
0.580	25.40	24.48	21.79	30.80	37.49	17.53	33.63	17.95	28.53	33.37	8.46	100.01	20.55
0.600	26.45	25.62	22.79	29.17	36.88	18.61	36.62	18.25	33.06	34.65	9.91	105.84	21.58
0.620	27.38	26.69	23.70	27.53	35.87	20.46	38.99	19.02	36.64	35.85	11.27	111.72	22.60
0.640	28.20	27.68	24.53	25.96	34.49	23.05	40.63	20.28	39.17	36.97	12.55	117.66	23.61
0.660	28.89	28.58	25.26	24.55	32.81	26.26	41.50	21.99	40.60	38.03	13.79	123.67	24.59
0.680	29.45	29.38	25.88	23.37	30.97	29.96	41.65	24.07	40.92	39.03	14.99	129.74	25.53
0.700	29.90	30.07	26.39	22.52	28.75	33.97	41.18	26.42	40.15	39.97	16.14	135.89	26.44
0.720	30.23	30.66	26.80	22.04	26.54	38.10	40.28	28.95	38.39	40.84	17.24	142.14	27.31
0.740	30.45	31.14	27.10	21.99	24.31	42.14	39.14	31.52	35.69	41.66	18.26	148.48	28.13
0.760	30.57	31.52	27.30	22.41	22.16	45.89	37.98	34.01	32.25	42.40	19.16	154.94	28.90
0.780	30.61	31.79	27.41	23.30	20.17	49.17	37.01	36.29	28.21	43.07	19.91	161.53	29.62
0.800	30.58	31.97	27.44	24.67	18.43	51.84	36.42	38.27	23.76	43.60	20.46	168.28	30.28
0.820	30.49	32.07	27.39	26.49	17.02	53.76	36.34	39.87	19.10	44.15	20.77	175.19	30.89
0.840	30.36	32.10	27.29	28.72	15.99	54.87	36.87	41.01	14.42	44.53	20.79	182.30	31.45
0.860	30.21	32.07	27.15	31.30	15.42	55.14	38.00	41.69	9.92	44.80	20.50	189.62	31.95
0.880	30.04	32.00	26.98	34.15	15.35	54.59	39.70	41.90	5.77	44.94	19.87	197.19	32.40
0.900	29.88	31.91	26.81	37.19	15.79	53.26	41.82	41.68	2.12	44.96	18.91	205.03	32.81
0.920	29.74	31.80	26.65	40.33	16.78	51.27	44.20	41.10	-0.91	44.84	17.61	213.16	33.17
0.940	29.63	31.71	26.53	43.46	18.30	48.75	46.61	40.22	-3.22	44.58	16.01	221.61	33.50
0.960	29.57	31.63	26.44	46.48	20.34	45.88	48.83	39.15	-4.74	44.18	14.13	230.40	33.80
0.980	29.56	31.58	26.42	49.29	22.86	42.83	50.64	37.99	-5.45	43.63	12.04	239.55	34.06
1.000	29.61	31.57	26.47	51.79	25.79	39.82	51.86	36.84	-5.33	42.95	9.79	249.07	34.31
1.020	29.73	31.61	26.59	53.90	29.08	37.01	52.35	35.80	-4.41	42.12	7.44	258.97	34.54
1.040	29.92	31.71	26.80	55.54	32.63	34.59	52.05	34.91	-2.75	41.15	5.07	269.25	34.75
1.060	30.16	31.87	27.10	56.68	36.34	32.69	50.95	34.33	-0.43	40.05	2.77	279.89	34.96
1.080	30.51	32.09	27.48	57.25	40.12	31.42	49.12	34.01	2.45	38.82	0.62	290.88	35.17
1.100	30.90	32.38	27.95	57.26	43.85	30.85	46.70	33.99	5.75	37.48	-1.28	302.18	35.37
1.120	31.35	32.73	28.50	56.70	47.43	31.00	43.84	34.25	9.34	36.05	-2.85	313.77	35.59
1.140	31.86	33.13	29.12	55.58	50.74	31.84	40.78	34.79	13.05	34.53	-3.99	325.58	35.81
1.160	32.40	33.59	29.79	53.96	53.70	33.32	37.76	35.54	16.72	32.95	-4.64	337.58	36.05
1.180	32.99	34.08	30.51	51.90	56.21	35.34	35.06	36.45	20.21	31.34	-4.72	349.71	36.30
1.200	33.59	34.61	31.27	49.47	58.19	37.76	32.94	37.45	23.37	29.72	-4.20	361.90	36.57
1.220	34.21	35.17	32.03	46.77	59.59	40.45	31.62	38.49	26.07	28.11	-3.07	374.12	36.85
1.240	34.84	35.73	32.79	43.91	60.36	43.25	31.27	39.49	28.22	26.56	-1.33	386.32	37.16
1.260	35.46	36.30	33.54	41.01	60.47	45.99	32.00	40.38	29.75	25.09	0.96	398.44	37.48

GRAPH FOR UNSUSTAINED FAULT WITHOUT AUTORECLOSER

REFFERENCE MACHINE 9 IS GHORASAL-132

3-PHASE FAULT AT SIDDIRGANG

FAULT TYPE = 3

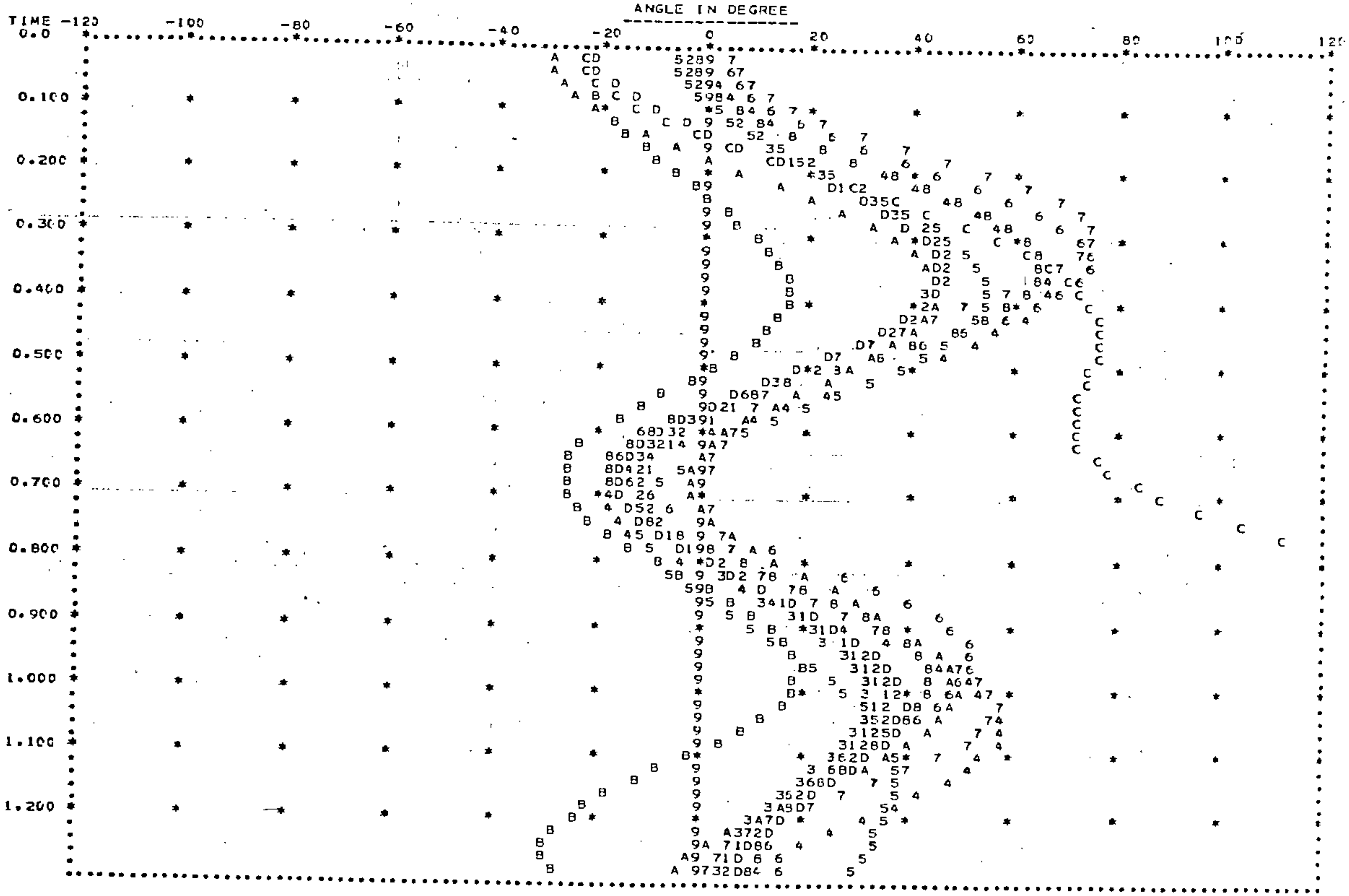

Fig.6.12 (With Governor)

* * * MEANING OF THE CODES * * *

1=KAPTAI 2=SIKALBAHA 3=HALISHAHAR 4=ASHUGANG-132 5=SHAHJIBAZAR 6=ASHUGANG-230 7=GHORASAL-230

8=SIDDIRGANG 9=GHORASAL-132 A=GOALPARA B=BHERAMARA C=BOGRA D=SAIDPUR

DATA FOR SPEED VS. POWER(PU) FOR GOVERNOR ACTION

TIME		KAPTAI	SIKAL-DAHA	HALI-SAHAR	ASUGANG -132-	SHAHJI-BAZAR	ASUGANG -230-	GHORASAL -230-	SIDDIP-GANG	GHORA-SAL-132	GOAL-PARA	BHERA-MARA	BOGRA	SAIDPUR
0.0	SPEED	314.16	314.16	314.16	314.16	314.16	314.16	314.16	314.15	314.16	314.16	314.16	314.16	314.15
	POWER	1.55	0.60	0.10	2.36	0.49	3.00	2.10	0.74	1.09	0.93	0.30	0.80	0.10
0.02	SPEED	314.18	314.21	314.19	314.33	314.20	314.52	314.84	314.42	313.46	314.43	313.90	314.56	314.96
	POWER	1.55	0.60	0.10	2.36	0.49	3.00	2.10	0.74	1.09	0.93	0.30	0.80	0.10
0.04	SPEED	314.20	314.26	314.22	314.51	314.25	314.87	315.50	314.68	312.78	314.70	313.66	314.96	315.73
	POWER	1.55	0.60	0.10	2.36	0.49	3.00	2.08	0.74	1.09	0.90	0.31	0.76	0.03
0.06	SPEED	314.22	314.31	314.26	314.68	314.30	315.22	316.09	314.93	312.15	314.95	313.43	315.34	315.98
	POWER	1.55	0.60	0.10	2.36	0.49	3.00	2.05	0.74	1.09	0.89	0.31	0.74	-0.01
0.08	SPEED	314.24	314.36	314.29	314.85	314.35	315.55	316.61	315.18	311.57	315.21	313.25	315.69	315.98
	POWER	1.55	0.60	0.10	2.36	0.49	2.99	2.02	0.74	1.09	0.87	0.33	0.71	0.00
0.10	SPEED	314.27	314.41	314.33	315.93	314.42	315.86	317.02	315.42	311.07	315.44	313.10	316.03	315.97
	POWER	1.55	0.59	0.10	2.36	0.49	2.99	1.98	0.74	1.09	0.85	0.34	0.69	[illegible]
0.12	SPEED	314.31	314.46	314.37	315.20	314.50	316.15	317.33	315.65	310.67	315.65	313.01	316.34	315.88
	POWER	1.54	0.59	0.10	2.36	0.49	2.98	1.95	0.74	1.09	0.84	0.35	0.67	[illegible]
0.14	SPEED	314.36	314.51	314.41	315.38	314.59	316.42	317.52	315.89	310.38	315.84	312.97	316.64	315.74
	POWER	1.54	0.59	0.10	2.35	0.49	2.97	1.92	0.74	1.10	0.83	0.35	0.65	-0.00
0.16	SPEED	314.41	314.55	314.46	315.56	314.70	316.66	317.61	316.15	310.21	316.00	312.98	316.91	315.55
	POWER	1.54	0.58	0.10	2.35	0.49	2.97	1.90	0.74	1.10	0.82	0.36	0.63	0.01
0.18	SPEED	314.47	314.60	314.50	315.74	314.82	316.88	317.61	315.31	310.17	316.14	313.04	317.16	315.36
	POWER	1.53	0.58	0.10	2.35	0.49	2.96	1.89	0.74	1.10	0.81	0.36	0.61	0.02
0.20	SPEED	314.53	314.60	314.54	315.79	315.01	316.54	316.34	316.12	310.44	316.27	313.40	317.38	315.30
	POWER	1.53	0.57	0.10	2.34	0.49	2.93	1.87	0.74	1.10	0.81	0.36	0.60	0.03
0.22	SPEED	314.61	314.62	314.58	315.83	315.22	316.17	315.05	315.92	310.88	316.38	313.83	317.59	315.19
	POWER	1.53	0.57	0.10	2.33	0.49	2.92	1.91	0.74	1.10	0.79	0.35	0.58	0.03
0.24	SPEED	314.71	314.65	314.64	315.87	315.43	315.76	313.82	315.69	311.45	316.46	314.28	317.77	315.10
	POWER	1.52	0.57	0.10	2.33	0.49	2.92	1.96	0.74	1.10	0.79	0.34	0.57	0.04
0.26	SPEED	314.81	314.69	314.70	315.89	315.65	315.33	312.74	315.45	312.13	316.51	314.74	317.95	315.05
	POWER	1.52	0.57	0.09	2.32	0.49	2.91	2.03	0.74	1.10	0.78	0.32	0.56	0.05
0.28	SPEED	314.91	314.74	314.76	315.88	315.86	314.88	311.88	315.19	312.91	316.54	315.18	318.10	315.01
	POWER	1.51	0.57	0.09	2.32	0.49	2.91	2.07	0.74	1.10	0.78	0.30	0.54	0.05
0.30	SPEED	315.02	314.79	314.83	315.84	316.05	314.41	311.27	314.91	313.74	316.55	315.59	318.24	314.99
	POWER	1.50	0.57	0.09	2.32	0.48	2.90	2.09	0.74	1.10	0.78	0.27	0.53	0.05
0.32	SPEED	315.12	314.85	314.90	315.76	316.21	313.94	310.93	314.61	314.62	316.53	315.94	318.37	314.97
	POWER	1.50	0.56	0.09	2.31	0.48	2.91	2.10	0.74	1.10	0.79	0.25	0.53	0.05
0.34	SPEED	315.21	314.92	314.96	315.64	316.32	313.48	310.87	314.31	315.52	316.50	316.24	318.48	314.96
	POWER	1.49	0.56	0.09	2.31	0.48	2.91	2.10	0.74	1.10	0.78	0.23	0.52	0.05
0.36	SPEED	315.29	314.98	315.02	315.48	316.39	313.06	311.10	314.01	316.41	316.44	316.46	318.59	314.96
	POWER	1.48	0.56	0.09	2.30	0.48	2.92	2.10	0.74	1.09	0.78	0.21	0.51	0.05
0.38	SPEED	315.36	315.04	315.08	315.27	316.40	312.68	311.58	313.72	317.27	316.37	316.60	318.68	314.96
	POWER	1.48	0.55	0.09	2.30	0.48	2.93	2.10	0.74	1.09	0.79	0.19	0.50	0.05
0.40	SPEED	315.41	315.10	315.13	315.03	316.35	312.37	312.28	313.45	318.07	316.28	316.66	318.76	314.97
	POWER	1.47	0.55	0.09	2.30	0.48	2.94	2.10	0.74	1.08	0.79	0.18	0.50	0.05
0.42	SPEED	315.45	315.15	315.16	314.76	316.24	312.15	313.13	313.23	318.77	316.18	316.65	318.83	314.98
	POWER	1.47	0.55	0.08	2.29	0.48	2.94	2.10	0.74	1.07	0.80	0.17	0.49	0.05
0.44	SPEED	315.46	315.19	315.19	314.46	316.08	312.05	314.06	313.07	319.35	316.07	316.58	318.90	315.00
	POWER	1.47	0.54	0.08	2.29	0.48	2.95	2.10	0.74	1.05	0.80	0.17	0.49	0.05
0.46	SPEED	315.46	315.23	315.21	314.16	315.85	312.06	315.00	312.98	319.77	315.95	316.45	318.96	315.01
	POWER	1.46	0.54	0.08	2.29	0.48	2.96	2.10	0.74	1.03	0.81	0.17	0.48	0.05
0.48	SPEED	315.44	315.25	315.22	313.85	315.58	312.22	315.86	312.97	320.03	315.83	316.29	319.01	315.03
	POWER	1.46	0.54	0.08	2.29	0.49	2.96	2.08	0.74	1.01	0.82	0.17	0.48	0.05
0.50	SPEED	315.41	315.26	315.21	313.56	315.27	312.50	316.57	313.05	320.10	315.72	316.10	319.06	315.04
	POWER	1.46	0.53	0.08	2.30	0.49	2.97	2.04	0.74	0.99	0.83	0.18	0.48	0.05
0.52	SPEED	315.36	315.26	315.19	313.29	314.92	312.92	317.05	313.22	319.97	315.60	315.92	319.10	315.05
	POWER	1.47	0.53	0.07	2.30	0.49	2.97	2.00	0.74	0.97	0.83	0.18	0.47	0.05
0.54	SPEED	315.29	315.24	315.16	313.06	314.56	313.45	317.28	313.47	319.65	315.52	315.75	319.14	315.06
	POWER	1.47	0.53	0.07	2.30	0.49	2.98	1.96	0.74	0.95	0.84	0.19	0.47	0.05
0.56	SPEED	315.21	315.21	315.11	312.88	314.18	314.07	317.25	313.81	319.15	315.40	315.59	319.19	315.06
	POWER	1.47	0.53	0.07	2.31	0.49	2.98	1.93	0.74	0.92	0.85	0.20	0.47	0.05
0.58	SPEED	315.12	315.17	315.06	312.77	313.81	314.75	316.98	314.19	318.50	315.32	315.47	319.23	315.06
	POWER	1.48	0.53	0.07	2.31	0.49	2.98	1.91	0.74	0.91	0.85	0.21	0.47	0.05
0.60	SPEED	315.07	315.20	315.12	312.77	313.48	315.55	316.91	314.54	318.47	315.05	316.04	318.49	315.66
	POWER	1.50	0.58	0.10	2.36	0.49	3.00	2.03	0.74	1.08	0.82	0.27	0.27	0.02
0.62	SPEED	315.00	315.21	315.17	312.86	313.19	316.34	316.67	314.92	318.28	314.76	316.57	317.46	315.73
	POWER	1.50	0.57	0.10	2.36	0.49	3.00	1.97	0.74	1.07	0.90	0.24	0.61	[illegible]
0.64	SPEED	314.93	315.20	315.21	313.03	312.95	317.07	316.29	315.32	317.95	314.51	317.03	316.62	315.72
	POWER	1.50	0.55	0.10	2.37	0.49	2.99	1.95	0.74	1.06	0.89	0.21	0.58	0.01
0.66	SPEED	314.86	315.16	315.24	313.29	312.76	317.71	315.84	315.72	317.49	314.27	317.41	315.77	315.75
	POWER	1.50	0.54	0.09	2.37	0.49	2.98	1.95	0.74	1.04	0.92	0.18	0.66	0.01
0.68	SPEED	314.81	315.12	315.26	313.62	312.64	318.22	315.39	316.11	316.94	314.06	317.69	314.95	315.76
	POWER	1.50	0.54	0.09	2.37	0.49	2.96	1.97	0.74	1.03	0.93	0.15	0.71	0.00
0.70	SPEED	314.76	315.07	315.26	314.02	312.59	318.59	314.98	316.49	316.32	313.87	317.87	314.16	315.77
	POWER	1.51	0.54	0.09	2.38	0.49	2.95	1.99	0.74	1.01	0.94	0.13	0.77	[illegible]
0.72	SPEED	314.73	315.01	315.25	314.47	312.62	318.78	314.67	316.84	315.67	313.71	317.94	313.40	315.77
	POWER	1.51	0.54	0.09	2.38	0.49	2.93	2.01	0.74	1.00	0.95	0.11	0.52	[illegible]
0.74	SPEED	314.71	314.96	315.22	314.97	312.73	318.80	314.49	317.14	315.01	313.59	317.91	312.67	315.77
	POWER	1.51	0.54	0.09	2.38	0.49	2.91	2.04	0.74	0.99	0.96	0.10	0.87	0.00
0.76	SPEED	314.71	314.92	315.18	315.50	312.93	318.64	314.45	317.38	314.37	313.50	317.76	311.97	315.77
	POWER	1.51	0.54	0.08	2.38	0.49	2.89	2.06	0.74	0.99	0.97	0.10	0.52	[illegible]
0.78	SPEED	314.72	314.88	315.12	316.03	313.20	318.32	314.64	317.56	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

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         POWER    1.51     0.54     0.08     2.30     0.49     2.87     2.07     0.74     0.99     0.97     0.10     0.96     0.00
0.80     SPEED  314.75   314.86   315.06   316.54   313.54   317.85   314.81   317.67   313.29   313.42   317.17   310.68   315.77
         POWER    1.51     0.55     0.08     2.37     0.49     2.86     2.07     0.74     0.99     0.98     0.11     1.01     0.00
0.82     SPEED  314.79   314.84   314.98   317.03   313.95   317.27   315.15   317.70   312.91   313.43   316.74   310.12   315.77
         POWER    1.51     0.55     0.08     2.37     0.49     2.84     2.07     0.74     1.00     0.98     0.12     1.05     0.00
0.84     SPEED  314.85   314.85   314.91   317.47   314.41   316.59   315.56   317.65   312.65   313.47   316.25   309.62   315.77
         POWER    1.51     0.55     0.08     2.36     0.49     2.83     2.05     0.74     1.01     0.98     0.14     1.05     0.00
0.86     SPEED  314.92   314.87   314.84   317.84   314.92   315.87   315.98   317.53   312.54   313.53   315.71   309.18   315.77
         POWER    1.51     0.55     0.07     2.35     0.49     2.82     2.03     0.74     1.02     0.97     0.16     1.05     0.00
0.88     SPEED  315.00   314.90   314.78   318.13   315.45   315.13   316.36   317.33   312.59   313.61   315.14   308.81   315.77
         POWER    1.50     0.55     0.07     2.34     0.49     2.82     2.01     0.74     1.03     0.97     0.18     1.05     0.00
0.90     SPEED  315.09   314.95   314.73   318.34   316.01   314.41   316.66   317.06   312.79   313.71   314.56   308.53   315.77
         POWER    1.50     0.55     0.07     2.33     0.49     2.82     1.98     0.74     1.03     0.95     0.21     1.05     0.00
0.92     SPEED  315.19   315.02   314.69   318.44   316.57   313.75   316.84   316.74   313.13   313.82   313.99   308.34   315.77
         POWER    1.49     0.55     0.07     2.32     0.48     2.83     1.96     0.74     1.04     0.96     0.24     1.05     0.00
0.94     SPEED  315.29   315.10   314.68   318.44   317.11   313.18   316.88   316.38   313.60   313.94   313.45   308.26   315.77
         POWER    1.48     0.55     0.07     2.31     0.48     2.84     1.94     0.74     1.05     0.95     0.27     1.05     0.00
0.96     SPEED  315.40   315.19   314.69   318.34   317.63   312.74   316.76   315.97   314.16   314.05   312.95   308.30   315.77
         POWER    1.48     0.55     0.07     2.29     0.48     2.85     1.93     0.74     1.05     0.94     0.30     1.05     0.00
0.98     SPEED  315.50   315.29   314.73   318.13   318.10   312.44   316.48   315.55   314.80   314.17   312.52   308.45   315.77
         POWER    1.47     0.54     0.07     2.28     0.48     2.87     1.93     0.74     1.06     0.93     0.33     1.05     0.00
1.00     SPEED  315.61   315.39   314.79   317.83   318.51   312.31   316.07   315.12   315.48   314.28   312.16   308.71   315.77
         POWER    1.46     0.54     0.07     2.27     0.48     2.89     1.93     0.74     1.06     0.93     0.36     1.05     0.00
1.02     SPEED  315.71   315.50   314.88   317.45   318.84   312.35   315.57   314.69   316.15   314.38   311.90   309.08   315.77
         POWER    1.46     0.53     0.07     2.26     0.48     2.90     1.95     0.74     1.06     0.92     0.38     1.05     0.00
1.04     SPEED  315.80   315.60   314.99   317.00   319.08   312.56   315.00   314.29   316.78   314.47   311.74   309.55   315.77
         POWER    1.45     0.52     0.07     2.25     0.48     2.91     1.97     0.74     1.06     0.91     0.40     1.05     0.00
1.06     SPEED  315.68   315.70   315.12   316.49   319.22   312.91   314.42   313.92   317.34   314.54   311.68   310.11   315.77
         POWER    1.44     0.52     0.07     2.24     0.47     2.92     2.01     0.74     1.05     0.91     0.42     1.05     0.00
1.08     SPEED  315.95   315.78   315.27   315.95   319.25   313.40   313.88   313.60   317.80   314.60   311.73   310.74   315.77
         POWER    1.44     0.51     0.07     2.23     0.47     2.93     2.04     0.74     1.05     0.90     0.43     1.05     0.00
1.10     SPEED  316.01   315.86   315.43   315.39   319.18   313.98   313.43   313.33   318.13   314.64   311.69   311.43   315.77
         POWER    1.43     0.50     0.07     2.22     0.47     2.94     2.08     0.74     1.03     0.90     0.43     1.01     0.00
1.12     SPEED  316.05   315.93   315.60   314.84   319.00   314.63   313.12   313.14   318.32   314.66   312.14   312.15   315.77
         POWER    1.43     0.50     0.06     2.22     0.47     2.95     2.09     0.74     1.02     0.90     0.43     0.96     0.00
1.14     SPEED  316.08   315.98   315.77   314.30   318.72   315.29   312.95   313.02   318.35   314.68   312.47   312.87   315.77
         POWER    1.43     0.49     0.06     2.22     0.48     2.95     2.10     0.74     1.01     0.90     0.42     0.91     0.00
1.16     SPEED  316.10   316.02   315.94   313.80   318.34   315.94   312.95   312.98   318.24   314.68   312.88   313.59   315.77
         POWER    1.42     0.49     0.06     2.22     0.48     2.96     2.10     0.74     0.99     0.90     0.41     0.87     0.00
1.18     SPEED  316.11   316.04   316.09   313.35   317.88   316.54   313.13   313.03   317.97   314.68   313.35   314.29   315.77
         POWER    1.42     0.48     0.06     2.22     0.48     2.96     2.10     0.74     0.98     0.90     0.39     0.82     0.00
1.20     SPEED  316.10   316.05   316.22   312.97   317.34   317.05   313.48   313.17   317.58   314.67   313.85   314.98   315.77
         POWER    1.42     0.48     0.06     2.23     0.48     2.95     2.10     0.74     0.97     0.90     0.37     0.77     0.00
1.22     SPEED  316.07   316.04   316.33   312.67   316.74   317.45   313.99   313.38   317.07   314.67   314.39   315.63   315.77
         POWER    1.42     0.48     0.05     2.24     0.48     2.95     2.10     0.74     0.96     0.90     0.35     0.73     0.00
1.24     SPEED  316.04   316.02   316.41   312.47   316.10   317.71   314.61   313.67   316.48   314.66   314.93   316.24   315.77
         POWER    1.42     0.48     0.05     2.25     0.48     2.94     2.10     0.74     0.95     0.90     0.32     0.69     0.00
1.26     SPEED  315.99   315.98   316.45   312.37   315.42   317.83   315.32   314.02   315.83   314.67   315.46   316.91   315.77
         POWER    1.42     0.48     0.05     2.26     0.48     2.92     2.09     0.74     0.94     0.90     0.29     0.65     0.00
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DATA FOR TIME VS. ANGLE(DEG)PLOTTING

TIME	KAPTAI	SIKAL-BAHA	HALI-SAHAR	ASUGANG -132-	SHAHJI-BAZAR	ASUGANG -230-	GHORASAL -230-	SIDDIR-GANG	GHORA-SAL-132	GOAL-PARA	BHERA-MARA	BOGRA	SAIDPUR
0.0	1.63	3.21	1.57	7.35	1.83	10.63	11.64	5.00	7.36	-23.47	-16.58	-16.62	-14.89
0.020	1.64	3.24	1.58	7.45	1.86	10.84	12.03	5.15	6.96	-23.31	-16.73	-16.38	-14.43
0.040	1.67	3.33	1.64	7.75	1.93	11.45	13.19	5.59	5.77	-22.84	-17.17	-15.69	-13.07
0.060	1.73	3.47	1.73	8.25	2.06	12.47	15.07	6.33	3.83	-22.07	-17.87	-14.56	-11.13
0.080	1.81	3.68	1.86	8.95	2.25	13.88	17.59	7.35	1.19	-21.01	-18.81	-13.01	-9.03
0.100	1.92	3.94	2.03	9.84	2.51	15.65	20.64	8.65	-2.07	-19.67	-19.95	-11.05	-6.94
0.120	2.08	4.26	2.25	10.94	2.86	17.77	24.11	10.24	-5.84	-18.09	-21.21	-8.73	-4.91
0.140	2.28	4.63	2.51	12.24	3.30	20.22	27.96	12.08	-10.01	-16.27	-22.56	-6.06	-3.01
0.160	2.53	5.06	2.82	13.75	3.85	22.95	31.77	14.19	-14.44	-14.25	-23.92	-3.06	-1.31
0.180	2.85	5.54	3.19	15.46	4.54	25.95	35.74	16.54	-18.99	-12.06	-25.25	0.23	0.18
0.200	3.24	6.04	3.61	17.30	5.41	28.88	38.98	18.92	-23.42	-9.71	-26.33	3.80	1.53
0.220	3.71	6.57	4.07	19.20	6.51	31.40	40.75	21.05	-27.44	-7.23	-26.95	7.60	2.78
0.240	4.29	7.12	4.59	21.14	7.85	33.48	41.07	22.94	-30.88	-4.64	-27.07	11.64	3.91
0.260	4.97	7.70	5.17	23.11	9.44	35.08	40.06	24.57	-33.66	-1.97	-26.67	15.88	4.97
0.280	5.78	8.34	5.83	25.09	11.27	36.16	37.93	25.91	-35.48	0.75	-25.75	20.31	5.97
0.300	6.70	9.04	6.56	27.04	13.33	36.72	34.95	26.93	-36.44	3.49	-24.34	24.90	6.94
0.320	7.74	9.80	7.37	28.92	15.59	36.74	31.43	27.62	-36.41	6.22	-22.49	29.65	7.88
0.340	8.89	10.63	8.26	30.69	18.01	36.22	27.67	27.97	-35.36	8.92	-20.27	34.54	8.85
0.360	10.14	11.54	9.21	32.30	20.53	35.20	24.02	27.97	-33.28	11.56	-17.76	39.55	9.72
0.380	11.48	12.52	10.24	33.69	23.09	33.71	20.77	27.63	-30.20	14.14	-15.04	44.68	10.64
0.400	12.86	13.57	11.32	34.83	25.63	31.83	18.19	26.97	-26.17	16.62	-12.20	49.90	11.57
0.420	14.33	14.67	12.45	35.68	28.09	29.65	16.52	26.03	-21.29	18.99	-9.33	55.21	12.51
0.440	15.82	15.84	13.63	36.20	30.38	27.29	15.87	24.87	-15.66	21.24	-6.50	60.60	13.47
0.460	17.32	17.05	14.82	36.37	32.46	24.87	16.29	23.56	-9.46	23.36	-3.80	66.07	14.44
0.480	18.80	18.29	16.04	36.20	34.24	22.54	17.76	22.19	-2.86	25.35	-1.26	71.59	15.42
0.500	20.25	19.55	17.25	35.67	35.79	20.47	20.13	20.87	3.92	27.22	1.08	77.17	16.43
0.520	21.66	20.81	18.44	34.83	36.77	18.81	23.18	19.68	10.66	28.92	3.22	82.81	17.45
0.540	22.99	22.07	19.61	33.70	37.44	17.69	26.65	18.75	17.15	30.51	5.14	88.49	18.48
0.560	24.25	23.29	20.73	32.33	37.68	17.24	30.23	18.15	23.17	31.99	6.88	94.22	19.51
0.580	25.40	24.48	21.79	30.80	37.49	17.53	33.63	17.95	28.53	33.37	8.46	100.01	20.55
0.600	26.47	25.67	22.86	29.20	36.90	18.67	36.85	18.21	33.50	34.54	10.29	105.39	21.92
0.620	27.48	26.87	23.99	27.66	35.95	20.72	39.88	18.85	38.34	35.40	12.76	109.76	23.68
0.640	28.40	28.07	25.17	26.26	34.70	23.65	42.55	19.95	42.89	35.94	15.80	113.07	25.48
0.660	29.24	29.24	26.40	25.12	33.20	27.37	44.75	21.52	46.98	36.21	19.31	115.40	27.28
0.680	30.01	30.37	27.65	24.30	31.53	31.75	46.43	23.54	50.50	36.21	23.21	116.77	29.11
0.700	30.73	31.44	28.92	23.91	29.75	36.63	47.61	26.01	53.34	35.99	27.37	117.23	30.95
0.720	31.40	32.46	30.18	24.01	27.97	41.83	48.38	28.89	55.45	35.57	31.68	116.80	32.80
0.740	32.05	33.41	31.42	24.66	26.27	47.16	48.86	32.13	56.80	34.98	36.01	115.51	34.64
0.760	32.68	34.31	32.61	25.89	24.74	52.40	49.22	35.69	57.41	34.28	40.23	113.40	36.49
0.780	33.32	35.16	33.75	27.73	23.48	57.36	49.63	39.55	57.32	33.49	44.22	110.51	38.34
0.800	33.98	35.97	34.82	30.17	22.58	61.87	50.23	43.47	55.61	32.66	47.87	106.88	40.19
0.820	34.68	36.77	35.80	33.19	22.10	65.77	51.18	47.52	55.39	31.82	51.08	102.57	42.04
0.840	35.45	37.56	36.71	36.73	22.12	68.96	52.56	51.56	53.81	31.01	53.77	97.65	43.89
0.860	36.28	38.36	37.53	40.75	22.70	71.34	54.41	55.50	52.01	30.26	55.87	92.19	45.74
0.880	37.20	39.19	38.28	45.14	23.89	72.88	56.72	59.25	50.18	29.56	57.33	86.27	47.59
0.900	38.22	40.08	38.96	49.82	25.68	73.59	59.43	62.74	48.49	29.01	58.12	79.97	49.43
0.920	39.35	41.03	39.59	54.67	28.13	73.50	62.42	65.93	47.11	28.56	58.26	73.41	51.28
0.940	40.59	42.06	40.20	59.59	31.20	72.70	65.53	68.65	46.19	28.23	57.75	66.69	53.13
0.960	41.95	43.20	40.81	64.44	34.88	71.32	68.59	70.97	45.87	28.04	56.65	59.94	54.98
0.980	43.43	44.44	41.44	69.12	39.13	69.52	71.42	72.81	46.24	27.99	55.01	53.30	56.83
1.000	45.03	45.79	42.13	73.51	43.89	67.46	73.86	74.15	47.37	28.07	52.92	46.90	58.68
1.020	46.75	47.27	42.90	77.51	49.07	65.36	75.78	75.01	49.27	28.26	50.47	40.86	60.53
1.040	48.57	48.86	43.79	81.03	54.58	63.39	77.07	75.39	51.92	28.57	47.78	35.31	62.38
1.060	50.50	50.57	44.82	84.00	60.30	61.76	77.70	75.33	55.26	28.96	44.97	30.35	64.22
1.080	52.51	52.39	46.01	86.36	66.13	60.61	77.69	74.87	59.18	29.43	42.16	26.06	65.07
1.100	54.60	54.30	47.38	88.10	71.94	60.07	77.12	74.07	63.55	29.95	39.46	22.54	67.92
1.120	56.74	56.30	48.94	89.20	77.60	60.24	76.10	73.01	68.23	30.51	36.99	19.82	69.77
1.140	58.93	58.36	50.59	89.67	82.99	61.16	74.80	71.77	73.03	31.10	34.86	17.93	71.62
1.160	61.15	60.48	52.64	89.54	88.01	62.84	73.41	70.44	77.78	31.70	33.15	16.86	73.47
1.180	63.38	62.63	54.77	88.87	92.54	65.23	72.13	69.12	82.31	32.30	31.95	16.61	75.32
1.200	65.51	64.80	57.06	87.73	96.50	68.26	71.15	67.91	85.47	32.89	31.31	17.15	77.17
1.220	67.82	66.97	59.48	86.19	99.81	71.81	70.66	66.89	90.11	33.48	31.27	18.46	79.01
1.240	69.99	69.12	62.02	84.37	102.40	75.74	70.82	66.15	93.12	34.06	31.84	20.50	80.86
1.260	72.12	71.24	64.63	82.37	104.24	79.89	71.75	65.82	95.41	34.64	33.03	23.21	82.71

GRAPH FOR FAULT CLEARED AT 8 CYCLES LATER & RECLOSE AFTER 28 CYCLES

REFFERENCE MACHINE 9 IS GHORASAL-132

3-PHASE FAULT AT SIDDIRGANG

FAULT TYPE = 3

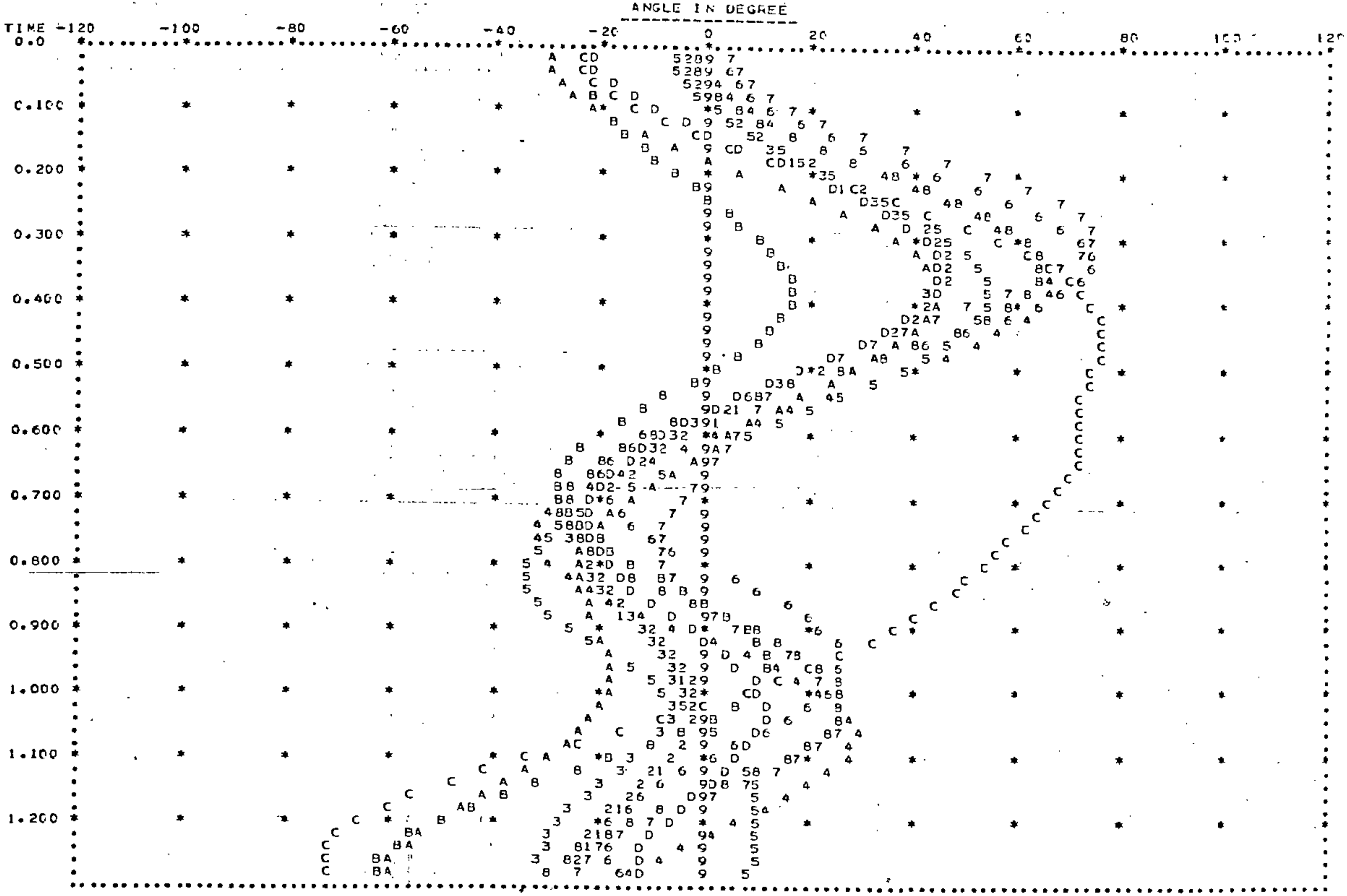

Fig. 6.13 (With Governor)

* * * MEANING OF THE CODES * * *

1=KAPTAI 2=SIKALBAHA 3=HALISHAHAR 4=ASHUGANG-132 5=SHAHJIBAZAR 6=ASHUGANG-230 7=GHORASAL-230

8=SIDDIRGANG 9=GHORASAL-132 A=GOALPARA B=BHERAMARA C=BOGRA D=SAIDPUR

DATA FOR TIME VS. ANGLE(DEG) PLOTTING

TIME	KAPTAI	SIKAL-BAHA	HALI-SAHAR	ASUGANG -132-	SHAHJI-BAZAR	ASUGANG -230-	GHORASAL -230-	SIDDIR-GANG	GHORA-SAL-132	GGAL-PARA	BHERA-MARA	BOGRA	SAIDPUR
0.0	1.63	3.21	1.57	7.35	1.83	10.63	11.64	5.00	7.36	-23.47	-16.58	-16.62	-14.89
0.020	1.64	3.24	1.58	7.45	1.86	10.84	12.03	5.15	5.96	-23.31	-16.73	-16.38	-14.43
0.040	1.67	3.33	1.64	7.75	1.93	11.45	13.19	5.59	5.77	-22.84	-17.17	-15.69	-13.07
0.060	1.73	3.47	1.73	8.25	2.06	12.47	15.07	6.33	3.83	-22.07	-17.87	-14.56	-11.13
0.080	1.81	3.68	1.86	8.95	2.25	13.88	17.59	7.35	1.19	-21.01	-18.81	-13.00	-9.03
0.100	1.92	3.94	2.03	9.84	2.51	15.65	20.64	8.65	-2.07	-19.67	-19.95	-11.05	-6.94
0.120	2.08	4.26	2.25	10.94	2.86	17.77	24.11	10.24	-5.84	-18.09	-21.21	-8.73	-4.91
0.140	2.28	4.63	2.51	12.24	3.30	20.22	27.86	12.08	-10.01	-16.27	-22.56	-6.06	-3.01
0.160	2.53	5.06	2.82	13.75	3.85	22.95	31.77	14.19	-14.44	-14.25	-23.92	-3.06	-1.31
0.180	2.85	5.54	3.19	15.46	4.54	25.95	35.74	16.54	-18.99	-12.00	-25.25	0.23	0.18
0.200	3.24	6.04	3.61	17.30	5.41	28.88	38.98	18.90	-23.42	-9.71	-26.33	3.80	1.53
0.220	3.71	6.57	4.07	19.20	6.51	31.40	40.75	21.05	-27.44	-7.23	-26.95	7.60	2.78
0.240	4.29	7.12	4.59	21.14	7.85	33.48	41.07	22.94	-30.88	-4.64	-27.07	11.64	3.91
0.260	4.97	7.70	5.17	23.11	9.44	35.08	40.06	24.57	-33.60	-1.97	-26.67	15.89	4.97
0.280	5.78	8.34	5.83	25.09	11.27	36.16	37.93	25.91	-35.48	0.75	-25.75	20.31	5.97
0.300	6.70	9.04	6.56	27.04	13.33	36.72	34.95	26.93	-36.44	3.49	-24.34	24.94	6.94
0.320	7.74	9.80	7.37	28.92	15.59	36.74	31.43	27.62	-36.41	6.22	-22.49	29.65	7.88
0.340	8.89	10.63	8.26	30.69	18.01	36.22	27.67	27.97	-35.36	8.92	-20.27	34.54	8.90
0.360	10.14	11.54	9.21	32.30	20.53	35.20	24.02	27.97	-33.28	11.56	-17.76	39.55	9.72
0.380	11.48	12.52	10.24	33.69	23.09	33.71	20.77	27.63	-30.20	14.14	-15.04	44.68	10.64
0.400	12.68	13.57	11.32	34.83	25.63	31.83	18.19	26.97	-26.17	16.62	-12.20	49.93	11.57
0.420	14.33	14.67	12.45	35.68	28.09	29.65	16.52	26.03	-21.29	18.99	-9.33	55.21	12.51
0.440	15.92	15.84	13.63	36.20	30.38	27.29	15.87	24.87	-15.66	21.24	-6.50	60.60	13.47
0.460	17.32	17.05	14.82	36.37	32.46	24.87	16.29	23.55	-9.46	23.36	-3.80	66.07	14.44
0.480	18.80	18.29	16.04	36.20	34.24	22.54	17.76	22.19	-2.86	25.35	-1.26	71.59	15.42
0.500	20.25	19.55	17.25	35.67	35.70	20.47	20.13	20.87	3.92	27.20	1.08	77.17	15.43
0.520	21.66	20.81	18.44	34.83	36.77	18.81	23.18	19.68	10.66	28.92	3.22	82.81	17.45
0.540	22.99	22.07	19.51	33.70	37.44	17.69	26.65	18.75	17.15	30.51	5.14	88.49	18.48
0.560	24.25	23.29	20.73	32.33	37.68	17.24	30.23	18.15	23.17	31.99	6.88	94.22	19.51
0.580	25.40	24.48	21.79	30.80	37.49	17.53	33.63	17.95	28.53	33.37	8.46	100.01	20.55
0.600	26.50	25.71	22.88	29.28	36.98	18.66	37.16	18.27	33.21	34.70	9.96	105.96	21.79
0.620	27.59	27.03	24.08	27.96	36.26	20.70	41.16	19.10	37.26	36.04	11.48	112.05	23.15
0.640	28.65	28.42	25.37	26.87	35.35	23.62	45.46	20.45	40.60	37.39	13.00	118.19	24.33
0.660	29.68	29.85	26.74	26.06	34.27	27.38	49.91	22.35	43.20	38.77	14.56	124.43	25.44
0.680	30.68	31.29	28.19	25.58	33.07	31.91	54.38	24.75	45.02	40.18	16.17	130.76	26.52
0.700	31.66	32.73	29.68	25.47	31.78	37.13	58.75	27.64	46.07	41.63	17.85	137.19	27.60
0.720	32.62	34.15	31.20	25.78	30.45	42.94	62.96	31.01	45.37	43.13	19.61	143.73	28.67
0.740	33.57	35.53	32.72	26.54	29.15	49.23	66.95	34.81	45.98	44.68	21.46	150.37	29.74
0.760	34.50	36.81	34.19	27.84	27.98	55.60	69.95	38.93	44.87	46.25	23.41	157.13	30.81
0.780	35.39	37.94	35.57	29.74	27.00	61.60	71.22	43.19	43.08	47.80	25.44	163.99	31.86
0.800	36.26	38.95	36.83	32.26	26.38	67.04	70.91	47.47	40.77	49.34	27.56	170.98	32.92
0.820	37.13	39.85	37.97	35.42	26.17	71.75	69.31	51.65	38.11	50.86	29.71	178.10	34.00
0.840	38.03	40.65	38.99	39.16	26.46	75.58	66.76	55.62	35.26	52.37	31.83	185.37	35.09
0.860	38.96	41.40	39.89	43.43	27.31	78.40	63.68	59.21	32.39	53.85	33.85	192.81	36.21
0.880	39.95	42.11	40.67	48.13	28.74	80.14	60.49	62.33	29.66	55.29	35.70	200.44	37.34
0.900	41.00	42.83	41.35	53.16	30.79	80.76	57.59	64.87	27.21	56.68	37.28	208.29	38.48
0.920	42.13	43.57	41.94	58.38	33.46	80.28	55.32	66.75	25.16	58.01	38.53	216.35	39.64
0.940	43.33	44.37	42.46	63.66	36.73	78.75	53.99	67.98	23.61	59.27	39.38	224.67	40.80
0.960	44.62	45.26	42.95	68.84	40.57	76.31	53.77	68.53	22.64	60.44	39.80	233.27	41.98
0.980	46.00	46.26	43.44	73.80	44.92	73.12	54.76	68.45	22.31	61.51	39.77	242.17	43.18
1.000	47.46	47.38	43.95	78.37	49.70	69.42	56.89	67.82	22.65	62.48	39.30	251.38	44.39
1.020	49.00	48.63	44.53	82.45	54.83	65.46	59.99	66.75	23.64	63.33	38.40	260.94	45.63
1.040	50.62	50.02	45.20	85.91	60.19	61.53	63.80	65.41	25.28	64.07	37.15	270.84	46.89
1.060	52.30	51.55	46.00	88.69	65.67	57.94	67.94	63.92	27.51	64.68	35.62	281.10	48.17
1.080	54.05	53.21	46.96	90.72	71.13	54.96	72.06	62.47	30.26	65.17	33.90	291.73	49.48
1.100	55.84	54.98	48.08	91.97	76.46	52.83	75.79	61.22	33.44	65.54	32.10	302.71	50.82
1.120	57.66	56.85	49.40	92.43	81.54	51.75	78.85	60.32	36.92	65.80	30.34	314.03	52.19
1.140	59.52	58.79	50.91	92.14	86.24	51.84	81.04	59.83	40.60	65.94	28.76	325.67	53.58
1.160	61.38	60.79	52.62	91.13	90.46	53.17	82.24	60.03	44.34	65.99	27.47	337.59	55.01
1.180	63.24	62.82	54.52	89.46	94.11	55.71	82.45	60.78	48.01	65.95	26.60	349.73	56.47
1.200	65.10	64.84	56.59	87.24	97.10	59.39	81.74	62.16	51.50	65.84	26.25	362.07	57.95
1.220	66.92	66.85	58.80	84.55	99.36	64.05	80.29	64.12	54.70	65.68	26.52	374.56	59.45
1.240	68.71	68.79	61.11	81.54	100.85	69.45	78.35	66.61	57.51	65.48	27.47	387.13	60.97
1.260	70.44	70.66	63.50	78.35	101.53	75.34	76.21	69.50	59.87	65.27	29.13	399.75	62.49

GRAPH FOR SUSTAINED FAULT CLEARED AT 8 CYCLES LATER,RECLOSES AFTER 28 CYCLES & THEN OPEN AFTER 36 CYCLES

REFFERENCE MACHINE 9 IS GHORASAL-132

3-PHASE FAULT AT SIDDIRGANG

FAULT TYPE = 3

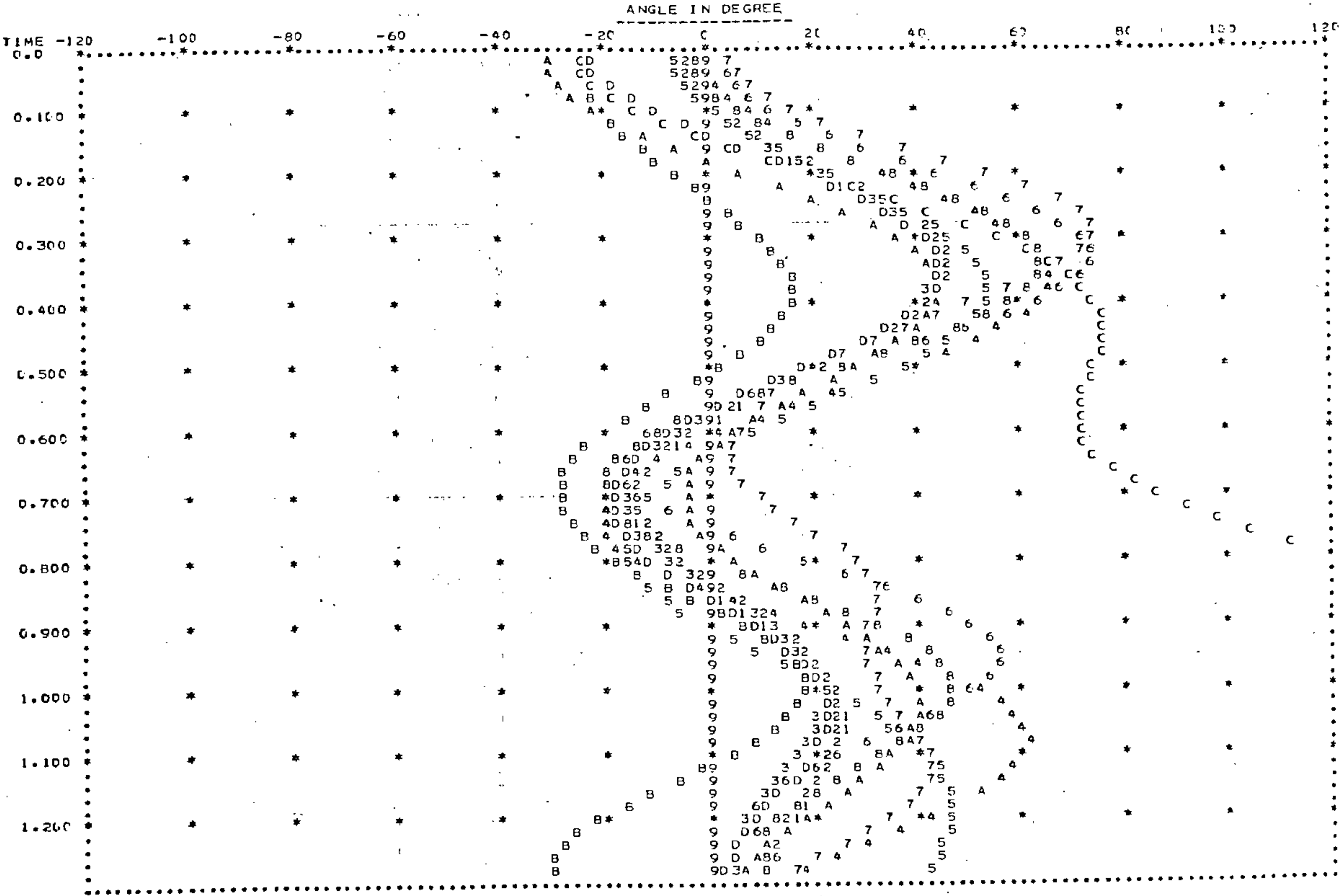

Fig. 6.14 (With Governor)

* * * MEANING OF THE CODES * * *

1=KAPTAI
2=SIKALBAHA
3=HALISHAHAR
4=ASHUGANG-132
5=SHAHJIBAZAR
6=ASHUGANG-230
7=GHORASAL-230
8=SIDDIRGANG
9=GHORASAL-132
A=GOALPARA
B=BHERAMARA
C=BOGRA
D=SAIDPUR

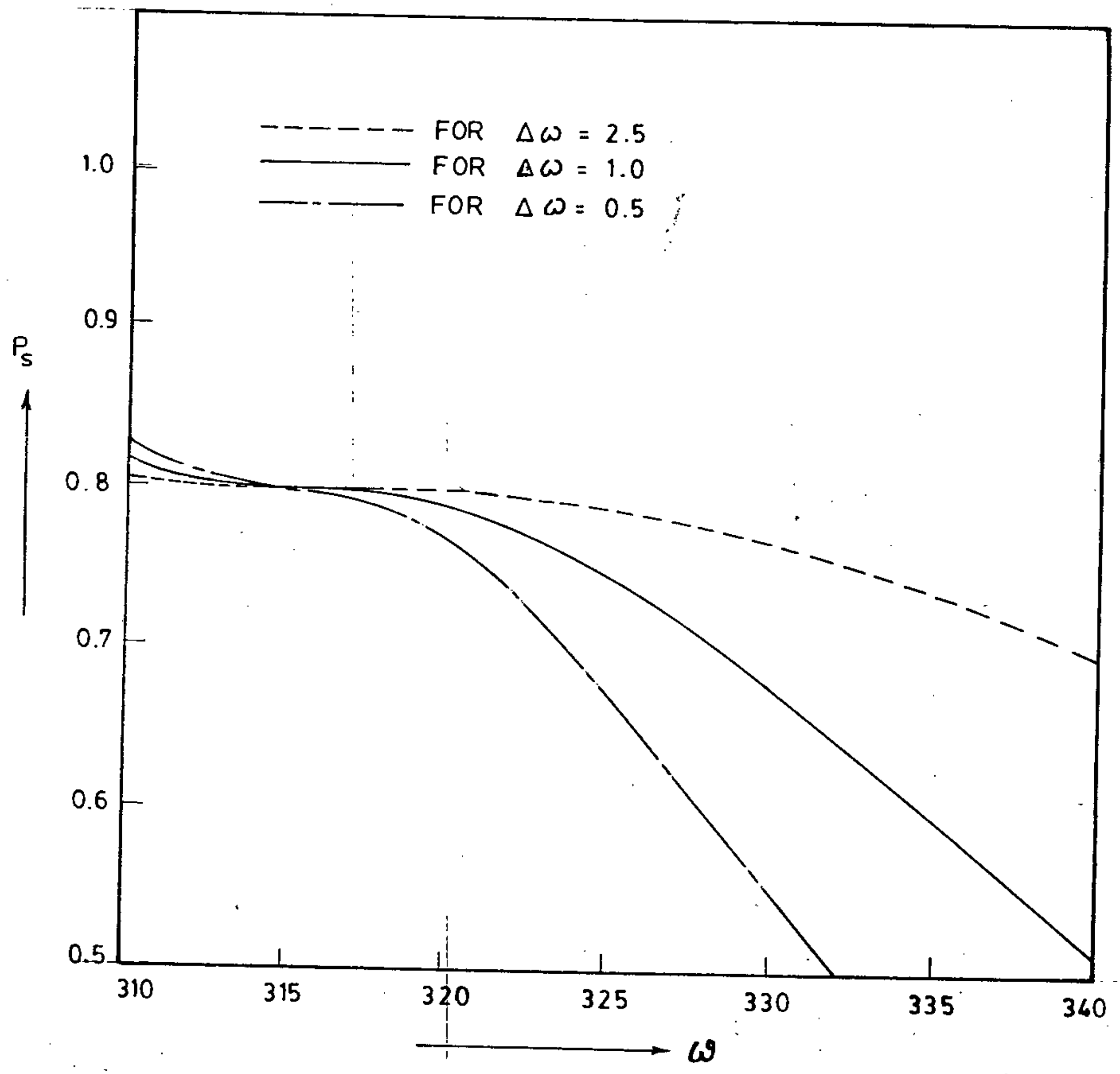

FIG. 6.15: CURVE FOR SHAFT POWER VS. ROTOR SPEED OF BOGRA -132 GENERATOR.

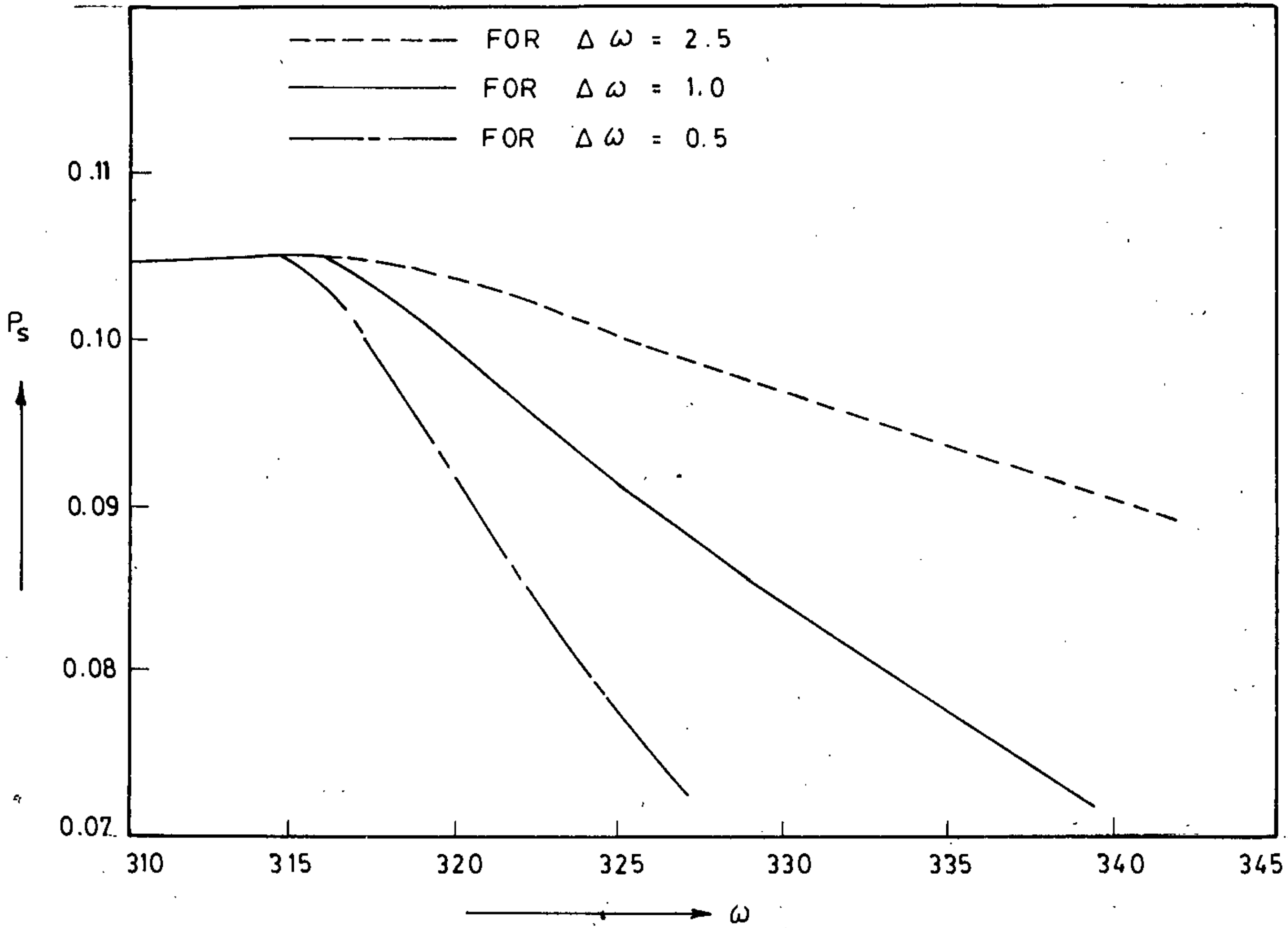

FIG. 6.16: CURVE FOR SHAFT POWER VS. ROTOR SPEED OF SAIDPUR 132 GENERATOR.

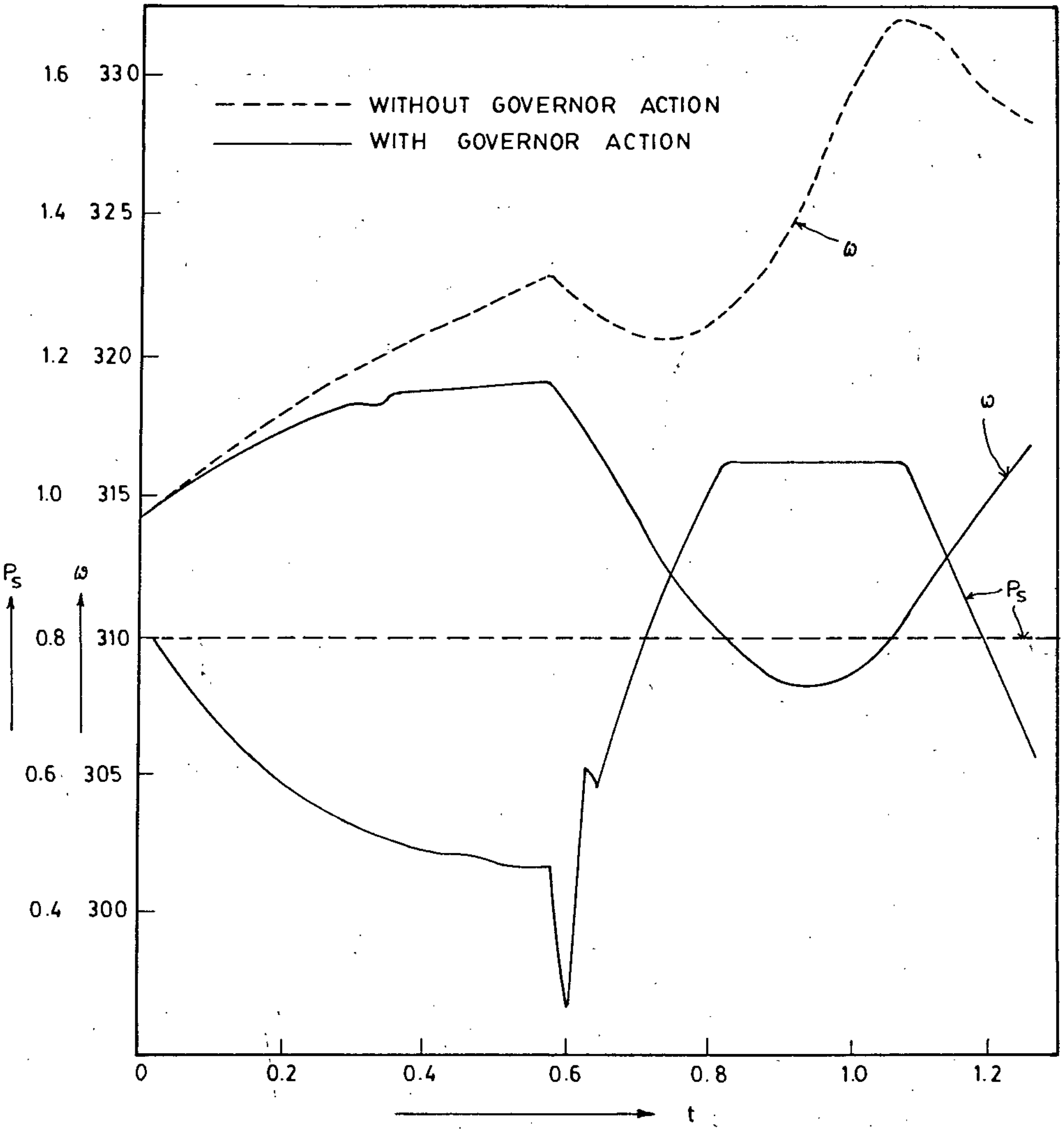

FIG. 6.17: VARIATION OF SHAFT POWER AND ROTOR SPEED WITH TIME (BOGRA - 132 GENERATOR).

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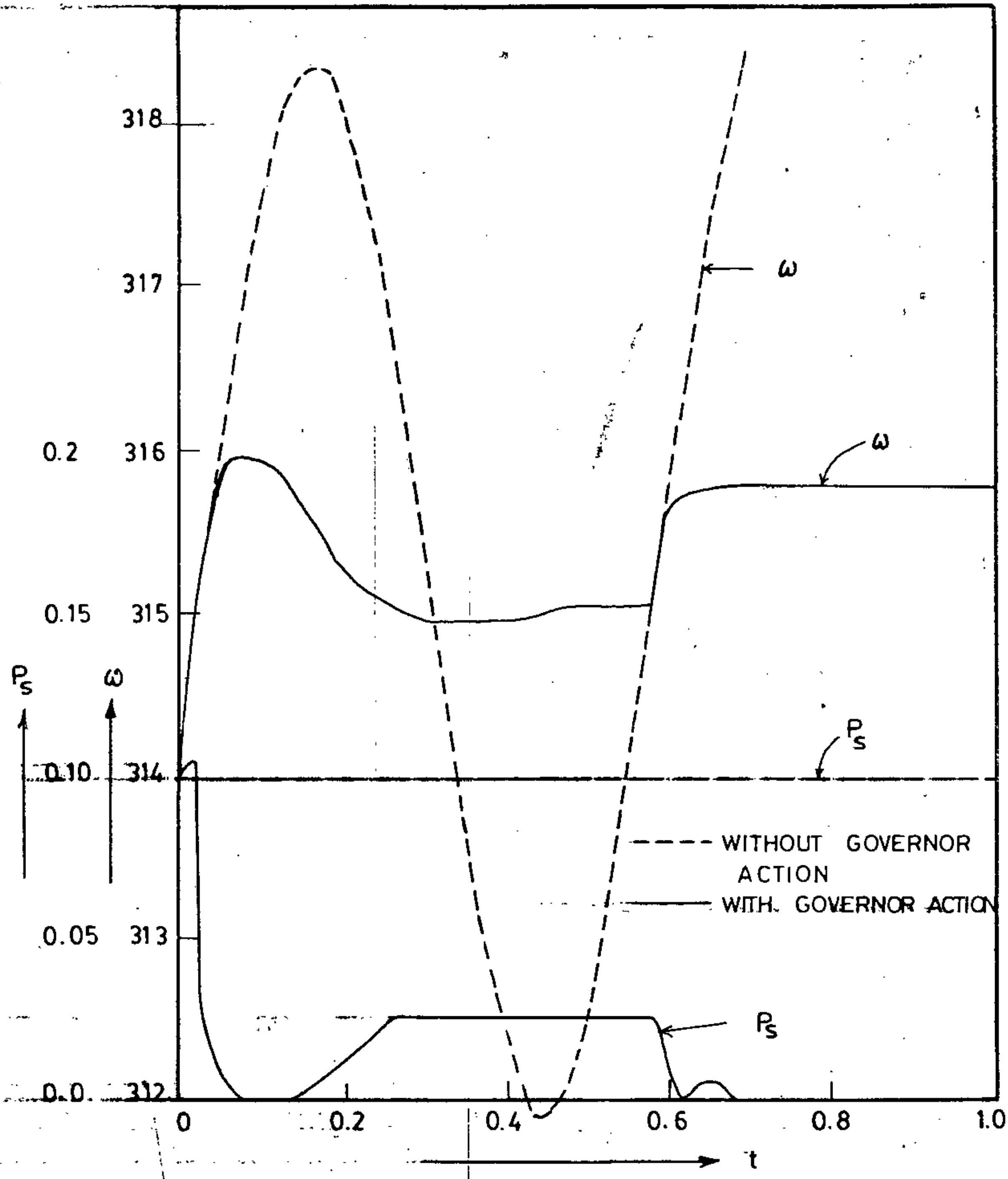

FIG. 6.18: VARIATION OF SHAFT POWER AND ROTOR SPEED WITH TIME (SAIDPUR-132 GENERATOR).

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                                                              Z-BUS DURING FAULT
                                   FAULTED BUS IS TONGI-230   ------------------
                                   ------------------------                                                     FAULT TYPE = 1
                  MAG    ANGLE                     MAG    ANGLE                    MAG    ANGLE                 ---------------
----------------------------------------------------------------------------------------------------  MAG    ANGLE               MAG    ANGLE
  Z( 1, 1)=     0.29    79.75 Z( 1, 2)=     1.19   101.36 Z( 1, 3)=     6.04   101.63 Z( 1, 4)=     3.05    98.15 Z( 1, 5)=     7.89    95.75
Z( 1, 6)=     6.68   102.73 Z( 1, 7)=    13.53   103.71 Z( 1, 8)=    10.43   101.38 Z( 1, 9)=     8.98    97.76 Z( 1,10)=    45.47   102.88
Z( 1,11)=    61.01   109.32 Z( 1,12)=    55.91   108.11 Z( 1,13)=   852.82   113.59 Z( 2, 1)=     1.19   101.36 Z( 2, 2)=     0.56    87.21
Z( 2, 3)=    15.20   103.62 Z( 2, 4)=     8.36   100.03 Z( 2, 5)=    21.62    97.62 Z( 2, 6)=    18.29   104.61 Z( 2, 7)=    37.07   105.58
Z( 2, 8)=    28.59   103.26 Z( 2, 9)=    24.61    99.63 Z( 2,10)=   124.58   104.76 Z( 2,11)=   167.15   111.20 Z( 2,12)=   153.16   109.98
Z( 2,13)=  2336.40   115.47 Z( 3, 1)=     6.04   101.63 Z( 3, 2)=    15.20   103.62 Z( 3, 3)=     2.49    89.41 Z( 3, 4)=    43.87   100.24
Z( 3, 5)=   113.43    97.84 Z( 3, 6)=    95.96   104.82 Z( 3, 7)=   194.47   105.80 Z( 3, 8)=   149.98   103.47 Z( 3, 9)=   129.14    99.84
Z( 3,10)=   653.60   104.97 Z( 3,11)=   876.94   111.41 Z( 3,12)=   803.59   110.19 Z( 3,13)=12258.11   115.68 Z( 4, 1)=     3.05    98.15
Z( 4, 2)=     8.36   100.03 Z( 4, 3)=    43.87   100.24 Z( 4, 4)=     0.14    87.45 Z( 4, 5)=     1.05    95.06 Z( 4, 6)=     1.08   102.08
Z( 4, 7)=     2.65   101.89 Z( 4, 8)=     3.85    99.35 Z( 4, 9)=     1.80    95.96 Z( 4,10)=     9.88   100.52 Z( 4,11)=    13.26   106.96
Z( 4,12)=    12.15   105.75 Z( 4,13)=   185.32   111.23 Z( 5, 1)=     7.89    95.75 Z( 5, 2)=    21.62    97.62 Z( 5, 3)=   113.43    97.84
Z( 5, 4)=     1.05    95.06 Z( 5, 5)=     0.29    85.83 Z( 5, 6)=     2.80    99.67 Z( 5, 7)=     6.85    99.49 Z( 5, 8)=     9.95    96.94
Z( 5, 9)=     4.65    93.55 Z( 5,10)=    25.55    98.12 Z( 5,11)=    34.28   104.56 Z( 5,12)=    31.41   103.34 Z( 5,13)=   479.20   108.83
Z( 6, 1)=     6.68   102.73 Z( 6, 2)=    18.29   104.61 Z( 6, 3)=    95.96   104.82 Z( 6, 4)=     1.08   102.08 Z( 6, 5)=     2.80    99.67
Z( 6, 6)=     0.13    87.99 Z( 6, 7)=     1.62    97.74 Z( 6, 8)=     5.52   104.42 Z( 6, 9)=     2.92   101.85 Z( 6,10)=     6.53    96.51
Z( 6,11)=     8.76   102.95 Z( 6,12)=     8.03   101.74 Z( 6,13)=   122.49   107.23 Z( 7, 1)=    13.53   103.71 Z( 7, 2)=    37.07   105.58
Z( 7, 3)=   194.47   105.80 Z( 7, 4)=     2.65   101.89 Z( 7, 5)=     6.85    99.49 Z( 7, 6)=     1.62    97.74 Z( 7, 7)=     0.18    89.15
Z( 7, 8)=     8.88   106.81 Z( 7, 9)=     4.95   104.40 Z( 7,10)=     8.64    98.24 Z( 7,11)=    11.59   104.68 Z( 7,12)=    10.62   103.47
Z( 7,13)=   161.96   108.96 Z( 8, 1)=    10.43   101.38 Z( 8, 2)=    28.59   103.26 Z( 8, 3)=   149.98   103.47 Z( 8, 4)=     3.85    99.35
Z( 8, 5)=     9.95    96.94 Z( 8, 6)=     5.52   104.42 Z( 8, 7)=     8.88   106.81 Z( 8, 8)=     0.44    88.65 Z( 8, 9)=     5.77   100.81
Z( 8,10)=    27.14   106.29 Z( 8,11)=    36.42   112.73 Z( 8,12)=    33.37   111.52 Z( 8,13)=   509.09   117.01 Z( 9, 1)=     8.98    97.76
Z( 9, 2)=    24.61    99.63 Z( 9, 3)=   129.14    99.84 Z( 9, 4)=     1.80    95.96 Z( 9, 5)=     4.65    93.55 Z( 9, 6)=     2.92   101.85
Z( 9, 7)=     4.95   104.40 Z( 9, 8)=     5.77   100.81 Z( 9, 9)=     0.27    88.73 Z( 9,10)=    17.91   103.03 Z( 9,11)=    24.03   109.46
Z( 9,12)=    22.02   108.25 Z( 9,13)=   335.92   113.74 Z(10, 1)=    45.47   102.88 Z(10, 2)=   124.58   104.76 Z(10, 3)=   653.60   104.97
Z(10, 4)=     9.88   100.52 Z(10, 5)=    25.55    98.12 Z(10, 6)=     6.53    96.51 Z(10, 7)=     8.64    99.24 Z(10, 8)=    27.14   106.29
Z(10, 9)=    17.91   103.03 Z(10,10)=     0.26    72.30 Z(10,11)=     1.90    96.95 Z(10,12)=     2.20    94.52 Z(10,13)=    33.50   100.01
Z(11, 1)=    61.01   109.32 Z(11, 2)=   167.15   111.20 Z(11, 3)=   876.94   111.41 Z(11, 4)=    13.26   106.96 Z(11, 5)=    34.28   104.56
Z(11, 6)=     8.76   102.95 Z(11, 7)=    11.59   104.68 Z(11, 8)=    36.42   112.73 Z(11, 9)=    24.03   109.46 Z(11,10)=     1.90    96.95
Z(11,11)=     0.42    87.77 Z(11,12)=     2.95   100.96 Z(11,13)=    44.95   106.45 Z(12, 1)=    55.91   108.11 Z(12, 2)=   153.16   109.98
Z(12, 3)=   803.59   110.19 Z(12, 4)=    12.15   105.75 Z(12, 5)=    31.41   103.34 Z(12, 6)=     8.03   101.74 Z(12, 7)=    10.62   103.47
Z(12, 8)=    33.37   111.52 Z(12, 9)=    22.02   108.25 Z(12,10)=     2.20    94.52 Z(12,11)=     2.95   100.96 Z(12,12)=     0.36    79.16
Z(12,13)=     7.91   111.07 Z(13, 1)=   852.82   113.59 Z(13, 2)=  2336.41   115.47 Z(13, 3)=12258.14   115.68 Z(13, 4)=   185.32   111.23
Z(13, 5)=   479.20   108.83 Z(13, 6)=   122.49   107.23 Z(13, 7)=   161.96   108.96 Z(13, 8)=   509.09   117.01 Z(13, 9)=   335.92   113.74
Z(13,10)=    33.50   100.01 Z(13,11)=    44.95   106.45 Z(13,12)=     7.91   111.07 Z(13,13)=     3.31    88.00 Z(
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                                                    Z-BUS AFTER CLEARING THE FAULT
                                  FAULTED BUS IS TONGI-230      ------------------------------
                                  ------------------------                                                  FAULT TYPE = 1
                   MAG    ANGLE                  MAG   ANGLE                    MAG    ANGLE                 MAG    ANGLE                 MAG    ANGLE
---------------------------------------------------------------------------------------------------------------------------------------------------
  Z( 1, 1)=      0.29    79.62 Z( 1, 2)=      1.18  101.41 Z( 1, 3)=      6.00  101.67 Z( 1, 4)=      2.42   99.21 Z( 1, 5)=      6.27   96.81
  Z( 1, 6)=      3.53   101.06 Z( 1, 7)=      5.69  102.13 Z( 1, 8)=      8.09  103.04 Z( 1, 9)=      6.36  100.12 Z( 1,10)=     18.46  101.16
  Z( 1,11)=     24.76   107.60 Z( 1,12)=     22.69  106.39 Z( 1,13)=    346.13  111.88 Z( 2, 1)=      1.18  101.41 Z( 2, 2)=      0.56   87.18
  Z( 2, 3)=     15.10   103.65 Z( 2, 4)=      6.64  101.09 Z( 2, 5)=     17.18   98.68 Z( 2, 6)=      9.66  102.94 Z( 2, 7)=     15.59  104.01
  Z( 2, 8)=     22.16   104.91 Z( 2, 9)=     17.44  101.99 Z( 2,10)=     50.56  103.04 Z( 2,11)=     67.84  109.48 Z( 2,12)=     62.16  108.27
  Z( 2,13)=    948.27   113.75 Z( 3, 1)=      6.00  101.67 Z( 3, 2)=     15.10  103.65 Z( 3, 3)=      2.49   89.41 Z( 3, 4)=     34.86  101.30
  Z( 3, 5)=     90.13    98.89 Z( 3, 6)=     50.70  103.15 Z( 3, 7)=     81.81  104.22 Z( 3, 8)=    116.25  105.12 Z( 3, 9)=     91.48  102.20
  Z( 3,10)=    265.27   103.25 Z( 3,11)=    355.92  109.69 Z( 3,12)=    326.15  108.48 Z( 3,13)=   4975.16  113.97 Z( 4, 1)=      2.42   99.21
  Z( 4, 2)=      6.64   101.09 Z( 4, 3)=     34.86  101.30 Z( 4, 4)=      0.14   86.64 Z( 4, 5)=      0.90   95.59 Z( 4, 6)=      0.64  100.01
  Z( 4, 7)=      1.15   100.19 Z( 4, 8)=      2.53  101.83 Z( 4, 9)=      1.28   98.18 Z( 4,10)=      3.89   98.90 Z( 4,11)=      5.22  105.34
  Z( 4,12)=      4.78   104.13 Z( 4,13)=     72.98  109.62 Z( 5, 1)=      6.27   96.81 Z( 5, 2)=     17.18   98.68 Z( 5, 3)=     90.13   98.89
  Z( 5, 4)=      0.90    95.59 Z( 5, 5)=      0.29   85.65 Z( 5, 6)=      1.65   97.61 Z( 5, 7)=      2.96   97.78 Z( 5, 8)=      6.55   99.43
  Z( 5, 9)=      3.32    95.78 Z( 5,10)=     10.06   96.50 Z( 5,11)=     13.50  102.94 Z( 5,12)=     12.37  101.73 Z( 5,13)=    188.72  107.21
  Z( 6, 1)=      3.53   101.06 Z( 6, 2)=      9.66  102.94 Z( 6, 3)=     50.70  103.15 Z( 6, 4)=      0.64  100.01 Z( 6, 5)=      1.65   97.61
  Z( 6, 6)=      0.14    87.25 Z( 6, 7)=      0.72   96.09 Z( 6, 8)=      2.53  103.37 Z( 6, 9)=      1.44  100.71 Z( 6,10)=      2.51   94.81
  Z( 6,11)=      3.37   101.25 Z( 6,12)=      3.09  100.04 Z( 6,13)=     47.13  105.52 Z( 7, 1)=      5.69  102.13 Z( 7, 2)=     15.59  104.01
  Z( 7, 3)=     81.81   104.22 Z( 7, 4)=      1.15  100.19 Z( 7, 5)=      2.96   97.78 Z( 7, 6)=      0.72   96.09 Z( 7, 7)=      0.20   88.27
  Z( 7, 8)=      3.64   105.31 Z( 7, 9)=      2.12  102.69 Z( 7,10)=      3.31   96.57 Z( 7,11)=      4.44  103.01 Z( 7,12)=      4.07  101.80
  Z( 7,13)=     62.11   107.29 Z( 8, 1)=      8.09  103.04 Z( 8, 2)=     22.16  104.91 Z( 8, 3)=    116.25  105.12 Z( 8, 4)=      2.53  101.83
  Z( 8, 5)=      6.55    99.43 Z( 8, 6)=      2.53  103.37 Z( 8, 7)=      3.64  105.31 Z( 8, 8)=      0.44   88.20 Z( 8, 9)=      4.06  103.28
  Z( 8,10)=     11.30   104.55 Z( 8,11)=     15.16  110.99 Z( 8,12)=     13.90  109.78 Z( 8,13)=    211.97  115.26 Z( 9, 1)=      6.36  100.12
  Z( 9, 2)=     17.44   101.99 Z( 9, 3)=     91.48  102.20 Z( 9, 4)=      1.28   98.18 Z( 9, 5)=      3.32   95.78 Z( 9, 6)=      1.44  100.71
  Z( 9, 7)=      2.12   102.69 Z( 9, 8)=      4.06  103.28 Z( 9, 9)=      0.28   88.14 Z( 9,10)=      7.12  101.43 Z( 9,11)=      9.55  107.87
  Z( 9,12)=      8.75   106.65 Z( 9,13)=    133.48  112.14 Z(10, 1)=     18.46  101.16 Z(10, 2)=     50.56  103.04 Z(10, 3)=    265.27  103.25
  Z(10, 4)=      3.89    98.90 Z(10, 5)=     10.06   96.50 Z(10, 6)=      2.51   94.81 Z(10, 7)=      3.31   96.57 Z(10, 8)=     11.30  104.55
  Z(10, 9)=      7.12   101.43 Z(10,10)=      0.26   71.96 Z(10,11)=      1.75   97.27 Z(10,12)=      1.98   95.03 Z(10,13)=     30.28  100.52
  Z(11, 1)=     24.76   107.60 Z(11, 2)=     67.84  109.48 Z(11, 3)=    355.92  109.69 Z(11, 4)=      5.22  105.34 Z(11, 5)=     13.50  102.94
  Z(11, 6)=      3.37   101.25 Z(11, 7)=      4.44  103.01 Z(11, 8)=     15.16  110.99 Z(11, 9)=      9.55  107.87 Z(11,10)=      1.75   97.27
  Z(11,11)=      0.43    87.49 Z(11,12)=      2.66  101.47 Z(11,13)=     40.62  106.96 Z(12, 1)=     22.69  106.39 Z(12, 2)=     62.16  108.27
  Z(12, 3)=    326.15   108.48 Z(12, 4)=      4.78  104.13 Z(12, 5)=     12.37  101.73 Z(12, 6)=      3.09  100.04 Z(12, 7)=      4.07  101.80
  Z(12, 8)=     13.90   109.78 Z(12, 9)=      8.75  106.65 Z(12,10)=      1.98   95.03 Z(12,11)=      2.66  101.47 Z(12,12)=      0.37   78.79
  Z(12,13)=      7.75   111.05 Z(13, 1)=    346.13  111.88 Z(13, 2)=    948.27  113.75 Z(13, 3)=   4975.17  113.97 Z(13, 4)=     72.98  109.62
  Z(13, 5)=    188.72   107.21 Z(13, 6)=     47.13  105.52 Z(13, 7)=     62.11  107.29 Z(13, 8)=    211.97  115.26 Z(13, 9)=    133.48  112.14
  Z(13,10)=     30.28   100.52 Z(13,11)=     40.62  106.96 Z(13,12)=      7.75  111.05 Z(13,13)=      3.31   87.99 Z(
```

GRAPH FOR UNSUSTAINED FAULT WITHOUT AUTORECLOSER

REFFERENCE MACHINE 9 IS GHORASAL-132

3-PHASE FAULT BETWEEN TONGI-230 & GHORASAL-230 LINE AT MIDDLE POINT

FAULT TYPE = 1

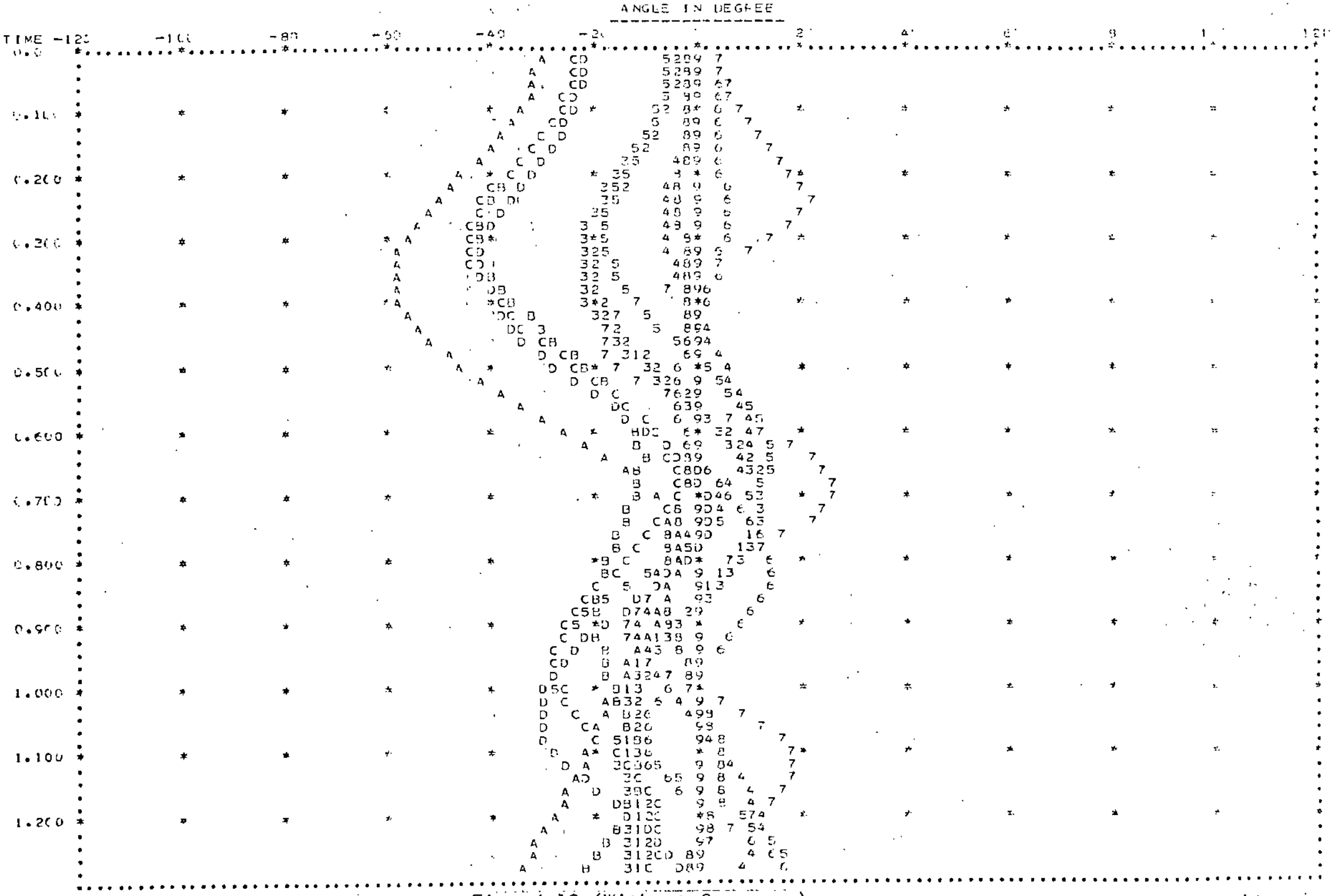

Fig. 6.19 (Without Governor)

* * * MEANING OF THE CODES * * *

1=KAPTAI 2=SIKALBAHA 3=HALISHAHAR 4=ASHUGANG-132 5=SHAHJIBAZAR 6=ASHUGANG-230 7=GHORASAL-23

REFERENCE MACHINE 9 IS GHORASAL-132

3-PHASE FAULT BETWEEN TONGI-230 & GHORASAL-230 LINE AT MIDDLE POINT

FAULT TYPE = 1

ANGLE IN DEGREE

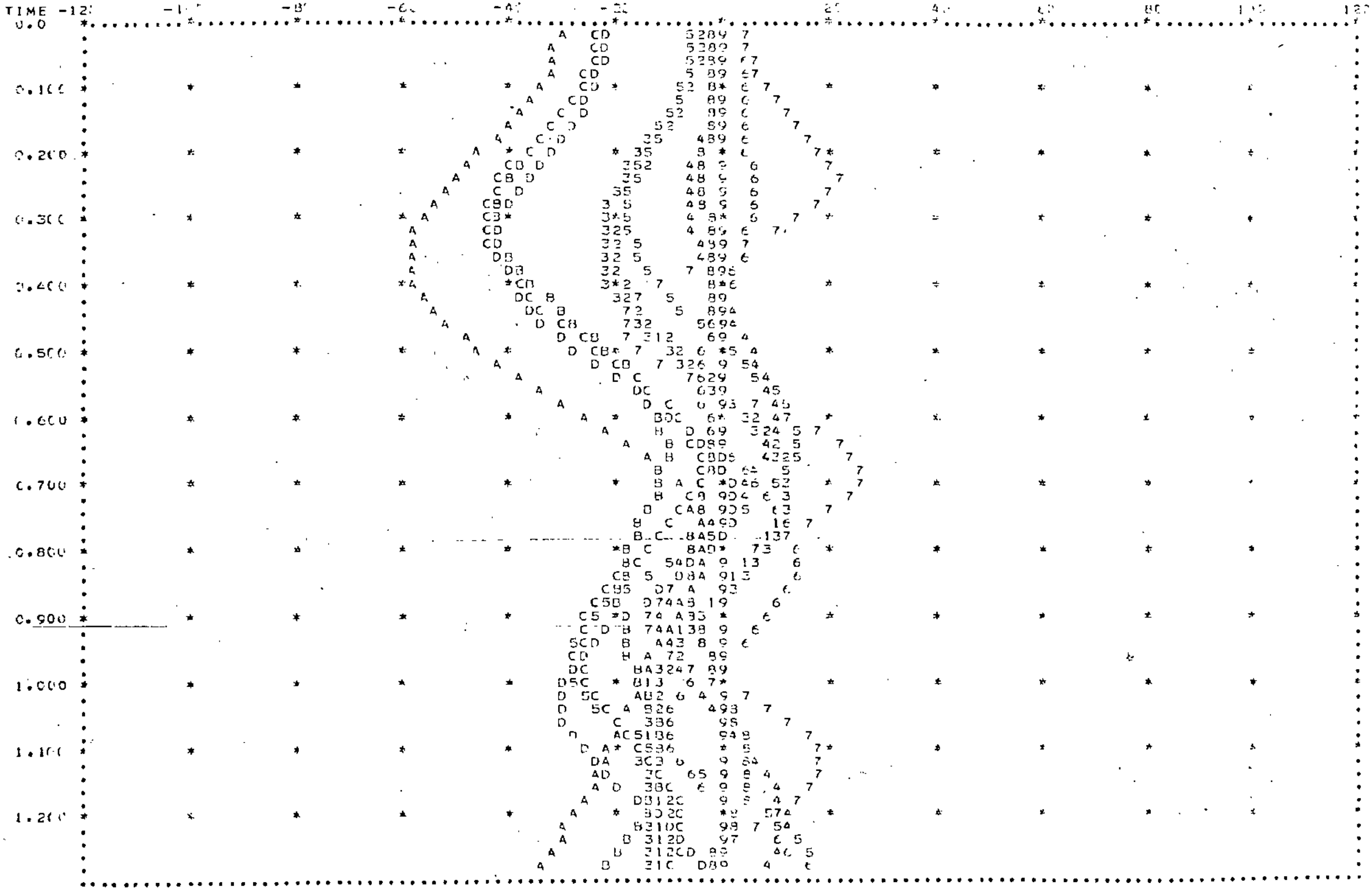

Fig. 6.20 (Without Governor)

* * * MEANING OF THE CODES * * *

1=KAPTAI 2=SIKALBAHA 3=HALISHAHAR 4=ASHUGANG-132 5=SHAHJIBAZAR 6=ASHUGANG-230 7=GHORASAL-230

8=SIDDIRGANG 9=GHORASAL-132 A=GOALPARA B=BHERAMARA C=BOGRA D=SAIDPUR

GRAPH FOR SUSTAINED FAULT CLEARED AT 8 CYCLES LATER,RECLOSES AFTER 28 CYCLES & THEN OPEN AFTER 36 CYCLES

REFERENCE MACHINE 9 IS GHORASAL-132

3-PHASE FAULT BETWEEN TONGI-230 & GHORASAL-230 LINE AT MIDDLE POINT

FAULT TYPE = 1

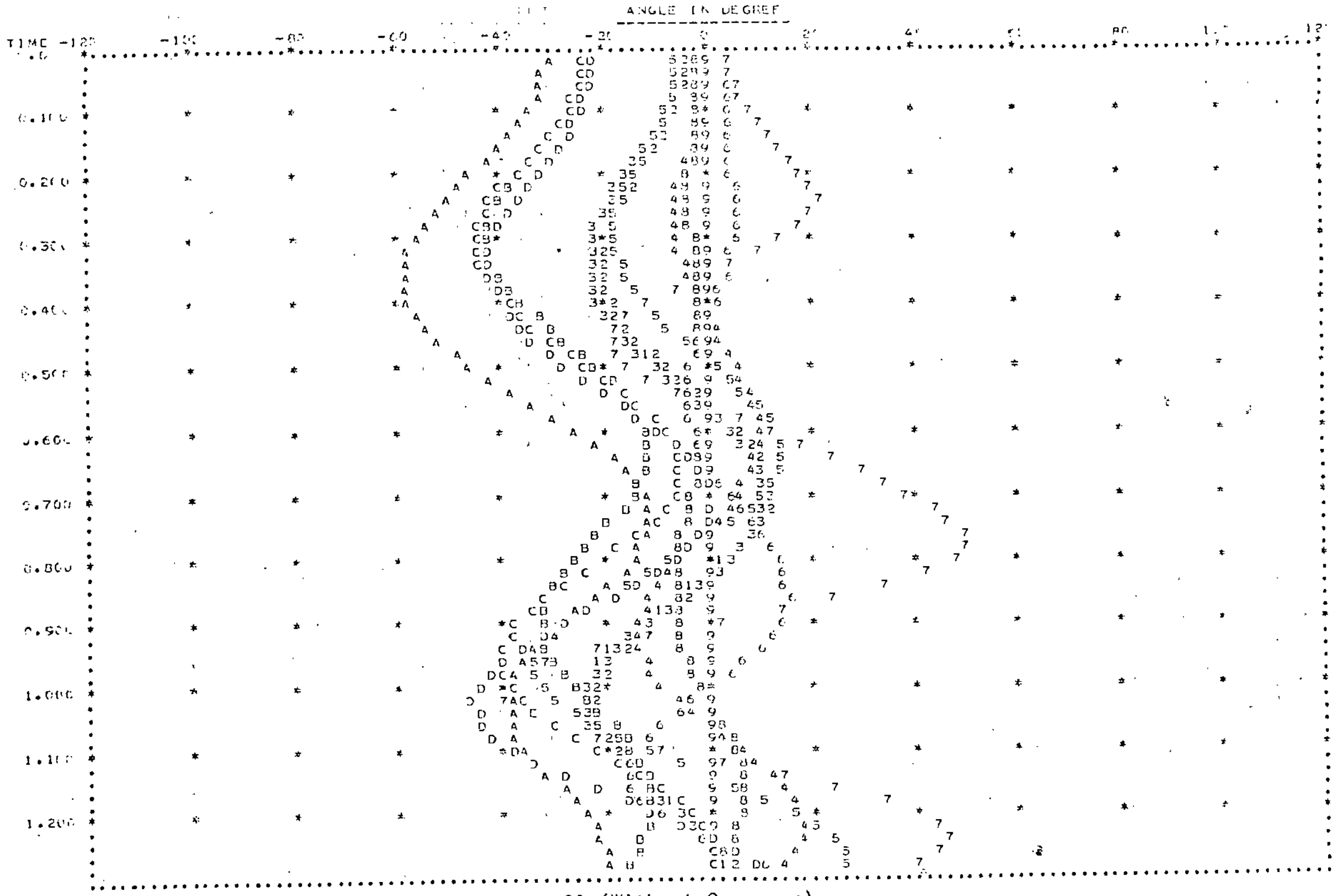

Fig. 6.21 (Without Governor)

* * * MEANING OF THE CODES * * *

1=KAPTAI	2=SIKALBAHA	3=HALISHAHAR	4=ASHUGANG-132	5=SHAHJIBAZAR	6=ASHUGANG-230	7=GHORASAL-23
8=SIDDIRGANG	9=GHORASAL-132	A=GOALPARA	B=BHERAMARA	C=BOGRA	D=SAIDPUR	

DATA FOR TIME VS. ANGLE(DEG) PLOTTING

TIME	KAPTAI	SIKALBAHA	HALISAHAR	ASUGANG -132-	SHAHJIBAZAR	ASUGANG -230-	GHORASAL -230-	SIDDIRGANG	GHORASAL-132	GOALPARA	BHERAMARA	BOGRA	SAIDPUR
0.0	1.63	3.21	1.57	7.35	1.83	10.63	11.64	5.00	7.36	-23.47	-16.58	-16.62	-14.89
0.020	1.64	3.23	1.58	7.43	1.85	10.79	12.00	5.13	7.50	-23.52	-16.62	-16.65	-14.86
0.040	1.68	3.29	1.62	7.66	1.91	11.28	13.09	5.52	7.92	-23.66	-16.71	-16.74	-14.85
0.060	1.74	3.39	1.68	8.05	2.00	12.08	14.88	6.15	8.61	-23.90	-16.86	-16.90	-14.80
0.080	1.83	3.53	1.77	8.59	2.14	13.20	17.31	7.05	9.58	-24.23	-17.07	-17.11	-14.74
0.100	1.95	3.71	1.90	9.29	2.34	14.62	20.34	8.20	10.80	-24.64	-17.31	-17.37	-14.66
0.120	2.11	3.95	2.06	10.15	2.60	16.33	23.89	9.59	12.28	-25.14	-17.58	-17.67	-14.57
0.140	2.32	4.23	2.27	11.18	2.95	18.32	27.88	11.21	13.99	-25.70	-17.87	-17.98	-14.47
0.160	2.59	4.59	2.53	12.38	3.40	20.59	32.24	13.05	15.95	-26.34	-18.15	-18.31	-14.37
0.180	2.93	5.01	2.85	13.75	3.97	23.11	36.87	15.12	18.12	-27.02	-18.41	-18.63	-14.27
0.200	3.34	5.49	3.24	15.25	4.70	25.63	40.89	17.25	20.34	-27.67	-18.47	-18.80	-14.13
0.220	3.84	6.04	3.69	16.81	5.61	27.90	43.37	19.31	22.42	-28.17	-18.14	-18.68	-13.90
0.240	4.45	6.68	4.23	18.45	6.73	29.88	44.26	21.27	24.37	-28.52	-17.40	-18.23	-13.57
0.260	5.18	7.40	4.86	20.16	8.08	31.56	43.61	23.11	26.14	-28.65	-16.25	-17.44	-13.13
0.280	6.04	8.23	5.60	21.92	9.66	32.90	41.56	24.82	27.74	-28.60	-14.71	-16.31	-12.56
0.300	7.02	9.15	6.45	23.71	11.45	33.89	38.32	26.38	29.13	-28.34	-12.81	-14.86	-11.86
0.320	8.13	10.19	7.41	25.51	13.44	34.48	34.20	27.75	30.28	-27.86	-10.60	-13.10	-11.02
0.340	9.36	11.32	8.47	27.27	15.58	34.68	29.54	28.92	31.17	-27.16	-8.16	-11.06	-10.02
0.360	10.71	12.54	9.64	28.95	17.86	34.46	24.78	29.80	31.77	-26.21	-5.58	-8.80	-8.87
0.380	12.16	13.85	10.91	30.49	20.20	33.82	20.32	30.42	32.07	-25.03	-2.93	-6.36	-7.56
0.400	13.70	15.23	12.26	31.87	22.56	32.80	16.56	30.75	32.05	-23.61	-0.33	-3.81	-6.09
0.420	15.30	16.66	13.68	33.02	24.89	31.43	13.84	30.76	31.72	-21.95	2.14	-1.22	-4.46
0.440	16.94	18.13	15.17	33.92	27.11	29.78	12.41	30.46	31.09	-20.09	4.40	1.36	-2.69
0.460	18.61	19.62	16.69	34.54	29.17	27.95	12.38	29.85	30.19	-18.00	6.36	3.86	-0.80
0.480	20.28	21.12	18.24	34.85	31.02	26.04	13.78	28.98	29.07	-15.72	7.98	6.21	1.21
0.500	21.94	22.60	19.79	34.86	32.60	24.16	16.47	27.85	27.77	-13.25	9.22	8.36	3.29
0.520	23.54	24.06	21.33	34.56	33.88	22.46	20.23	26.55	26.37	-10.63	10.08	10.27	5.42
0.540	25.09	25.47	22.84	33.98	34.82	21.06	24.74	25.11	24.93	-7.87	10.55	11.91	7.56
0.560	26.55	26.82	24.29	33.13	35.39	20.08	29.61	23.61	23.55	-5.00	10.67	13.24	9.67
0.580	27.92	28.09	25.68	32.06	35.58	19.62	34.42	22.11	22.29	-2.06	10.51	14.26	11.71
0.600	29.16	29.28	26.98	30.82	35.39	19.76	38.80	20.71	21.24	0.92	10.11	14.97	13.61
0.620	30.27	30.36	28.17	29.46	34.82	20.52	42.39	19.47	20.48	3.91	9.56	15.38	15.34
0.640	31.24	31.32	29.23	28.05	33.89	21.90	44.95	18.47	20.04	6.86	8.95	15.50	16.85
0.660	32.05	32.16	30.16	26.65	32.63	23.86	46.30	17.75	19.97	9.74	8.36	15.37	18.10
0.680	32.70	32.87	30.94	25.32	31.07	26.31	46.36	17.39	20.30	12.50	7.87	15.02	19.03
0.700	33.19	33.43	31.56	24.12	29.27	29.12	45.18	17.39	21.01	15.12	7.55	14.49	19.64
0.720	33.49	33.85	32.00	23.10	27.27	32.14	42.88	17.77	22.09	17.55	7.46	13.83	19.88
0.740	33.63	34.11	32.26	22.32	25.14	35.20	39.69	18.53	23.49	19.75	7.63	13.08	19.76
0.760	33.59	34.20	32.33	21.80	22.93	38.12	35.92	19.65	25.16	21.70	8.10	12.30	19.28
0.780	33.38	34.14	32.22	21.57	20.73	40.73	31.92	21.08	27.01	23.36	8.86	11.53	18.45
0.800	33.00	33.92	31.92	21.65	18.58	42.87	28.10	22.78	28.97	24.72	9.89	10.81	17.20
0.820	32.47	33.54	31.45	22.03	16.57	44.40	24.82	24.68	30.94	25.75	11.17	10.19	15.88
0.840	31.80	33.01	30.80	22.70	14.76	45.25	22.41	26.70	32.83	26.44	12.63	9.70	14.24
0.860	30.99	32.35	30.00	23.65	13.21	45.34	21.13	28.78	34.57	26.78	14.22	9.37	12.45
0.880	30.07	31.55	29.05	24.84	11.96	44.70	21.12	30.83	35.09	26.77	15.86	9.22	10.59
0.900	29.05	30.64	27.98	26.23	11.07	43.34	22.40	32.79	37.31	26.42	17.49	9.26	8.73
0.920	27.96	29.64	26.81	27.78	10.58	41.37	24.90	34.59	38.21	25.73	19.02	9.52	6.90
0.940	26.81	28.55	25.56	29.43	10.52	38.90	28.40	36.16	38.75	24.74	20.40	9.99	5.37
0.960	25.62	27.42	24.25	31.14	10.90	36.12	32.61	37.46	38.92	23.45	21.54	10.66	4.03
0.980	24.43	26.25	22.92	32.85	11.72	33.21	37.16	38.45	38.74	21.91	22.41	11.51	3.02
1.000	23.24	25.08	21.58	34.50	12.98	30.38	41.64	39.11	38.23	20.13	22.95	12.53	2.40
1.020	22.09	23.92	20.27	36.04	14.66	27.84	45.67	39.41	37.43	18.15	23.15	13.66	2.21
1.040	21.00	22.79	19.00	37.43	16.71	25.78	48.90	39.36	36.40	16.02	22.98	14.88	2.49
1.060	19.97	21.73	17.80	38.62	19.09	24.35	51.05	38.97	35.20	13.76	22.44	16.12	3.24
1.080	19.04	20.75	16.70	39.58	21.74	23.67	51.95	38.26	33.90	11.42	21.55	17.33	4.44
1.100	18.21	19.87	15.70	40.27	24.59	23.78	51.50	37.26	32.57	9.03	20.33	18.44	6.06
1.120	17.50	19.09	14.83	40.69	27.55	24.69	49.74	36.00	31.27	6.62	18.81	19.41	8.04
1.140	16.91	18.45	14.10	40.81	30.55	26.34	46.79	34.54	30.07	4.23	17.05	20.16	10.29
1.160	16.46	17.93	13.53	40.64	33.49	28.63	42.87	32.92	29.02	1.89	15.11	20.65	12.72
1.180	16.14	17.56	13.11	40.19	36.29	31.39	38.29	31.19	28.15	-0.38	13.04	20.84	15.21
1.200	15.96	17.32	12.85	39.47	38.96	34.42	33.45	29.41	27.51	-2.55	10.91	20.67	17.64
1.220	15.91	17.23	12.76	38.50	41.13	37.53	28.75	27.64	27.10	-4.60	8.79	20.14	19.87
1.240	15.99	17.28	12.84	37.33	43.02	40.49	24.62	25.93	26.93	-6.51	6.73	19.23	21.79
1.260	16.20	17.46	13.06	35.99	44.47	43.09	21.42	24.35	27.00	-8.27	4.81	17.94	23.29

GRAPH FOR UNSUSTAINED FAULT WITHOUT AUTORECLOSER

REFFERENCE MACHINE 9 IS GHORASAL-132

3-PHASE FAULT BETWEEN TONGI-230 & GHORASAL-230 LINE AT MIDDLE POINT

FAULT TYPE = 1

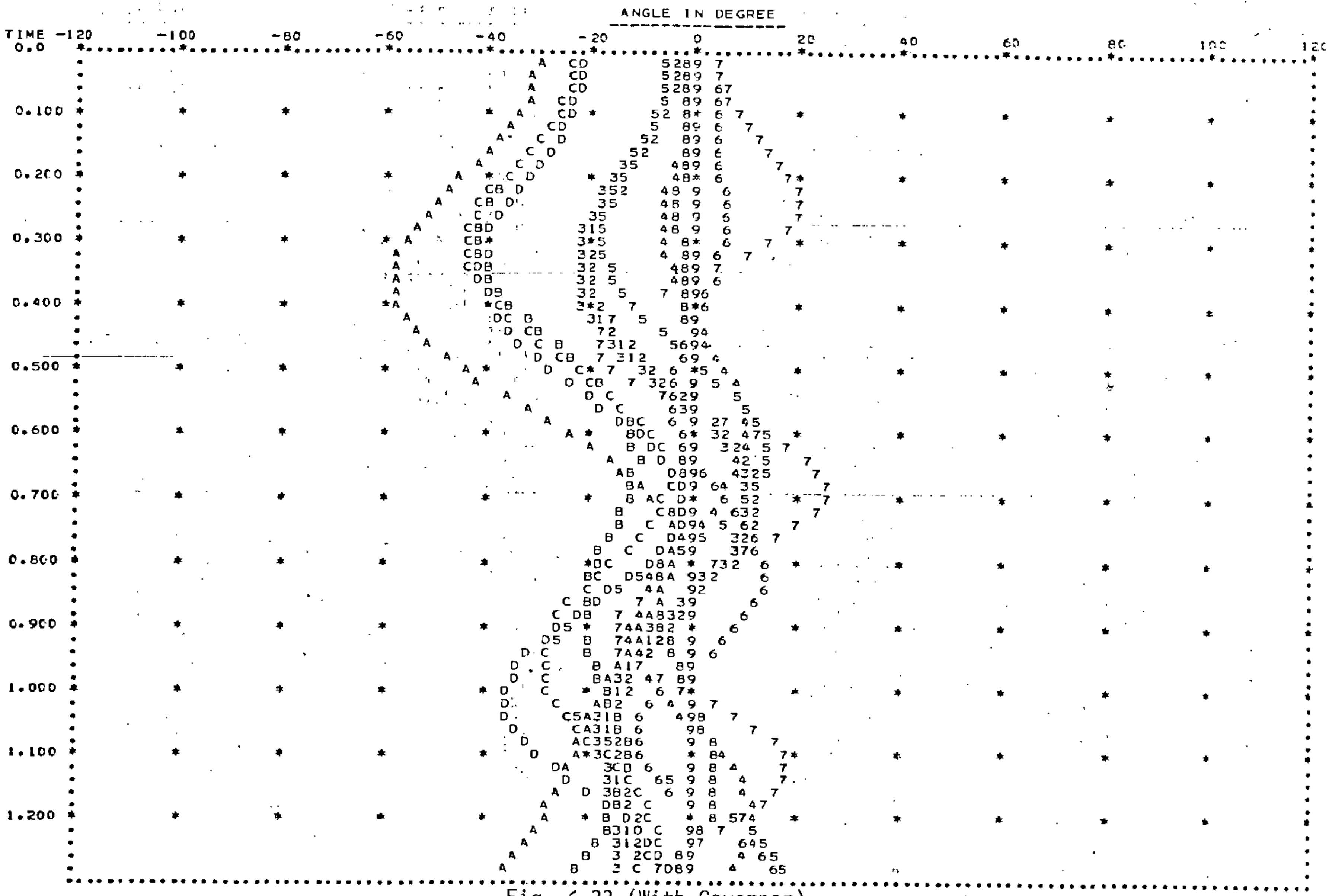

Fig. 6.22 (With Governor)

* * * MEANING OF THE CODES * * *

1=KAPTAI	2=SIKALBAHA	3=HALISHAHAR	4=ASHUGANG-132	5=SHAHJIBAZAR	6=ASHUGANG-230	7=GHORASAL-230
8=SIDDIRGANG	9=GHORASAL-132	A=GOALPARA	B=BHERAMARA	C=BOGRA	D=SAIDPUR	

DATA FOR TIME VS. ANGLE(DEG)PLOTTING

TIME	KAPTAI	SIKAL-BAHA	HALI-SAHAR	ASUGANG -132-	SHAHJI-BAZAR	ASUGANG -230-	GHORASAL -230-	SIDDIR-GANG	GHORA-SAL-132	GOAL-PARA	BHERA-MARA	BOGRA	SAIDPUR
0.0	1.63	3.21	1.57	7.35	1.83	10.63	11.64	5.00	7.36	-23.47	-16.58	-16.62	-14.89
0.020	1.64	3.23	1.58	7.43	1.85	10.79	12.00	5.13	7.50	-23.52	-16.62	-16.65	-14.88
0.040	1.68	3.29	1.62	7.66	1.91	11.28	13.09	5.52	7.92	-23.66	-16.71	-16.74	-14.85
0.060	1.74	3.39	1.68	8.05	2.00	12.08	14.88	6.16	8.61	-23.90	-16.86	-16.90	-14.80
0.080	1.83	3.53	1.77	8.59	2.14	13.20	17.31	7.05	9.58	-24.23	-17.07	-17.11	-14.74
0.100	1.95	3.71	1.90	9.29	2.34	14.62	20.34	8.20	10.80	-24.64	-17.31	-17.37	-14.66
0.120	2.11	3.95	2.06	10.15	2.60	16.33	23.89	9.59	12.28	-25.14	-17.58	-17.67	-14.57
0.140	2.32	4.23	2.27	11.18	2.95	18.32	27.88	11.21	13.99	-25.70	-17.87	-17.58	-14.47
0.160	2.59	4.59	2.53	12.38	3.40	20.59	32.24	13.05	15.95	-26.34	-18.15	-18.31	-14.37
0.180	2.93	5.01	2.85	13.75	3.97	23.11	36.87	15.12	18.12	-27.02	-18.41	-18.63	-14.27
0.200	3.34	5.49	3.24	15.25	4.70	25.63	40.89	17.26	20.34	-27.67	-18.47	-18.80	-14.13
0.220	3.84	6.04	3.69	16.81	5.61	27.90	43.37	19.31	22.42	-28.17	-18.14	-18.68	-13.90
0.240	4.45	6.68	4.23	18.45	6.73	29.88	44.26	21.27	24.37	-28.50	-17.40	-18.23	-13.57
0.260	5.18	7.40	4.86	20.16	8.08	31.56	43.61	23.11	26.14	-28.65	-16.25	-17.44	-13.13
0.280	6.04	8.23	5.60	21.92	9.66	32.90	41.56	24.82	27.74	-28.60	-14.71	-16.31	-12.56
0.300	7.02	9.15	6.45	23.71	11.45	33.89	39.32	26.38	29.13	-28.34	-12.81	-14.86	-11.86
0.320	8.13	10.19	7.41	25.51	13.44	34.48	34.20	27.75	30.28	-27.86	-10.60	-13.10	-11.02
0.340	9.36	11.32	8.47	27.27	15.58	34.68	29.54	28.90	31.17	-27.16	-8.16	-11.06	-10.02
0.360	10.71	12.54	9.64	28.95	17.86	34.46	24.78	29.80	31.77	-26.21	-5.58	-8.80	-8.87
0.380	12.16	13.85	10.91	30.49	20.20	33.82	20.32	30.42	32.07	-25.03	-2.93	-6.36	-7.56
0.400	13.70	15.23	12.26	31.87	22.56	32.80	16.56	30.75	32.05	-23.61	-0.33	-3.81	-6.09
0.420	15.30	16.66	13.68	33.02	24.89	31.43	13.84	30.76	31.72	-21.96	2.14	-1.22	-4.46
0.440	16.94	18.13	15.17	33.92	27.11	29.78	12.41	30.45	31.09	-20.09	4.40	1.36	-2.69
0.460	18.61	19.62	16.69	34.54	29.17	27.95	12.38	29.85	30.19	-18.00	6.36	3.86	-0.80
0.480	20.28	21.12	18.24	34.85	31.02	26.04	13.78	28.98	29.07	-15.72	7.98	6.21	1.21
0.500	21.94	22.60	19.79	34.86	32.60	24.16	16.47	27.86	27.77	-13.25	9.22	8.36	3.29
0.520	23.54	24.06	21.33	34.56	33.88	22.46	20.23	26.55	26.37	-10.63	10.08	10.27	5.42
0.540	25.09	25.47	22.84	33.98	34.82	21.06	24.74	25.11	24.93	-7.87	10.55	11.91	7.56
0.560	26.55	26.82	24.29	33.13	35.39	20.08	29.61	23.61	23.55	-5.00	10.67	13.24	9.07
0.580	27.92	28.09	25.68	32.06	35.58	19.62	34.42	22.11	22.29	-2.06	10.51	14.26	11.71
0.600	29.16	29.28	27.01	30.82	35.39	19.76	38.80	20.71	21.25	0.92	10.12	14.98	13.67
0.620	30.28	30.39	28.29	29.47	34.82	20.52	42.43	19.48	20.49	3.92	9.61	15.43	15.57
0.640	31.27	31.40	29.51	28.07	33.89	21.91	45.03	18.49	20.08	6.88	9.06	15.61	17.36
0.660	32.10	32.30	30.65	26.68	32.63	23.87	46.44	17.78	20.05	9.78	8.55	15.56	18.99
0.680	32.78	33.08	31.70	25.36	31.08	26.32	46.58	17.42	20.41	12.57	8.16	15.32	20.40
0.700	33.30	33.73	32.62	24.18	29.27	29.14	45.49	17.43	21.17	15.22	7.96	14.91	21.57
0.720	33.65	34.25	33.41	23.19	27.28	32.18	43.28	17.83	22.31	17.66	8.00	14.40	22.43
0.740	33.84	34.62	34.05	22.43	25.16	35.26	40.19	18.62	23.77	19.93	8.32	13.81	22.97
0.760	33.86	34.84	34.51	21.95	22.97	38.22	36.51	19.77	25.49	21.94	8.94	13.21	23.15
0.780	33.73	34.90	34.79	21.76	20.78	40.87	32.60	21.25	27.41	23.67	9.85	12.62	22.98
0.800	33.44	34.80	34.87	21.88	18.66	43.06	28.85	22.99	29.44	25.10	11.04	12.10	22.45
0.820	33.00	34.56	34.75	22.32	16.68	44.66	25.63	24.95	31.49	26.21	12.47	11.68	21.59
0.840	32.43	34.16	34.42	23.05	14.91	45.59	23.27	27.05	33.46	26.99	14.07	11.38	20.43
0.860	31.75	33.62	33.89	24.07	13.41	45.78	22.03	29.20	35.28	27.44	15.79	11.25	19.02
0.880	30.95	32.95	33.16	25.34	12.23	45.24	22.05	31.35	36.87	27.55	17.56	11.29	17.42
0.900	30.08	32.16	32.28	26.82	11.41	44.00	23.37	33.41	38.19	27.33	19.29	11.51	15.72
0.920	29.13	31.28	31.19	28.46	11.01	42.16	25.90	35.31	39.17	26.78	20.92	11.94	13.90
0.940	28.14	30.31	29.98	30.22	11.04	39.83	29.45	37.00	39.80	25.93	22.37	12.56	12.29
0.960	27.12	29.29	28.65	32.05	11.53	37.18	33.72	38.43	40.07	24.81	23.59	13.36	10.75
0.980	26.09	28.23	27.24	33.88	12.48	34.42	38.34	39.55	39.98	23.42	24.51	14.33	9.63
1.000	25.08	27.16	25.78	35.66	13.87	31.74	42.92	40.34	39.57	21.82	25.11	15.43	8.41
1.020	24.11	26.10	24.30	37.34	15.69	29.34	47.07	40.79	38.88	20.03	25.35	16.64	7.76
1.040	23.19	25.09	22.84	38.87	17.90	27.43	50.44	40.88	37.96	18.08	25.23	17.90	7.53
1.060	22.35	24.13	21.43	40.22	20.45	26.15	52.76	40.65	36.88	16.01	24.74	19.17	7.74
1.080	21.59	23.26	20.11	41.33	23.28	25.60	53.84	40.09	35.71	13.86	23.91	20.38	8.40
1.100	20.93	22.49	18.90	42.20	26.31	25.85	53.59	39.25	34.52	11.66	22.75	21.49	9.51
1.120	20.39	21.84	17.85	42.78	29.47	26.90	52.04	38.17	33.37	9.45	21.31	22.44	11.03
1.140	19.96	21.32	16.96	43.08	32.67	28.69	49.30	36.87	32.32	7.25	19.65	23.17	12.89
1.160	19.66	20.94	16.27	43.09	35.82	31.11	45.58	35.42	31.43	5.09	17.82	23.64	15.02
1.180	19.48	20.71	15.80	42.82	38.83	34.00	41.21	33.86	30.74	3.01	15.88	23.80	17.32
1.200	19.43	20.62	15.54	42.28	41.62	37.18	36.55	32.25	30.28	1.02	13.89	23.62	19.68
1.220	19.51	20.69	15.51	41.50	44.10	40.43	32.03	30.65	30.06	-0.85	11.94	23.09	21.98
1.240	19.72	20.90	15.71	40.52	46.21	43.53	28.05	29.13	30.09	-2.60	10.06	22.19	24.08
1.260	20.04	21.24	16.13	39.37	47.87	46.29	24.98	27.73	30.36	-4.19	8.33	20.95	25.87

GRAPH FOR FAULT CLEARED AT 8 CYCLES LATER & RECLOSE AFTER 28 CYCLES

REFFERENCE MACHINE 9 IS GHORASAL-132

3-PHASE FAULT BETWEEN TONGI-230 & GHORASAL-230 LINE AT MIDDLE POINT FAULT TYPE = 1

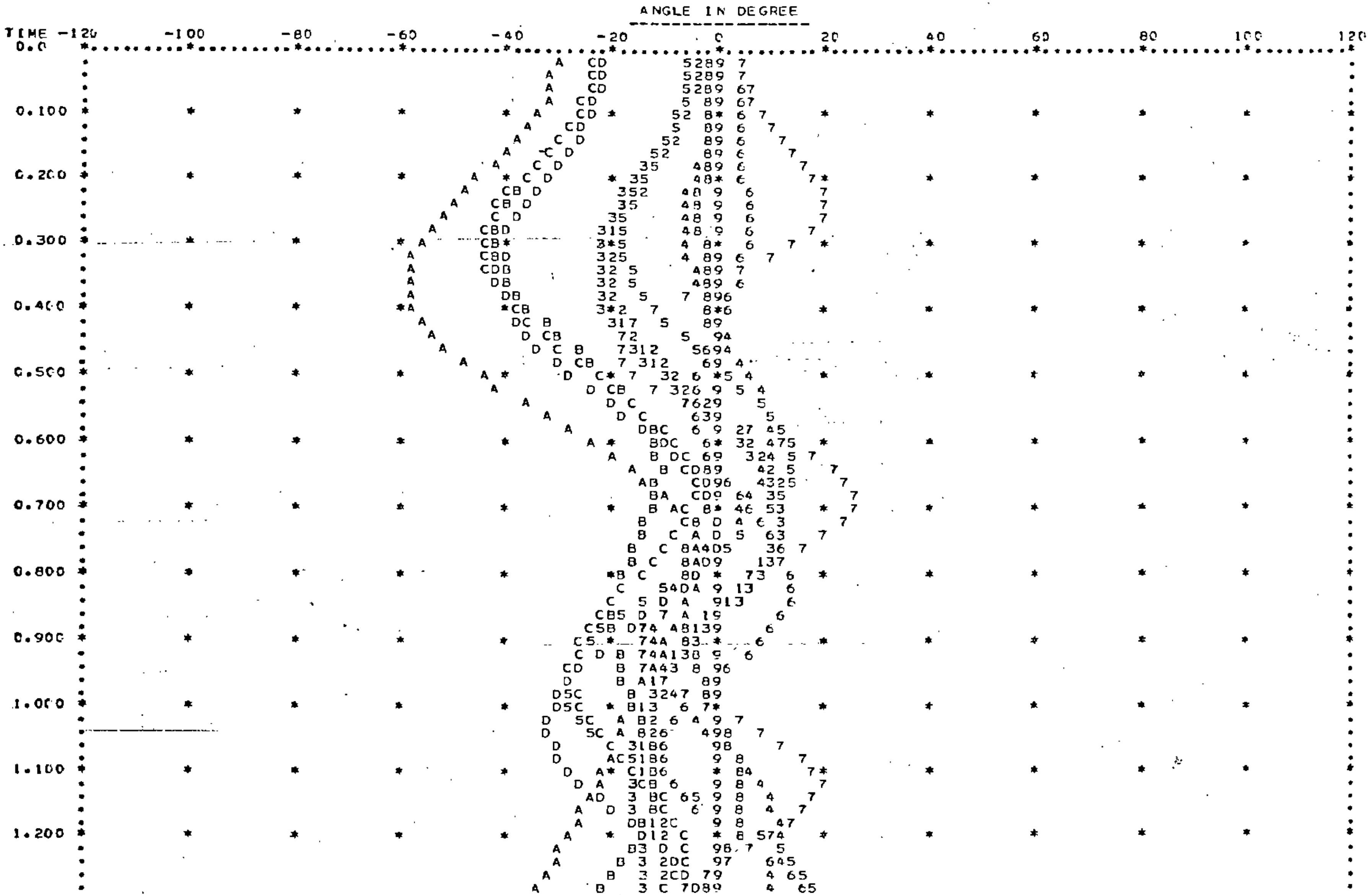

Fig. 6.23 (With Governor)

* * * MEANING OF THE CODES * * *

1=KAPTAI 2=SIKALBAHA 3=HALISHAHAR 4=ASHUGANG-132 5=SHAHJIBAZAR 6=ASHUGANG-230 7=GHORASAL-230

8=SIDDIRGANG 9=GHORASAL-132 A=GOALPARA B=BHERAMARA C=BOGRA D=SAIDPUR

DATA FOR TIME VS. ANGLE(DEG)PLOTTING

TIME	KAPTAI	SIKAL-BAHA	HALI-SAHAR	ASUGANG -132-	SHAHJI-BAZAR	ASUGANG -230-	GHORASAL -230-	SIDDIR-GANG	GHORA-SAL-132	GOAL-PARA	BHERA-MARA	BOGRA	SAIDPUR
0.0	1.63	3.21	1.57	7.35	1.83	10.63	11.64	5.00	7.36	-23.47	-16.58	-16.62	-14.99
0.020	1.64	3.23	1.58	7.43	1.85	10.79	12.00	5.13	7.50	-23.52	-16.62	-16.65	-14.88
0.040	1.68	3.29	1.62	7.66	1.91	11.28	13.09	5.52	7.92	-23.65	-16.71	-16.74	-14.85
0.060	1.74	3.39	1.68	8.05	2.00	12.08	14.88	6.16	8.61	-23.90	-16.86	-16.90	-14.80
0.080	1.83	3.53	1.77	8.59	2.14	13.20	17.31	7.06	9.58	-24.23	-17.07	-17.11	-14.74
0.100	1.95	3.71	1.90	9.29	2.34	14.62	20.34	8.23	10.80	-24.64	-17.31	-17.37	-14.66
0.120	2.11	3.95	2.06	10.15	2.60	16.33	23.89	9.59	12.28	-25.14	-17.58	-17.67	-14.57
0.140	2.32	4.23	2.27	11.18	2.95	18.32	27.88	11.21	13.99	-25.70	-17.87	-17.98	-14.47
0.160	2.59	4.59	2.53	12.38	3.40	20.59	32.24	13.05	15.95	-26.34	-18.15	-18.31	-14.37
0.180	2.93	5.01	2.85	13.75	3.97	22.11	36.87	15.12	18.12	-27.02	-18.41	-18.63	-14.27
0.200	3.34	5.49	3.24	15.25	4.70	25.63	40.89	17.26	20.34	-27.67	-18.47	-18.80	-14.13
0.220	3.84	6.04	3.69	16.81	5.61	27.90	43.37	19.31	22.42	-28.17	-18.14	-18.68	-13.90
0.240	4.45	6.68	4.23	18.45	6.73	29.98	44.26	21.27	24.37	-28.50	-17.40	-18.23	-13.57
0.260	5.18	7.40	4.86	20.16	8.08	31.56	43.61	23.11	26.14	-28.65	-16.25	-17.44	-13.13
0.280	6.04	8.23	5.60	21.92	9.66	32.90	41.56	24.82	27.74	-28.60	-14.71	-16.31	-12.56
0.300	7.02	9.15	6.45	23.71	11.45	33.89	38.32	26.38	29.13	-28.34	-12.81	-14.86	-11.86
0.320	8.13	10.19	7.41	25.51	13.44	34.48	34.20	27.75	30.28	-27.86	-10.60	-13.10	-11.02
0.340	9.36	11.32	8.47	27.27	15.58	34.68	29.54	28.90	31.17	-27.16	-8.16	-11.06	-10.02
0.360	10.71	12.54	9.64	28.95	17.86	34.46	24.78	29.80	31.77	-26.21	-5.58	-8.80	-8.87
0.380	12.16	13.85	10.91	30.49	20.20	33.82	20.32	30.42	32.07	-25.03	-2.93	-6.36	-7.56
0.400	13.70	15.23	12.26	31.87	22.56	32.80	16.56	30.75	32.05	-23.61	-0.33	-3.81	-6.29
0.420	15.30	16.66	13.68	33.02	24.89	31.43	13.84	30.76	31.72	-21.90	2.14	-1.22	-4.46
0.440	16.94	18.13	15.17	33.92	27.11	29.78	12.41	30.45	31.09	-20.09	4.40	1.36	-2.69
0.460	18.61	19.62	16.69	34.54	29.17	27.95	12.38	29.85	30.19	-18.00	6.36	3.86	-0.80
0.480	20.28	21.12	18.24	34.85	31.02	26.04	13.78	28.98	29.07	-15.72	7.98	6.21	1.21
0.500	21.94	22.60	19.79	34.86	32.60	24.16	16.47	27.86	27.77	-13.25	9.22	8.36	3.29
0.520	23.54	24.06	21.33	34.56	33.88	22.46	20.23	26.55	26.37	-10.63	10.06	10.27	5.42
0.540	25.09	25.47	22.84	33.98	34.82	21.06	24.74	25.11	24.93	-7.87	10.55	11.91	7.55
0.560	26.55	26.82	24.29	33.13	35.39	20.08	29.61	23.61	23.55	-5.00	10.67	13.24	9.67
0.580	27.92	28.09	25.68	32.06	35.58	19.62	34.42	22.11	22.29	-2.06	10.51	14.26	11.71
0.600	29.20	29.33	27.04	30.94	35.48	19.79	39.35	20.83	21.36	0.87	10.12	15.00	13.69
0.620	30.44	30.58	28.42	29.93	35.16	20.64	44.73	19.93	20.91	3.72	9.58	15.49	15.67
0.640	31.62	31.83	29.81	29.06	34.65	22.17	50.40	19.44	20.97	6.46	8.97	15.75	17.61
0.660	32.74	33.08	31.20	28.36	33.94	24.37	56.20	19.40	21.55	9.06	8.34	15.80	19.45
0.680	33.79	34.30	32.56	27.88	33.08	27.22	62.01	19.82	22.65	11.52	7.77	15.67	21.16
0.700	34.77	35.50	33.90	27.64	32.08	30.67	67.71	20.72	24.30	13.81	7.33	15.39	22.70
0.720	35.68	36.66	35.18	27.68	30.98	34.68	73.20	22.11	26.46	15.91	7.06	15.01	24.03
0.740	36.54	37.79	36.41	28.04	29.84	39.18	78.41	24.01	29.12	17.81	7.03	14.56	25.11
0.760	37.31	38.84	37.55	28.73	28.70	43.99	82.12	26.38	32.21	19.54	7.43	14.15	25.89
0.780	38.00	39.79	38.57	29.81	27.65	48.84	83.13	29.19	35.64	21.11	8.44	13.92	26.34
0.800	38.63	40.64	39.47	31.30	26.77	53.60	81.51	32.43	39.34	22.53	10.10	13.93	26.48
0.820	39.20	41.41	40.26	33.22	26.13	58.10	77.47	36.03	43.25	23.80	12.39	14.24	26.33
0.840	39.74	42.09	40.93	35.56	25.82	62.19	71.35	39.94	47.25	24.93	15.28	14.90	25.93
0.860	40.27	42.72	41.49	38.31	25.89	65.68	63.68	44.05	51.24	25.91	18.71	15.93	25.33
0.880	40.80	43.29	41.96	41.40	26.39	68.43	55.11	48.25	55.08	26.76	22.55	17.34	24.60
0.900	41.34	43.81	42.34	44.77	27.35	70.31	46.45	52.41	58.64	27.49	26.67	19.14	23.81
0.920	41.90	44.29	42.64	48.34	28.78	71.22	38.52	56.41	61.81	28.09	30.91	21.29	23.04
0.940	42.49	44.76	42.88	52.00	30.68	71.12	32.11	60.12	64.47	28.60	35.10	23.75	22.39
0.960	43.11	45.21	43.07	55.66	33.04	70.04	27.85	63.43	66.56	29.00	39.07	26.47	21.93
0.980	43.78	45.66	43.24	59.22	35.82	68.04	26.18	66.25	68.01	29.33	42.66	29.38	21.76
1.000	44.48	46.13	43.40	62.58	38.99	65.28	27.33	68.52	69.82	29.60	45.75	32.41	21.96
1.020	45.24	46.63	43.58	65.66	42.49	61.94	31.28	70.16	69.98	29.83	48.22	35.50	22.61
1.040	46.05	47.19	43.80	68.39	46.27	58.26	37.76	71.31	68.52	30.04	50.02	38.57	23.75
1.060	46.92	47.80	44.08	70.70	50.24	54.53	46.29	71.59	67.52	30.26	51.10	41.55	25.43
1.080	47.85	48.49	44.46	72.55	54.34	51.07	56.18	71.36	66.06	30.50	51.47	44.38	27.67
1.100	48.84	49.27	44.94	73.92	58.48	48.20	66.60	70.56	64.27	30.78	51.18	47.00	30.44
1.120	49.89	50.16	45.56	74.79	62.58	46.19	76.73	69.26	62.29	31.13	50.31	49.35	33.70
1.140	51.01	51.15	46.32	75.20	66.56	45.31	85.81	67.58	60.29	31.55	48.95	51.38	37.38
1.160	52.19	52.25	47.25	75.18	70.33	45.69	93.23	65.62	58.43	32.05	47.25	53.07	41.38
1.180	53.42	53.47	48.33	74.77	73.81	47.43	98.56	63.53	56.85	32.64	45.34	54.38	45.58
1.200	54.71	54.79	49.58	74.04	76.95	50.49	101.53	61.42	55.69	33.31	43.37	55.30	49.85
1.220	56.05	56.21	50.98	73.05	79.66	54.78	102.03	59.42	55.05	34.07	41.47	55.83	54.03
1.240	57.43	57.72	52.53	71.88	81.99	60.10	100.08	57.64	55.01	34.90	39.79	55.95	57.99
1.260	58.84	59.30	54.21	70.61	83.62	66.20	95.86	56.23	55.60	35.80	38.43	55.72	61.57

GRAPH FOR SUSTAINED FAULT CLEARED AT 8 CYCLES LATER,RECLOSES AFTER 28 CYCLES & THEN OPEN AFTER 36 CYCLES

REFFERENCE MACHINE 9 IS GHORASAL-132

3-PHASE FAULT BETWEEN TONGI-230 & GHORASAL-230 LINE AT MIDDLE POINT

FAULT TYPE = 1

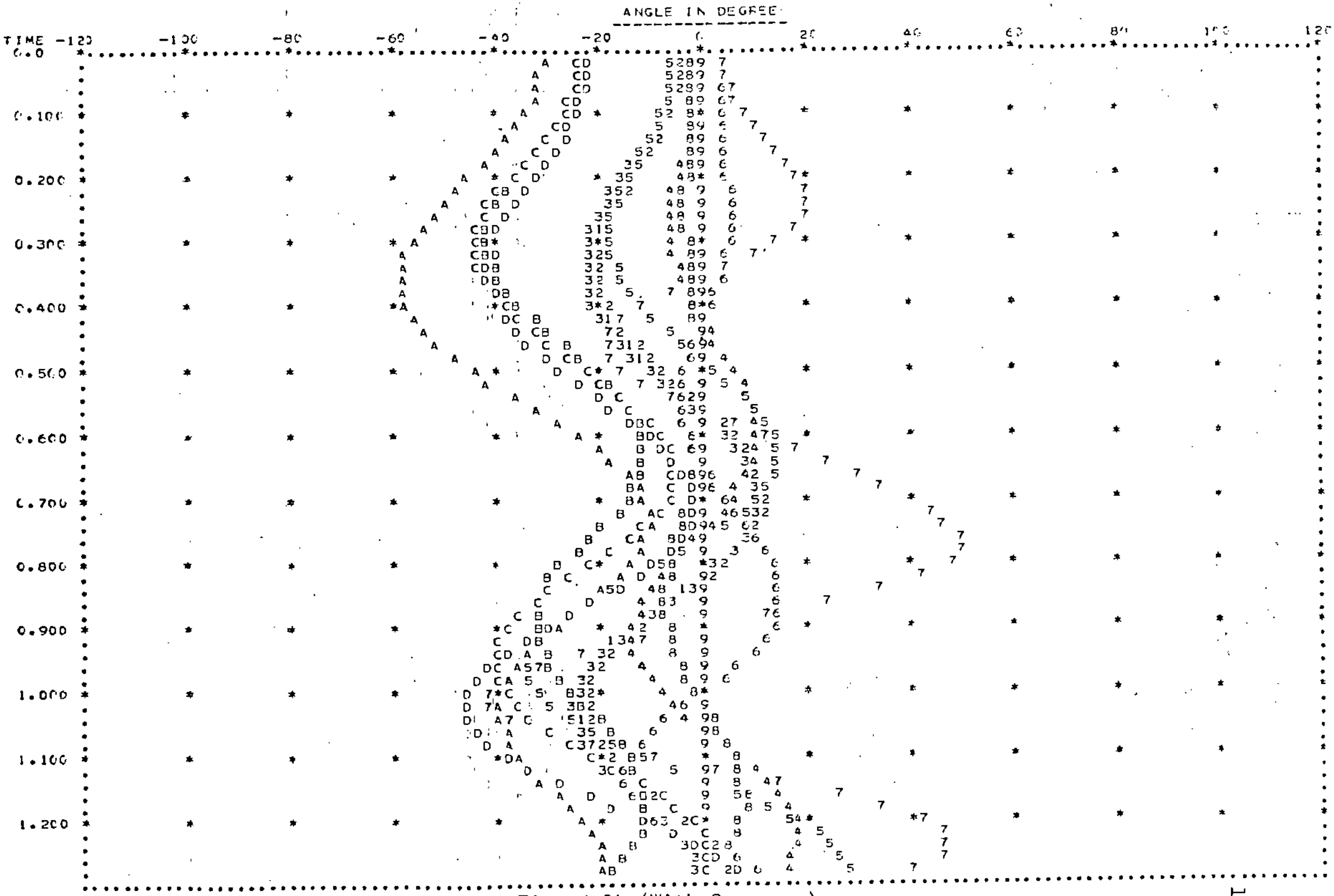

Fig. 6.24 (With Governor)

* * * MEANING OF THE CODES * * *

1=KAPTAI 2=SIKALBAHA 3=HALISHAHAR 4=ASHUGANG-132 5=SHAHJIBAZAR 6=ASHUGANG-230 7=GHORASAL-230

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                                                              YBUS DURING FAULT
                                                              -----------------
                              FAULTED BUS IS ISHURDI-132                                                  FAULT TYPE = 4
                              --------------------------                                                  --------------
                  MAG    ANGLE                    MAG    ANGLE                     MAG    ANGLE                     MAG    ANGLE                    MAG    ANGLE
------------------------------------------------------------------------------------------------------------------------------------------------------------------
Y( 1, 1)=        3.47   -79.67 Y( 1, 2)=         0.84   78.55 Y( 1, 3)=          0.17   78.28 Y( 1, 4)=          0.39   81.34 Y( 1, 5)=          0.15   83.74
Y( 1, 6)=        0.25    79.54 Y( 1, 7)=         0.15   78.76 Y( 1, 8)=          0.12   77.75 Y( 1, 9)=          0.15   80.86 Y( 2, 1)=          0.84   78.55
Y( 2, 2)=        1.79   -87.19 Y( 2, 3)=         0.07   76.30 Y( 2, 4)=          0.14   79.46 Y( 2, 5)=          0.06   81.87 Y( 2, 6)=          0.09   77.66
Y( 2, 7)=        0.05    76.89 Y( 2, 8)=         0.04   75.87 Y( 2, 9)=          0.05   78.99 Y( 3, 1)=          0.17   78.28 Y( 3, 2)=          0.07   76.30
Y( 3, 3)=        0.40   -89.41 Y( 3, 4)=         0.03   79.25 Y( 3, 5)=          0.01   81.65 Y( 3, 6)=          0.02   77.45 Y( 3, 7)=          0.01   76.67
Y( 3, 8)=        0.01    75.66 Y( 3, 9)=         0.01   78.78 Y( 4, 1)=          0.39   81.34 Y( 4, 2)=          0.14   79.46 Y( 4, 3)=          0.03   79.25
Y( 4, 4)=        7.05   -86.96 Y( 4, 5)=         1.07   84.71 Y( 4, 6)=          1.40   80.33 Y( 4, 7)=          0.74   80.62 Y( 4, 8)=          0.36   79.27
Y( 4, 9)=        0.72    82.73 Y( 5, 1)=         0.15   83.74 Y( 5, 2)=          0.06   81.87 Y( 5, 3)=          0.01   81.65 Y( 5, 4)=          1.07   84.71
Y( 5, 5)=        3.44   -85.73 Y( 5, 6)=         0.54   82.74 Y( 5, 7)=          0.29   83.02 Y( 5, 8)=          0.14   81.67 Y( 5, 9)=          0.28   85.13
Y( 6, 1)=        0.25    79.54 Y( 6, 2)=         0.09   77.66 Y( 6, 3)=          0.02   77.45 Y( 6, 4)=          1.40   80.33 Y( 6, 5)=          0.54   82.74
Y( 6, 6)=        7.22   -87.69 Y( 6, 7)=         1.19   84.67 Y( 6, 8)=          0.34   77.54 Y( 6, 9)=          0.60   80.03 Y( 7, 1)=          0.15   78.76
Y( 7, 2)=        0.05    76.89 Y( 7, 3)=         0.01   76.67 Y( 7, 4)=          0.74   80.62 Y( 7, 5)=          0.29   83.02 Y( 7, 6)=          1.19   84.67
Y( 7, 7)=        5.13   -88.70 Y( 7, 8)=         0.23   75.66 Y( 7, 9)=          0.40   78.13 Y( 8, 1)=          0.12   77.75 Y( 8, 2)=          0.04   75.87
Y( 8, 3)=        0.01    75.66 Y( 8, 4)=         0.36   79.27 Y( 8, 5)=          0.14   81.67 Y( 8, 6)=          0.34   77.54 Y( 8, 7)=          0.23   75.66
Y( 8, 8)=        2.26   -88.37 Y( 8, 9)=         0.23   77.76 Y( 9, 1)=          0.15   80.86 Y( 9, 2)=          0.05   78.99 Y( 9, 3)=          0.01   78.78
Y( 9, 4)=        0.72    82.73 Y( 9, 5)=         0.28   85.13 Y( 9, 6)=          0.60   80.03 Y( 9, 7)=          0.40   78.13 Y( 9, 8)=          0.23   77.76
Y( 9, 9)=        3.60   -88.35 Y(10,10)=         4.42  -74.42 Y(10,11)=          0.11   78.29 Y(11,10)=          0.11   78.30 Y(11,11)=          2.67  -89.42
Y(12,12)=        3.12   -81.55 Y(12,13)=         0.10   67.48 Y(13,12)=          0.10   67.48 Y(13,13)=          0.30  -88.12 Y(
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                                                    YBUS AFTER CLEARING THE FAULT
                                                    -----------------------------
                          FAULTED BUS 'IS ISHURDI-132                                                    FAULT TYPE = 4
                          ---------------------------                                                    --------------
              MAG    ANGLE                  MAG    ANGLE                  MAG    ANGLE                  MAG    ANGLE                  MAG    ANGLE
------------------------------------------------------------------------------------------------------------------------------------------------------

 Y( 1, 1)=   3.47  -79.63 Y( 1, 2)=   0.84   78.52 Y( 1, 3)=   0.17   78.26 Y( 1, 4)=   0.41   80.82 Y( 1, 5)=   0.16   83.22
 Y( 1, 6)=   0.29   79.12 Y( 1, 7)=   0.18   78.10 Y( 1, 8)=   0.12   77.04 Y( 1, 9)=   0.16   79.96 Y( 1,10)=   0.06   81.37
 Y( 1,11)=   0.04   74.93 Y( 1,12)=   0.05   76.15 Y( 1,13)=   0.00   70.66 Y( 2, 1)=   0.84   78.52 Y( 2, 2)=   1.79  -87.18
 Y( 2, 3)=   0.07   76.28 Y( 2, 4)=   0.15   78.95 Y( 2, 5)=   0.06   81.35 Y( 2, 6)=   0.10   77.25 Y( 2, 7)=   0.06   76.22
 Y( 2, 8)=   0.05   75.16 Y( 2, 9)=   0.06   78.08 Y( 2,10)=   0.02   79.50 Y( 2,11)=   0.02   73.06 Y( 2,12)=   0.02   74.27
 Y( 2,13)=   0.00   68.78 Y( 3, 1)=   0.17   78.26 Y( 3, 2)=   0.07   76.28 Y( 3, 3)=   0.40  -89.41 Y( 3, 4)=   0.03   78.73
 Y( 3, 5)=   0.01   81.14 Y( 3, 6)=   0.02   77.04 Y( 3, 7)=   0.01   76.01 Y( 3, 8)=   0.01   74.95 Y( 3, 9)=   0.01   77.87
 Y( 3,10)=   0.00   79.29 Y( 3,11)=   0.00   72.85 Y( 3,12)=   0.00   74.06 Y( 3,13)=   0.00   68.57 Y( 4, 1)=   0.41   80.82
 Y( 4, 2)=   0.15   78.95 Y( 4, 3)=   0.03   78.73 Y( 4, 4)=   6.94  -86.66 Y( 4, 5)=   1.12   84.41 Y( 4, 6)=   1.58   80.13
 Y( 4, 7)=   0.88   80.03 Y( 4, 8)=   0.40   78.27 Y( 4, 9)=   0.78   81.88 Y( 4,10)=   0.27   83.56 Y( 4,11)=   0.20   77.12
 Y( 4,12)=   0.22   78.33 Y( 4,13)=   0.01   72.84 Y( 5, 1)=   0.16   83.22 Y( 5, 2)=   0.06   81.35 Y( 5, 3)=   0.01   81.14
 Y( 5, 4)=   1.12   84.41 Y( 5, 5)=   3.43  -85.65 Y( 5, 6)=   0.61   82.54 Y( 5, 7)=   0.34   82.43 Y( 5, 8)=   0.15   80.68
 Y( 5, 9)=   0.30   84.28 Y( 5,10)=   0.11   85.96 Y( 5,11)=   0.08   79.52 Y( 5,12)=   0.09   80.73 Y( 5,13)=   0.01   75.25
 Y( 6, 1)=   0.29   79.12 Y( 6, 2)=   0.10   77.25 Y( 6, 3)=   0.02   77.04 Y( 6, 4)=   1.58   80.13 Y( 6, 5)=   0.61   82.54
 Y( 6, 6)=   6.94  -87.31 Y( 6, 7)=   1.40   84.10 Y( 6, 8)=   0.40   76.86 Y( 6, 9)=   0.70   79.48 Y( 6,10)=   0.42   87.63
 Y( 6,11)=   0.32   81.19 Y( 6,12)=   0.34   82.41 Y( 6,13)=   0.02   76.92 Y( 7, 1)=   0.18   78.10 Y( 7, 2)=   0.06   76.22
 Y( 7, 3)=   0.01   76.01 Y( 7, 4)=   0.88   80.03 Y( 7, 5)=   0.34   82.43 Y( 7, 6)=   1.40   84.10 Y( 7, 7)=   4.97  -88.31
 Y( 7, 8)=   0.28   74.94 Y( 7, 9)=   0.47   77.53 Y( 7,10)=   0.32   85.85 Y( 7,11)=   0.24   79.41 Y( 7,12)=   0.26   80.63
 Y( 7,13)=   0.02   75.14 Y( 8, 1)=   0.12   77.04 Y( 8, 2)=   0.05   75.16 Y( 8, 3)=   0.01   74.95 Y( 8, 4)=   0.40   78.27
 Y( 8, 5)=   0.15   80.68 Y( 8, 6)=   0.40   76.86 Y( 8, 7)=   0.28   74.94 Y( 8, 8)=   2.25  -88.21 Y( 8, 9)=   0.25   76.80
 Y( 8,10)=   0.09   78.04 Y( 8,11)=   0.07   71.60 Y( 8,12)=   0.07   72.81 Y( 8,13)=   0.00   67.33 Y( 9, 1)=   0.16   79.96
 Y( 9, 2)=   0.06   78.08 Y( 9, 3)=   0.01   77.87 Y( 9, 4)=   0.78   81.88 Y( 9, 5)=   0.30   84.28 Y( 9, 6)=   0.70   79.48
 Y( 9, 7)=   0.47   77.53 Y( 9, 8)=   0.25   76.80 Y( 9, 9)=   3.57  -88.15 Y( 9,10)=   0.15   81.05 Y( 9,11)=   0.11   74.61
 Y( 9,12)=   0.12   75.82 Y( 9,13)=   0.01   70.33 Y(10, 1)=   0.06   81.37 Y(10, 2)=   0.02   79.50 Y(10, 3)=   0.00   79.29
 Y(10, 4)=   0.27   83.56 Y(10, 5)=   0.11   85.96 Y(10, 6)=   0.42   87.63 Y(10, 7)=   0.32   85.85 Y(10, 8)=   0.09   78.04
 Y(10, 9)=   0.15   81.05 Y(10,10)=   3.79  -72.24 Y(10,11)=   0.59   84.77 Y(10,12)=   0.53   87.43 Y(10,13)=   0.03   81.95
 Y(11, 1)=   0.04   74.93 Y(11, 2)=   0.02   73.06 Y(11, 3)=   0.00   72.85 Y(11, 4)=   0.20   77.12 Y(11, 5)=   0.08   79.52
 Y(11, 6)=   0.32   81.19 Y(11, 7)=   0.24   79.41 Y(11, 8)=   0.07   71.60 Y(11, 9)=   0.11   74.61 Y(11,10)=   0.59   84.77
 Y(11,11)=   2.32  -87.77 Y(11,12)=   0.39   80.99 Y(11,13)=   0.03   75.51 Y(12, 1)=   0.05   76.15 Y(12, 2)=   0.02   74.27
 Y(12, 3)=   0.00   74.06 Y(12, 4)=   0.22   78.33 Y(12, 5)=   0.09   80.73 Y(12, 6)=   0.34   82.41 Y(12, 7)=   0.26   80.63
 Y(12, 8)=   0.07   72.81 Y(12, 9)=   0.12   75.82 Y(12,10)=   0.53   87.43 Y(12,11)=   0.39   80.99 Y(12,12)=   2.71  -79.02
 Y(12,13)=   0.13   69.47 Y(13, 1)=   0.00   70.66 Y(13, 2)=   0.00   68.78 Y(13, 3)=   0.00   68.57 Y(13, 4)=   0.01   72.84
 Y(13, 5)=   0.01   75.25 Y(13, 6)=   0.02   76.92 Y(13, 7)=   0.02   75.14 Y(13, 8)=   0.00   67.33 Y(13, 9)=   0.01   70.33
 Y(13,10)=   0.03   81.95 Y(13,11)=   0.03   75.51 Y(13,12)=   0.13   69.47 Y(13,13)=   0.30  -88.00 Y(
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GRAPH FOR UNSUSTAINED FAULT WITHOUT AUTORECLOSER

REFERENCE MACHINE 9 IS GHORASAL-132

3-PHASE FAULT AT ISHURDI-132

FAULT TYPE = A

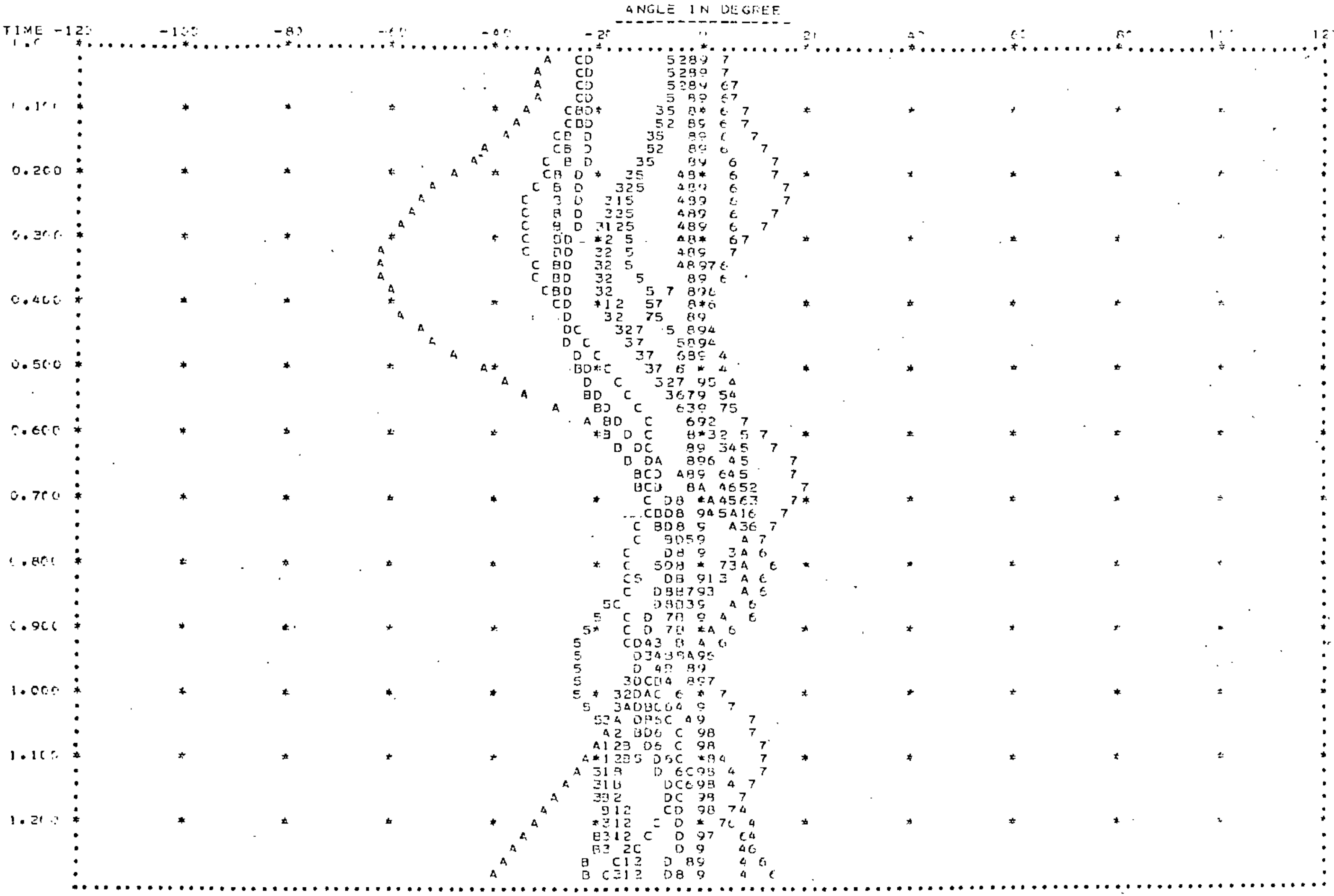

Fig.6.25 (Without Governor)

* * * MEANING OF THE CODES * * *

1=KAPTAI 2=SIKALBAHA 3=HALISHAHAR 4=ASHUGANG-132 5=SHAHJIBAZAR 6=ASHUGANG-23 7=GHORASAL-23

8=SIDDIRGANG 9=GHORASAL-132 A=GOALPARA B=BHERAMARA C=BOGRA D=SAIDPUR

GRAPH FOR FAULT CLEARED AT 8 CYCLES LATER & RECLOSE AFTER 28 CYCLES

REFFERENCE MACHINE 9 IS GHORASAL-132

3-PHASE FAULT AT ISHURDI-132

FAULT TYPE = A

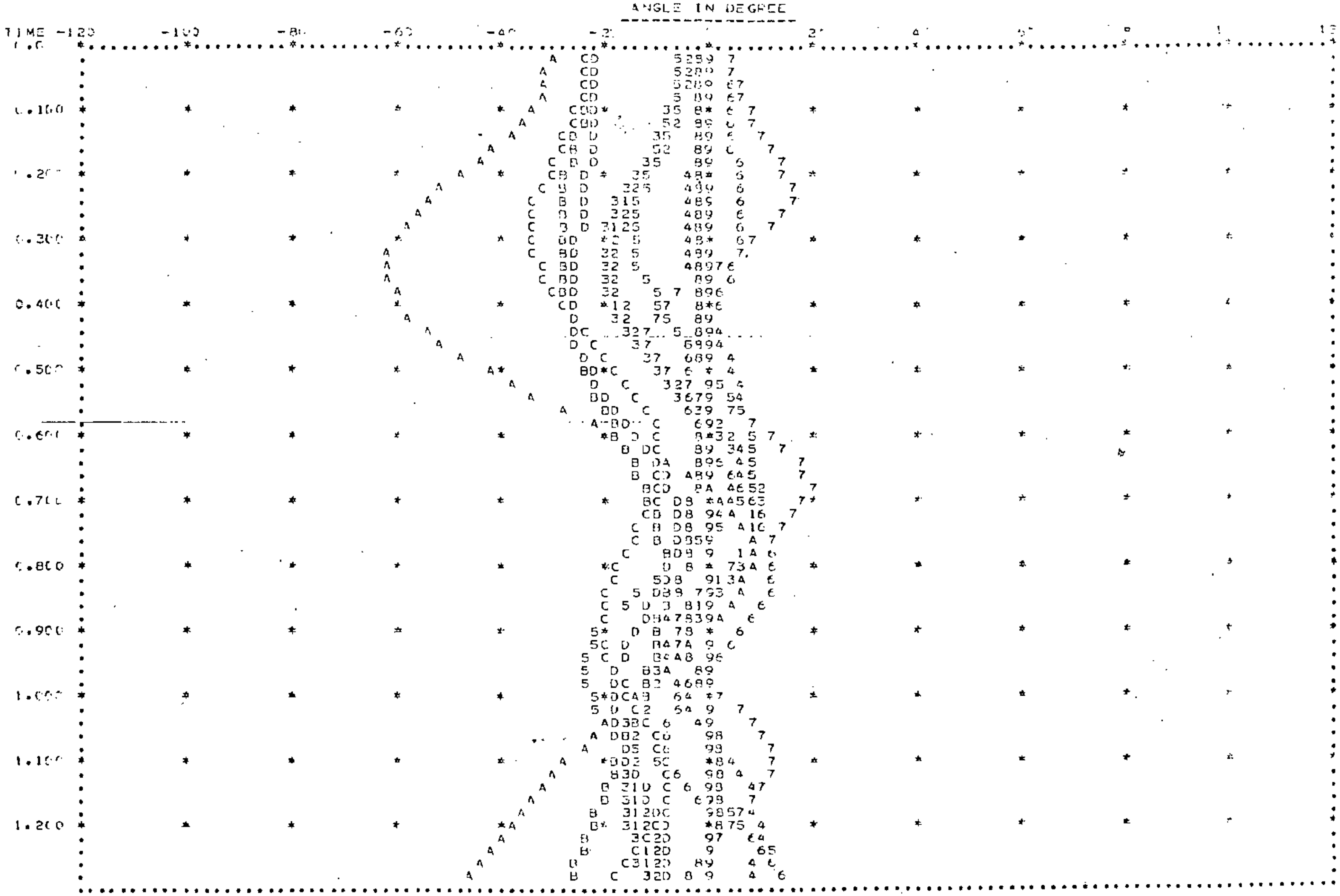

Fig.6.26 (Without Governor)

* * * MEANING OF THE CODES * * *

1=KAPTAI
2=SIKALBAHA
3=HALISHAHAR
4=ASHUGANG-132
5=SHAHJIBAZAR
6=ASHUGANG-230
7=GHORASAL-230
8=SIDDIRGANG
9=GHORASAL-132
A=GOALPARA
B=BHERAMARA
C=BOGRA
D=SAIDPUR

GRAPH FOR SUSTAINED FAULT CLEARED AT 8 CYCLES LATER,RECLOSES AFTER 28 CYCLES & THEN OPEN AFTER 30 CYCLES

REFERENCE MACHINE 9 IS GHORASAL-132

3-PHASE FAULT AT ISHURDI-132

FAULT TYPE = 4

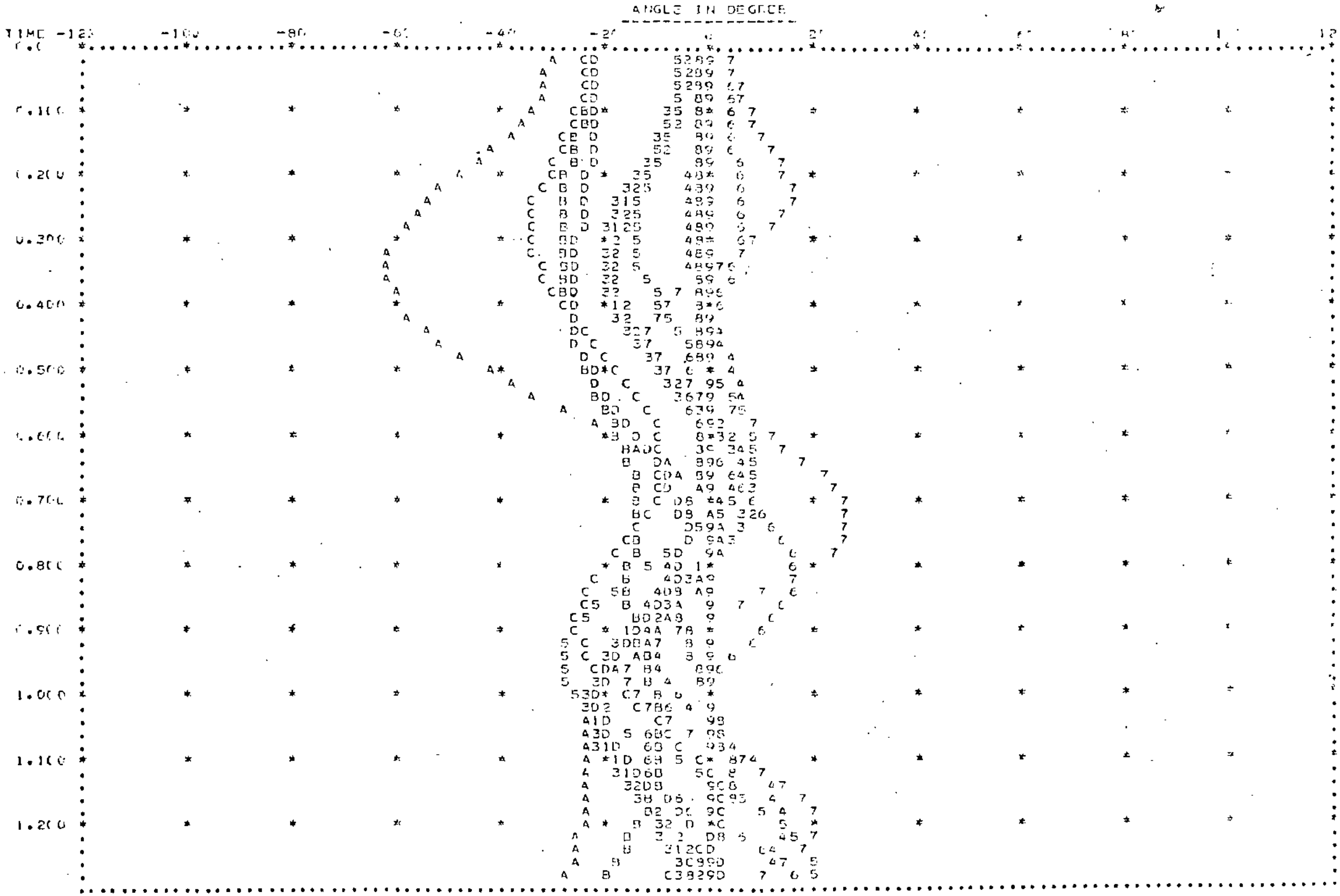

Fig.6.27 (Without Governor)

* * * MEANING OF THE CODES * * *

1=KAPTAI
2=SIKALBAHA
3=HALISHAHAR
4=ASHUGANG-132
5=SHAHJIBAZAR
6=ASHUGANG-230
7=GHORASAL-230
8=SIDDIRGANG
9=GHORASAL-132
A=GOALPARA
B=BHERAMARA
C=BOGRA
D=SAIDPUR

DATA FOR TIME VS. ANGLE(DEG)PLOTTING

TIME	KAPTAI	SIKAL-BAHA	HALI-SAHAR	ASUGANG -132-	SHAHJI-BAZAR	ASUGANG -230-	GHORASAL -230-	SIDDIR-GANG	GHORA-SAL-132	GOAL-PARA	BHERA-MARA	BOGRA	SAIDPUR
0.0	1.63	3.21	1.57	7.35	1.83	10.63	11.64	5.00	7.36	-23.47	-16.58	-16.62	-14.89
0.020	1.65	3.23	1.58	7.43	1.87	10.79	11.96	5.11	7.48	-23.56	-16.50	-16.58	-14.76
0.040	1.69	3.29	1.62	7.66	1.98	11.28	12.90	5.47	7.86	-23.82	-16.25	-16.47	-14.43
0.060	1.78	3.39	1.70	8.04	2.17	12.08	14.44	6.06	8.47	-24.26	-15.84	-16.29	-13.85
0.080	1.90	3.54	1.81	8.57	2.44	13.18	16.50	6.87	9.33	-24.87	-15.27	-16.04	-13.06
0.100	2.08	3.74	1.96	9.27	2.81	14.59	19.01	7.92	10.42	-25.65	-14.54	-15.72	-12.06
0.120	2.30	4.00	2.16	10.14	3.28	16.28	21.89	9.20	11.75	-26.61	-13.65	-15.33	-10.86
0.140	2.60	4.33	2.41	11.18	3.89	18.25	25.04	10.70	13.31	-27.74	-12.61	-14.86	-9.47
0.160	2.96	4.74	2.74	12.43	4.63	20.48	28.35	12.44	15.11	-29.04	-11.42	-14.31	-7.92
0.180	3.43	5.24	3.14	13.87	5.54	22.95	31.75	14.40	17.12	-30.50	-10.10	-13.69	-6.23
0.200	3.97	5.82	3.62	15.44	6.60	25.40	34.60	16.43	19.20	-31.91	-8.66	-12.91	-4.53
0.220	4.59	6.47	4.17	17.06	7.79	27.56	36.31	18.39	21.17	-33.01	-7.16	-11.88	-2.99
0.240	5.31	7.19	4.79	18.74	9.12	29.39	36.88	20.27	23.02	-33.77	-5.62	-10.61	-1.63
0.260	6.12	8.00	5.51	20.45	10.61	30.88	36.36	22.05	24.73	-34.15	-4.08	-9.11	-0.46
0.280	7.05	8.90	6.32	22.20	12.24	32.00	34.92	23.71	26.30	-34.17	-2.56	-7.39	0.49
0.300	8.08	9.91	7.23	23.96	14.01	32.76	32.73	25.23	27.68	-33.78	-1.11	-5.48	1.25
0.320	9.23	11.00	8.25	25.70	15.90	33.14	30.06	26.58	28.86	-32.96	0.24	-3.43	1.61
0.340	10.48	12.19	9.37	27.38	17.87	33.14	27.18	27.74	29.82	-31.76	1.48	-1.28	2.20
0.360	11.83	13.47	10.58	28.97	19.90	32.79	24.38	28.69	30.54	-30.13	2.57	0.91	2.45
0.380	13.26	14.82	11.88	30.43	21.95	32.11	21.94	29.38	31.00	-28.10	3.50	3.10	2.59
0.400	14.77	16.23	13.26	31.72	23.96	31.16	20.11	29.83	31.20	-25.68	4.26	5.21	2.65
0.420	16.34	17.69	14.70	32.81	25.91	29.99	19.07	30.01	31.14	-22.88	4.86	7.19	2.75
0.440	17.94	19.18	16.20	33.67	27.74	28.69	18.94	29.94	30.84	-19.75	5.30	9.00	2.85
0.460	19.57	20.69	17.73	34.28	29.41	27.34	19.74	29.62	30.32	-16.31	5.63	10.59	3.04
0.480	21.21	22.20	19.28	34.63	30.88	26.05	21.44	29.07	29.61	-12.60	5.87	11.93	3.35
0.500	22.82	23.70	20.84	34.72	32.12	24.91	23.89	28.34	28.76	-8.67	6.07	13.01	3.82
0.520	24.41	25.16	22.38	34.55	33.10	24.03	26.90	27.45	27.84	-4.56	6.29	13.81	4.47
0.540	25.94	26.58	23.88	34.15	33.79	23.50	30.22	26.48	26.89	-0.22	6.58	14.35	5.33
0.560	27.40	27.94	25.34	33.53	34.20	23.39	33.60	25.46	25.99	3.98	7.01	14.65	6.41
0.580	28.77	29.22	26.73	32.75	34.30	23.76	36.78	24.47	25.21	8.29	7.63	14.76	7.66
0.600	30.04	30.42	28.03	31.84	34.11	24.62	39.52	23.57	24.60	12.55	8.47	14.71	9.1
0.620	31.20	31.52	29.23	30.86	33.64	25.98	41.63	22.82	24.23	16.70	9.59	14.56	10.70
0.640	32.24	32.52	30.32	29.85	32.91	27.79	43.00	22.27	24.13	20.70	10.99	14.37	12.41
0.660	33.14	33.41	31.28	28.89	31.94	30.00	43.57	21.99	24.34	24.48	12.69	14.22	14.19
0.680	33.90	34.17	32.11	28.02	30.79	32.49	43.35	22.00	24.87	28.01	14.66	14.15	15.99
0.700	34.52	34.82	32.78	27.29	29.49	35.17	42.44	22.33	25.73	31.23	16.87	14.23	17.77
0.720	34.99	35.34	33.31	26.76	28.09	37.91	40.98	22.99	26.91	34.12	19.29	14.52	19.48
0.740	35.32	35.73	33.68	26.47	26.65	40.56	39.10	23.98	28.36	36.64	21.84	15.06	21.08
0.760	35.50	36.00	33.90	26.45	25.21	43.01	37.28	25.29	30.06	38.77	24.46	15.88	22.54
0.780	35.54	36.14	33.97	26.71	23.85	45.14	35.54	26.89	31.93	40.50	27.07	17.00	23.83
0.800	35.46	36.17	33.89	27.28	22.62	46.85	34.19	28.73	33.93	41.80	29.59	18.43	24.94
0.820	35.26	36.09	33.68	28.16	21.57	48.08	33.45	30.78	35.99	42.69	31.94	20.15	25.87
0.840	34.96	35.92	33.35	29.33	20.76	48.79	33.48	32.98	38.05	43.17	34.06	22.15	26.63
0.860	34.57	35.66	32.91	30.79	20.24	48.99	34.34	35.26	40.03	43.24	35.86	24.39	27.23
0.880	34.11	35.33	32.38	32.51	20.04	48.70	36.06	37.58	41.90	42.93	37.35	26.81	27.72
0.900	33.60	34.95	31.80	34.44	20.21	47.99	38.55	39.87	43.60	42.26	38.45	29.37	28.12
0.920	33.07	34.54	31.17	36.56	20.77	46.97	41.68	42.07	45.09	41.26	39.16	31.98	28.48
0.940	32.54	34.11	30.52	38.80	21.74	45.76	45.22	44.14	46.36	39.96	39.47	34.59	28.64
0.960	32.03	33.69	29.89	41.14	23.13	44.49	48.94	46.04	47.39	38.41	39.41	37.10	29.26
0.980	31.56	33.31	29.29	43.50	24.92	43.32	52.56	47.71	48.18	36.64	39.02	39.43	29.77
1.000	31.16	32.97	28.76	45.85	27.10	42.40	55.83	49.15	48.76	34.70	38.23	41.52	30.39
1.020	30.84	32.70	28.30	48.12	29.65	41.84	58.52	50.32	49.13	32.63	37.42	43.28	31.16
1.040	30.63	32.52	27.96	50.28	32.51	41.75	60.46	51.23	49.33	30.47	36.33	44.66	32.07
1.060	30.55	32.45	27.75	52.27	35.64	42.21	61.54	51.87	49.41	28.28	35.14	45.60	33.11
1.080	30.61	32.49	27.68	54.06	38.98	43.23	61.72	52.24	49.39	26.09	33.92	46.07	34.27
1.100	30.81	32.67	27.77	55.63	42.46	44.82	61.04	52.37	49.33	23.93	32.73	46.03	35.49
1.120	31.18	33.00	28.03	56.94	46.01	46.91	59.61	52.27	49.27	21.85	31.62	45.50	36.72
1.140	31.70	33.47	28.47	57.98	49.54	49.41	57.61	51.99	49.24	19.88	30.63	44.47	37.90
1.160	32.40	34.10	29.09	58.75	52.97	52.22	55.28	51.55	49.28	18.04	29.82	42.99	38.95
1.180	33.26	34.88	29.90	59.26	56.24	55.17	52.87	50.99	49.43	16.37	29.19	41.09	39.81
1.200	34.28	35.81	30.90	59.50	59.26	58.12	50.67	50.37	49.69	14.88	28.76	38.85	40.39
1.220	35.46	36.89	32.07	59.52	61.97	60.91	48.93	49.72	50.09	13.59	28.54	36.34	40.62
1.240	36.78	38.12	33.40	59.33	64.30	63.40	47.89	49.10	50.64	12.51	28.50	33.65	40.47
1.260	38.23	39.47	34.89	58.97	66.21	65.46	47.68	48.55	51.33	11.67	28.63	30.88	39.87

GRAPH FOR UNSUSTAINED FAULT WITHOUT AUTORECLOSER

REFFERENCE MACHINE 9 IS GHORASAL-132

3-PHASE FAULT AT ISHURDI-132

FAULT TYPE = 4

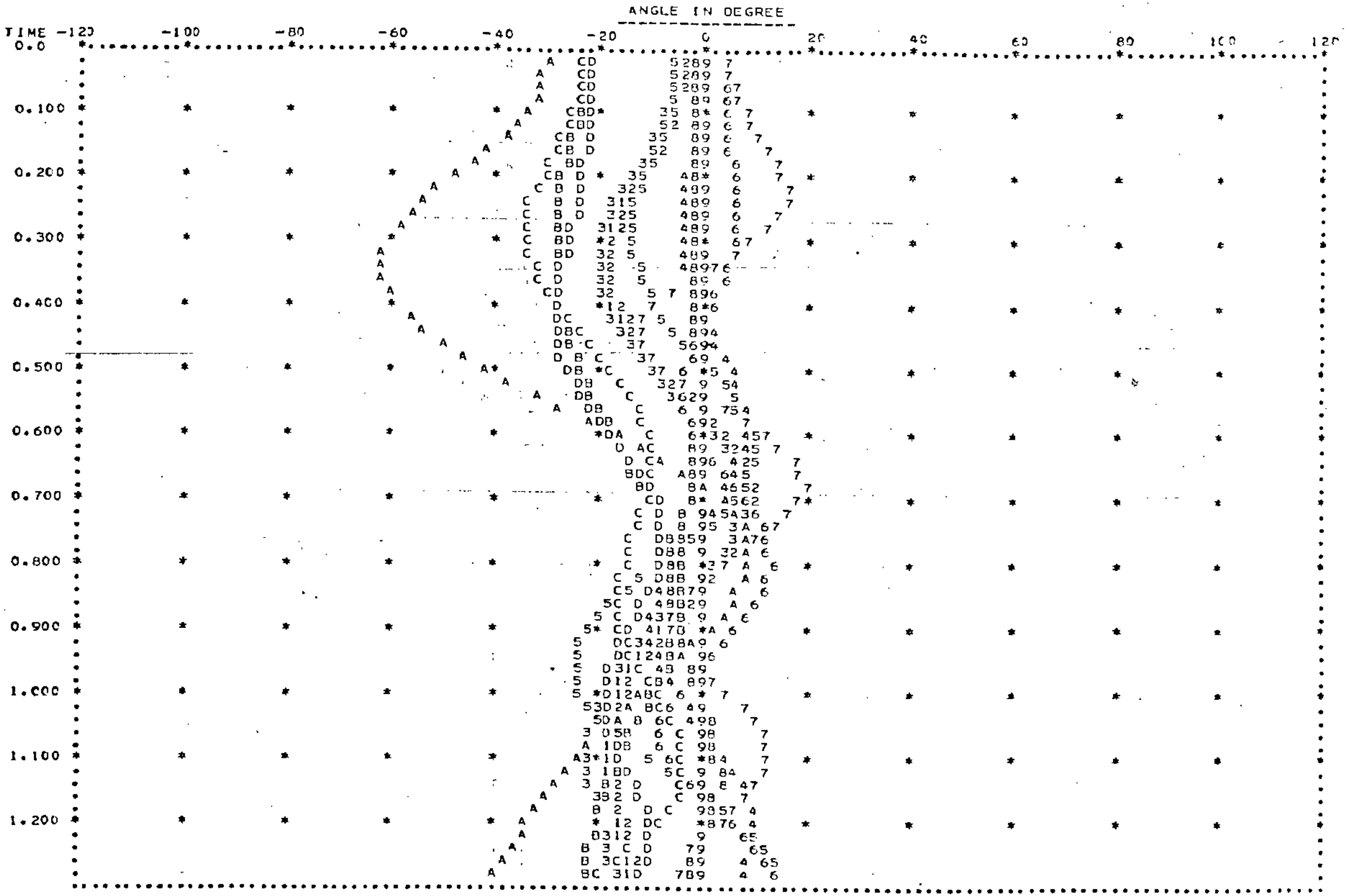

Fig. 6.28 (With Governor)

* * * MEANING OF THE CODES * * *

1=KAPTAI
2=SIKALBAHA
3=HALISHAHAR
4=ASHUGANG-132
5=SHAHJIBAZAR
6=ASHUGANG-230
7=GHORASAL-230
8=SIDDIRGANG
9=GHORASAL-132
A=GOALPARA
B=BHERAMARA
C=BOGRA
D=SAIDPUR

DATA FOR TIME VS. ANGLE(DEG)PLOTTING

TIME	KAPTAI	SIKAL-BAHA	HALI-SAHAR	ASUGANG -132-	SHAHJI-BAZAR	ASUGANG -230-	GHORASAL -230-	SIDDIR-GANG	GHORA-SAL-132	GUAL-PARA	BHERA-MAPA	BOGRA	SAIDPUR
0.0	1.63	3.21	1.57	7.35	1.83	10.63	11.64	5.00	7.36	-23.47	-16.58	-16.62	-14.89
0.020	1.65	3.23	1.58	7.43	1.87	10.79	11.96	5.11	7.48	-23.56	-16.50	-16.58	-14.78
0.040	1.69	3.29	1.62	7.66	1.98	11.28	12.90	5.47	7.86	-23.82	-16.25	-16.47	-14.43
0.060	1.78	3.39	1.70	8.04	2.17	12.08	14.44	6.05	8.47	-24.26	-15.84	-16.29	-13.85
0.080	1.90	3.54	1.81	8.57	2.44	13.18	16.50	6.87	9.33	-24.87	-15.27	-16.04	-13.06
0.100	2.08	3.74	1.96	9.27	2.81	14.59	19.01	7.92	10.42	-25.65	-14.54	-15.72	-12.06
0.120	2.30	4.00	2.16	10.14	3.28	16.28	21.89	9.20	11.75	-26.61	-13.65	-15.33	-10.86
0.140	2.60	4.33	2.41	11.18	3.89	18.25	25.04	10.72	13.31	-27.74	-12.61	-14.86	-9.47
0.160	2.96	4.74	2.74	12.43	4.63	20.48	28.35	12.44	15.11	-29.04	-11.42	-14.31	-7.92
0.180	3.43	5.24	3.14	13.87	5.54	22.95	31.75	14.40	17.12	-30.50	-10.10	-13.69	-6.23
0.200	3.97	5.82	3.62	15.44	6.60	25.40	34.60	16.43	19.20	-31.91	-8.66	-12.91	-4.53
0.220	4.59	6.47	4.17	17.06	7.79	27.56	36.31	18.39	21.17	-33.01	-7.16	-11.88	-2.99
0.240	5.31	7.19	4.79	18.74	9.12	29.39	36.88	20.27	23.02	-33.77	-5.62	-10.61	-1.63
0.260	6.12	8.00	5.51	20.45	10.61	30.88	36.36	22.05	24.73	-34.16	-4.08	-9.11	-0.46
0.280	7.05	8.90	6.32	22.20	12.24	32.00	34.92	23.71	26.30	-34.17	-2.56	-7.39	0.49
0.300	8.08	9.91	7.23	23.96	14.01	32.76	32.73	25.23	27.68	-33.78	-1.11	-5.48	1.25
0.320	9.23	11.00	8.25	25.70	15.90	33.14	30.06	26.58	28.86	-32.98	0.24	-3.43	1.81
0.340	10.48	12.19	9.37	27.38	17.87	33.14	27.18	27.74	29.82	-31.76	1.48	-1.20	2.20
0.360	11.83	13.47	10.58	28.97	19.90	32.79	24.38	28.68	30.54	-30.13	2.57	0.91	2.45
0.380	13.26	14.82	11.88	30.43	21.95	32.11	21.94	29.38	31.00	-28.10	3.50	3.10	2.59
0.400	14.77	16.23	13.26	31.72	23.96	31.16	20.11	29.83	31.20	-25.68	4.26	5.21	2.68
0.420	16.34	17.69	14.70	32.81	25.91	29.99	19.07	30.01	31.14	-22.88	4.86	7.19	2.75
0.440	17.94	19.18	16.20	33.67	27.74	28.69	18.94	29.94	30.84	-19.75	5.30	9.00	2.85
0.460	19.57	20.69	17.73	34.28	29.41	27.34	19.74	29.62	30.32	-16.31	5.63	10.59	3.04
0.480	21.21	22.20	19.28	34.63	30.88	26.05	21.44	29.07	29.61	-12.60	5.87	11.93	3.35
0.500	22.82	23.70	20.84	34.72	32.12	24.91	23.89	28.34	28.76	-8.67	6.07	13.01	3.82
0.520	24.41	25.16	22.38	34.55	33.10	24.03	26.90	27.45	27.84	-4.56	6.29	13.81	4.47
0.540	25.94	26.58	23.88	34.15	33.79	23.50	30.22	26.48	26.89	-0.32	6.58	14.35	5.33
0.560	27.40	27.94	25.34	33.53	34.20	23.39	33.60	25.46	25.99	3.98	7.01	14.66	6.40
0.580	28.77	29.22	26.73	32.75	34.30	23.76	36.78	24.47	25.21	8.29	7.63	14.76	7.66
0.600	30.04	30.43	28.06	31.84	34.11	24.61	39.52	23.55	24.60	12.52	8.41	14.68	9.13
0.620	31.21	31.56	29.36	30.85	33.63	25.94	41.64	22.80	24.22	16.62	9.36	14.43	10.79
0.640	32.26	32.59	30.60	29.84	32.89	27.69	43.01	22.23	24.12	20.51	10.47	14.07	12.60
0.660	33.17	33.53	31.78	28.87	31.91	29.82	43.59	21.95	24.31	24.15	11.78	13.68	14.52
0.680	33.95	34.37	32.88	27.98	30.73	32.23	43.37	21.85	24.82	27.50	13.28	13.31	16.48
0.700	34.59	35.09	33.87	27.22	29.40	34.81	42.44	22.12	25.65	30.52	14.96	13.03	18.42
0.720	35.08	35.69	34.74	26.65	27.96	37.43	40.95	22.70	26.78	33.18	16.80	12.90	20.29
0.740	35.44	36.16	35.48	26.30	26.46	39.96	39.08	23.59	28.17	35.44	18.75	12.96	22.02
0.760	35.65	36.52	36.07	26.21	24.97	42.28	37.07	24.79	29.79	37.28	20.77	13.27	23.56
0.780	35.72	36.74	36.50	26.39	23.52	44.27	35.16	26.26	31.58	38.69	22.80	13.83	24.87
0.800	35.67	36.85	36.77	26.85	22.20	45.85	33.59	27.97	33.46	39.67	24.78	14.68	25.92
0.820	35.49	36.83	36.86	27.60	21.03	46.93	32.56	29.86	35.39	40.19	26.66	15.81	26.70
0.840	35.21	36.70	36.78	28.63	20.09	47.49	32.24	31.88	37.28	40.29	28.37	17.22	27.19
0.860	34.84	36.46	36.52	29.91	19.41	47.52	32.72	33.98	39.09	39.95	29.86	18.88	27.42
0.880	34.38	36.13	36.11	31.43	19.04	47.04	34.01	36.10	40.75	39.21	31.09	20.74	27.40
0.900	33.87	35.72	35.55	33.14	19.01	46.13	36.07	38.17	42.22	38.09	32.02	22.78	27.18
0.920	33.32	35.25	34.86	35.01	19.35	44.88	38.76	40.14	43.47	36.61	32.62	24.92	26.81
0.940	32.74	34.73	34.06	36.99	20.06	43.40	41.89	41.97	44.46	34.82	32.89	27.11	26.33
0.960	32.16	34.18	33.18	39.02	21.17	41.83	45.24	43.60	45.19	32.74	32.83	29.26	25.83
0.980	31.60	33.63	32.24	41.07	22.66	40.32	48.53	44.99	45.66	30.44	32.45	31.31	25.34
1.000	31.07	33.09	31.28	43.08	24.51	39.02	51.53	46.13	45.88	27.95	31.77	33.17	24.95
1.020	30.59	32.58	30.33	44.99	26.70	38.04	54.00	47.00	45.88	25.31	30.85	34.79	24.70
1.040	30.19	32.13	29.42	46.77	29.18	37.51	55.77	47.59	45.70	22.56	29.71	36.08	24.62
1.060	29.87	31.74	28.58	48.37	31.92	37.50	56.72	47.87	45.37	19.85	28.41	36.98	24.74
1.080	29.04	31.44	27.84	49.76	34.83	38.04	56.80	47.89	44.94	17.02	27.00	37.47	25.07
1.100	29.52	31.23	27.23	50.90	37.87	39.13	56.01	47.64	44.45	14.28	25.54	37.49	25.60
1.120	29.51	31.14	26.77	51.79	40.96	40.74	54.46	47.16	43.95	11.61	24.06	37.02	26.30
1.140	29.62	31.16	26.49	52.41	44.03	42.77	52.30	46.48	43.49	9.05	22.61	36.07	27.13
1.160	29.85	31.31	26.39	52.75	46.99	45.13	49.73	45.63	43.09	6.63	21.24	34.65	28.01
1.180	30.20	31.59	26.49	52.82	49.78	47.67	47.00	44.65	42.80	4.38	19.97	32.78	28.89
1.200	30.67	31.99	26.81	52.63	52.32	50.25	44.39	43.60	42.64	2.32	18.83	30.52	29.60
1.220	31.24	32.51	27.32	52.21	54.55	52.71	42.14	42.52	42.62	0.47	17.84	27.91	30.26
1.240	31.93	33.15	28.05	51.59	56.41	54.90	40.49	41.45	42.75	-1.15	17.00	25.03	30.61
1.260	32.70	33.90	28.96	50.80	57.84	56.70	39.59	40.45	43.03	-2.53	16.31	21.97	30.63

REFFERENCE MACHINE 9 IS GHORASAL-132

3-PHASE FAULT AT ISHURDI-132

FAULT TYPE = 4

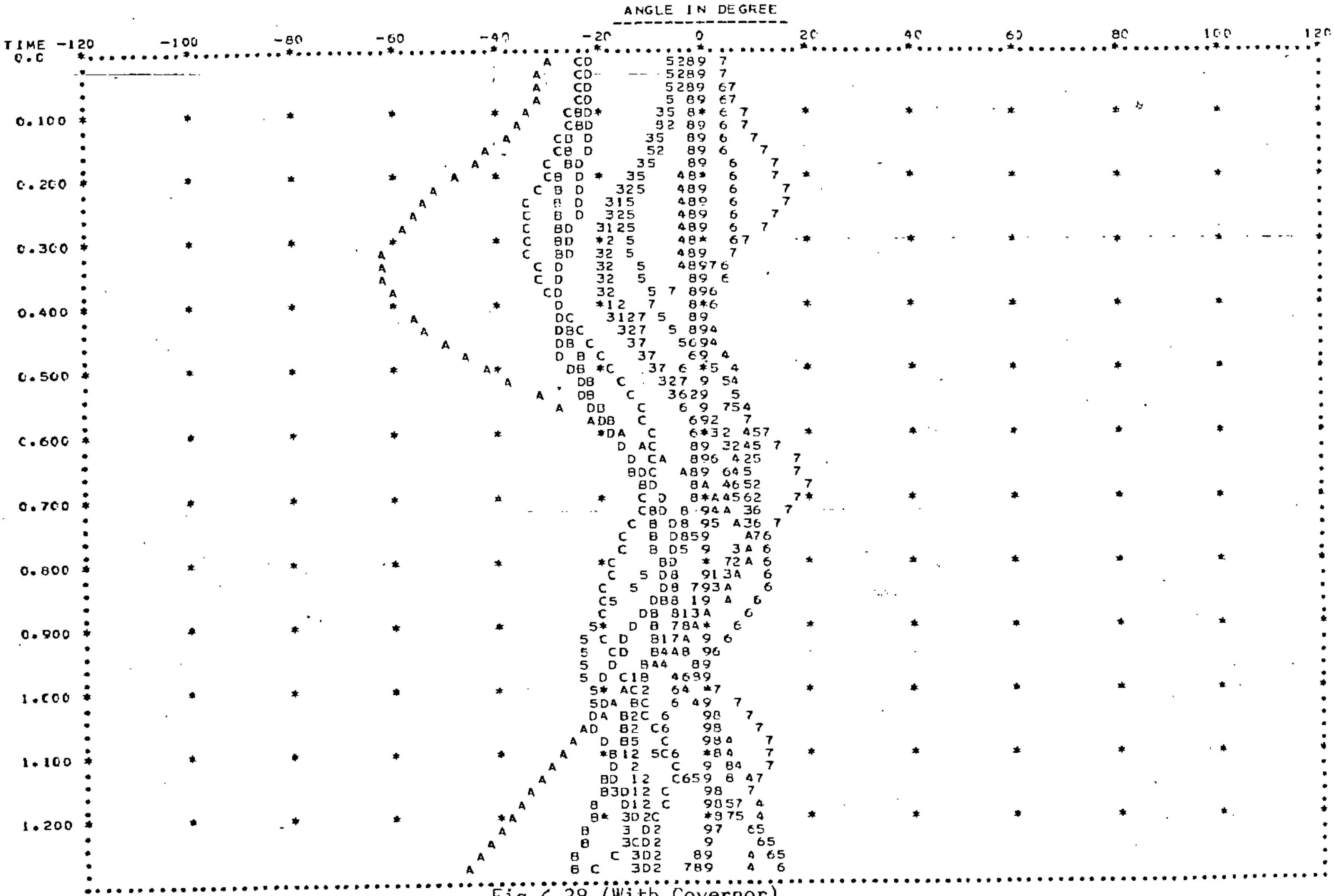

Fig.6.29 (With Governor)

* * * MEANING OF THE CODES * * *

1=KAPTAI
2=SIKALBAHA
3=HALISHAHAR
4=ASHUGANG-132
5=SHAHJIBAZAR
6=ASHUGANG-230
7=GHORASAL-230
8=SIDDIRGANG
9=GHORASAL-132
A=GOALPARA
B=BHERAMARA
C=UOGPA
D=SAIDPUR

DATA FOR TIME VS. ANGLE(DEG) PLOTTING

TIME	KAPTAI	SIKAL-BAHA	HALI-SAHAR	ASUGANG -132-	SHAHJI-BAZAR	ASUGANG -230-	GHORASAL -230-	SIDDIR-GANG	GHORA-SAL-132	GOAL-PARA	BHERA-MARA	BOGRA	SAIDPUR
0.0	1.63	3.21	1.57	7.35	1.83	10.63	11.64	5.03	7.36	-23.47	-16.58	-16.62	-14.89
0.020	1.65	3.23	1.58	7.43	1.87	10.79	11.96	5.11	7.48	-23.56	-16.50	-16.58	-14.78
0.040	1.69	3.29	1.62	7.66	1.98	11.28	12.90	5.47	7.86	-23.82	-16.25	-16.47	-14.43
0.060	1.78	3.39	1.70	8.04	2.17	12.08	14.44	6.05	8.47	-24.26	-15.84	-16.29	-13.85
0.080	1.90	3.54	1.81	8.57	2.44	13.18	16.50	6.87	9.33	-24.87	-15.27	-16.04	-13.06
0.100	2.08	3.74	1.96	9.27	2.81	14.59	19.01	7.92	10.42	-25.65	-14.54	-15.72	-12.06
0.120	2.30	4.00	2.16	10.14	3.28	16.28	21.89	9.20	11.75	-26.61	-13.65	-15.33	-10.86
0.140	2.50	4.33	2.41	11.18	3.89	18.25	25.04	10.73	13.31	-27.74	-12.61	-14.86	-9.47
0.160	2.96	4.74	2.74	12.43	4.63	20.48	28.35	12.44	15.11	-29.04	-11.42	-14.31	-7.92
0.180	3.43	5.24	3.14	13.87	5.54	22.95	31.75	14.40	17.12	-30.50	-10.10	-13.69	-6.23
0.200	3.97	5.82	3.62	15.44	6.60	25.40	34.60	16.43	19.20	-31.91	-8.66	-12.91	-4.53
0.220	4.59	6.47	4.17	17.06	7.79	27.56	36.31	18.39	21.17	-33.01	-7.16	-11.88	-2.99
0.240	5.31	7.19	4.79	18.74	9.12	29.39	36.88	20.27	23.02	-33.77	-5.62	-10.61	-1.65
0.260	6.12	8.00	5.51	20.45	10.61	30.88	36.36	22.05	24.73	-34.16	-4.08	-9.11	-0.46
0.280	7.05	8.90	6.32	22.20	12.24	32.00	34.92	23.71	26.30	-34.17	-2.56	-7.39	0.49
0.300	8.08	9.91	7.23	23.96	14.01	32.76	32.73	25.23	27.68	-33.78	-1.11	-5.48	1.25
0.320	9.23	11.00	8.25	25.70	15.90	33.14	30.06	26.58	28.86	-32.98	0.24	-3.43	1.81
0.340	10.48	12.19	9.37	27.38	17.87	33.14	27.18	27.74	29.82	-31.76	1.48	-1.28	2.20
0.360	11.83	13.47	10.58	28.97	19.90	32.79	24.38	28.69	30.54	-30.13	2.57	0.91	2.45
0.380	13.26	14.82	11.88	30.43	21.95	32.11	21.94	29.38	31.00	-28.10	3.50	3.10	2.59
0.400	14.77	16.23	13.26	31.72	23.96	31.16	20.11	29.83	31.20	-25.68	4.26	5.21	2.68
0.420	16.34	17.69	14.70	32.81	25.91	29.99	19.07	30.01	31.14	-22.88	4.86	7.19	2.75
0.440	17.94	19.18	16.20	33.67	27.74	28.69	18.94	29.94	30.84	-19.75	5.30	9.00	2.85
0.460	19.57	20.69	17.73	34.28	29.41	27.34	19.74	29.62	30.32	-16.31	5.63	10.59	3.04
0.480	21.21	22.20	19.28	34.63	30.88	26.05	21.44	29.07	29.61	-12.60	5.87	11.93	3.35
0.500	22.82	23.70	20.84	34.72	32.12	24.91	23.89	28.34	28.76	-8.67	6.07	13.01	3.82
0.520	24.41	25.16	22.38	34.55	33.10	24.03	26.90	27.46	27.84	-4.56	6.29	13.81	4.47
0.540	25.94	26.58	23.88	34.15	33.79	23.50	30.22	26.48	26.89	-0.32	6.58	14.25	5.33
0.560	27.40	27.94	25.34	33.53	34.20	23.39	33.60	25.46	25.99	3.98	7.01	14.66	6.49
0.580	28.77	29.22	26.73	32.75	34.30	23.76	36.78	24.47	25.21	8.29	7.63	14.76	7.66
0.600	30.07	30.46	28.09	31.93	34.16	24.73	39.92	23.67	24.71	12.49	8.44	14.80	9.19
0.620	31.33	31.70	29.46	31.19	33.86	26.42	43.23	23.23	24.66	16.51	9.43	14.90	11.07
0.640	32.53	32.91	30.84	30.59	33.40	28.78	46.57	23.17	25.07	20.34	10.63	15.07	13.26
0.660	33.66	34.11	32.20	30.16	32.80	31.75	49.80	23.53	25.96	23.99	12.02	15.30	15.72
0.680	34.72	35.27	33.54	29.96	32.12	35.28	52.82	24.35	27.36	27.45	13.62	15.59	18.41
0.700	35.72	36.40	34.85	30.03	31.38	39.26	55.53	25.63	29.24	30.72	15.43	15.96	21.30
0.720	36.66	37.50	36.11	30.41	30.64	43.60	57.92	27.39	31.61	33.79	17.45	16.40	24.32
0.740	37.55	38.57	37.33	31.16	29.96	48.19	59.96	29.64	34.44	36.67	19.69	16.92	27.44
0.760	38.38	39.59	38.46	32.26	29.39	52.73	61.20	32.30	37.61	39.29	22.25	17.68	30.49
0.780	39.14	40.54	39.50	33.72	28.97	56.90	61.25	35.29	40.99	41.58	25.20	18.88	33.28
0.800	39.85	41.43	40.45	35.56	28.79	60.59	60.30	38.54	44.51	43.55	28.49	20.56	35.77
0.820	40.54	42.27	41.29	37.79	28.90	63.67	58.59	42.03	48.10	45.19	32.07	22.74	37.92
0.840	41.21	43.07	42.06	40.38	29.35	66.08	56.46	45.69	51.67	46.51	35.83	25.42	39.72
0.860	41.89	43.86	42.74	43.31	30.20	67.75	54.23	49.44	55.14	47.52	39.68	28.56	41.17
0.880	42.58	44.62	43.36	46.53	31.47	68.67	52.26	53.18	58.42	48.24	43.51	32.13	42.28
0.900	43.32	45.40	43.92	49.98	33.17	68.86	50.88	56.84	61.42	48.69	47.20	36.05	43.11
0.920	44.10	46.18	44.44	53.59	35.32	68.38	50.35	60.33	64.10	48.90	50.63	40.24	43.71
0.940	44.95	46.99	44.94	57.28	37.91	67.32	50.85	63.56	66.38	48.91	53.72	44.59	44.16
0.960	45.88	47.85	45.44	60.97	40.92	65.84	52.47	66.47	68.23	48.73	56.36	48.99	44.53
0.980	46.89	48.76	45.97	64.58	44.31	64.11	55.19	69.01	69.65	48.42	58.51	53.33	44.93
1.000	48.00	49.74	46.54	68.03	48.05	62.32	58.88	71.13	70.63	48.00	60.11	57.47	45.44
1.020	49.21	50.81	47.18	71.26	52.08	60.69	63.31	72.81	71.21	47.52	61.16	61.32	46.14
1.040	50.53	51.96	47.92	74.20	56.33	59.44	68.21	74.05	71.44	47.02	61.67	64.76	47.12
1.060	51.97	53.23	48.78	76.82	60.73	58.74	73.24	74.86	71.39	46.52	61.69	67.70	48.41
1.080	53.51	54.60	49.78	79.07	65.20	58.78	78.07	75.29	71.14	46.05	61.28	70.08	50.06
1.100	55.18	56.10	50.93	80.94	69.67	59.66	82.40	75.35	70.78	45.60	60.53	71.84	52.05
1.120	56.95	57.72	52.26	82.44	74.05	61.44	85.98	75.14	70.43	45.36	59.53	72.94	54.36
1.140	58.83	59.47	53.77	83.56	78.26	64.13	88.63	74.72	70.16	45.17	58.40	73.39	56.94
1.160	60.81	61.34	55.46	84.33	82.23	67.66	90.26	74.18	70.09	45.12	57.24	73.20	59.71
1.180	62.88	63.33	57.35	84.79	85.89	71.93	90.85	73.58	70.28	45.20	56.15	72.40	62.55
1.200	65.04	65.43	59.42	84.98	89.17	76.76	90.49	73.03	70.80	45.43	55.25	71.06	65.35
1.220	67.26	67.62	61.65	84.96	92.01	81.93	89.34	72.60	71.70	45.82	54.60	69.26	67.99
1.240	69.55	69.90	64.05	84.78	94.39	87.22	87.63	72.37	73.00	46.37	54.29	67.08	70.34
1.260	71.87	72.24	66.58	84.51	96.25	92.38	85.64	72.40	74.70	47.06	54.35	64.66	72.27

GRAPH FOR SUSTAINED FAULT CLEARED AT 8 CYCLES LATER,RECLOSES AFTER 28 CYCLES & THEN OPEN AFTER 36 CYCLES

REFFERENCE MACHINE 9 IS GHORASAL-132

3-PHASE FAULT AT ISHURDI-132

FAULT TYPE = 4

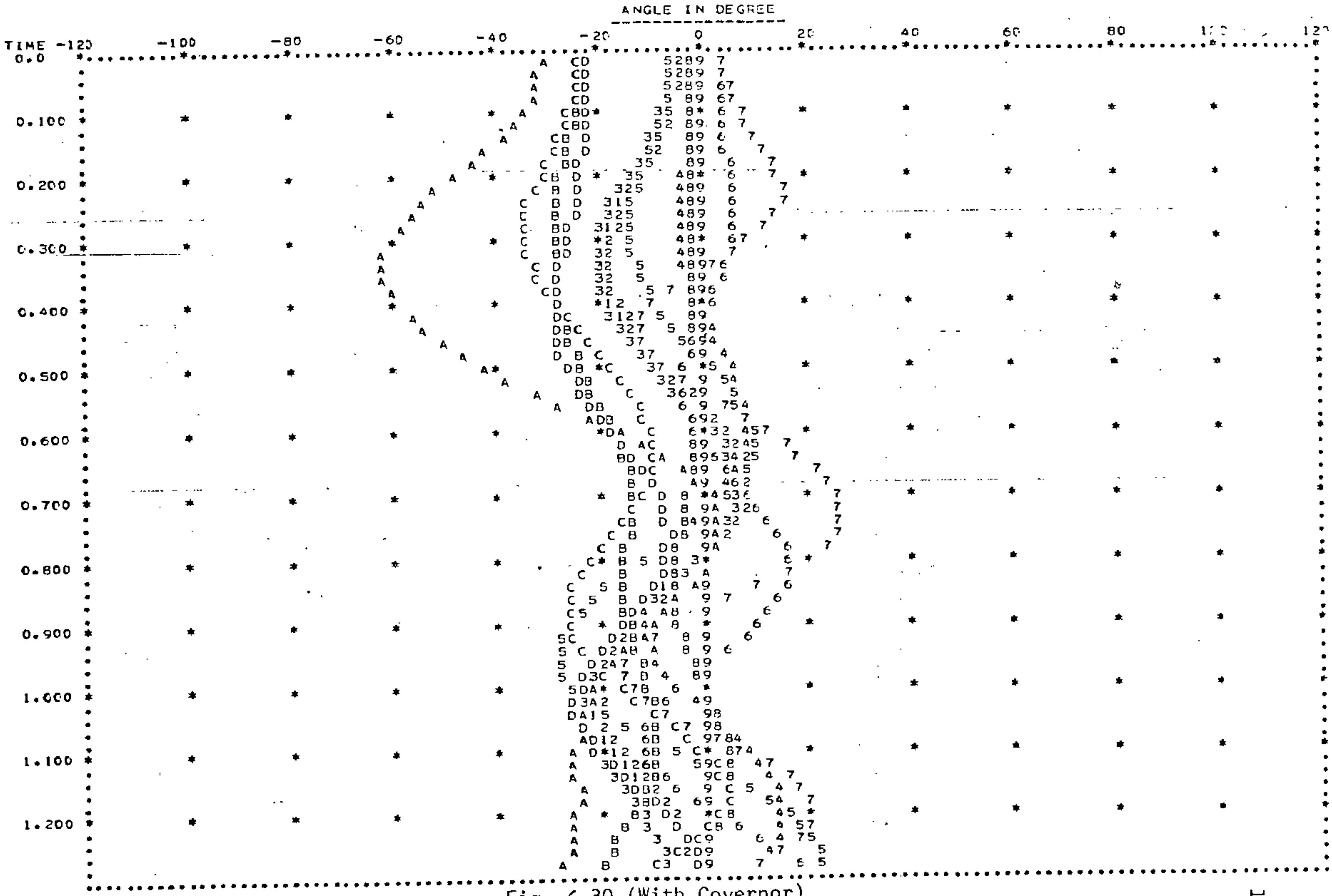

Fig. 6.30 (With Governor)

* * * MEANING OF THE CODES * * *

1=KAPTAI
2=SIKALBAHA
3=HALISHAHAR
4=ASHUGANG-132
5=SHAHJIBAZAR
6=ASHUGANG-230
7=GHORASAL-230
8=SIDDIRGANG
9=GHORASAL-132
A=GOALPARA
B=BHERAMARA
C=BOGRA
D=SAIDPUR

TABLE - 9

Fault No.	Driving point & transfer		Mode of CB operation	Result with Governor action	
	Admittance	Impedance		neglected	considered
1	✓	✓	A	Stable	Stable
			B	Stable	Stable
			C	Ghorasal-230 unstable	Stable
2	✓	—	A	Bogra unstable	Bogra unstable
			B	Bogra & Saidpur unstable	Stable
			C	Bogra unstable	Bogra unstable
3	—	✓	A	Stable	Stable
			B	Stable	Stable
			C	Stable	Stable
4	✓	—	A	Stable	Stable
			B	Stable	Stable
			C	Stable	Stable

CHAPTER 7

SUGGESTIONS AND CONCLUSIONS

7.1 SUMMARY AND CONCLUSIONS

In this study the interconnected grid system of Bangladesh Power Development Board is studied for 3-phase faults of different types with three MODE of circuit breakers/Autoreclosers operations. Transient stability study by using driving point and transfer admittances is very fast and convenient. The transfer and driving point admittances is obtained by reducing all the physical buses of the network except the ficticious buses at which machine internal voltages are connected. The reduction of physical buses is done by matrix node elimination method. Some assumptions have been made in this study. These are:

(1) Damping is assumed same and constant for all the machines.

(2) Each machine in the system is represented by a constant reactance (direct axis transient reactance) in series with a constant electromotive force (voltage behind the direct axis transient reactance or internal bus voltage).

(3) The governor and turbine time constants are assumed values as suggested in different books.[5,13]

The four different 3-phase short circuit (sustained and unsustained) at four different locations which are studied in this work cover all types of major disturbances such as load rejection, generation rejection, loss of transmission facility. The swing equations are solved by Rungee-Kutta fourth order approximation & printed by the computer.

The computer program given in the Appendix is very efficient with less human intervention and this generalized program can be used for any power system network. In order to reduce computer storage requirements nine different COMMON statements are used to share the storage by the main program and different SUBROUTINES.

The calculation of driving point and transfer admittances, driving point and transfer impedances for post-fault, during fault and prefault conditions and plotting of the swing curves after calculating the swing equations is automatic. Calculation and plotting can be made by taking or neglecting the governor actions for any machine by the same program with simply IGVORN = 1 or IGVORN = 0 respectively.

By a single computer RUN, any number of faults of different or same type at any location can be computed for any number of circuit breker/Autorecloser time setting.

7.2 SCOPE OF FURTHER RESEARCH

In this study we consider that the internal voltage magnitudes of the machines remain constant during transient period. But in the actual case the voltage magnitude in much reduced. In actual practicethe exciter control system comes into play and increases the excitation and hance the excitation voltage. So, in order to obtain more realestic results, the effect of exciter control system should be taken into consideration. Further [illegible] include the effect of excitation ther extension of this work can include the effect of excitation control. By including another SUBROUTINE with the computer program given in the appendix, the effect of excitation can be taken into consideration. Through this SUBROUTINE the magnitude of the voltages will be calculated by solving the set of differential equations representating the excitation control system and the modified internal voltage with time should be used for solving swing equations.

In this study it is found that the machine at Kaptai, Sikalbaha and Halishahar power stations oscillate almost together in the same manner with other machines of the system. So in future studies these machines can be grouped together and represented by a single equivalent machine with equivalent inertia constant.

Machines of Bogra and Saidpur also oscillate with smaller relative angular displacement between themselves. These machines also may grouped together.

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APPENDIX

COMPUTER PROGRAMS

```
 ********************************************************************
 *                                                                  *
 *         PROGRAMME TO SHOW TRANSIENT STABILITY RESPONSE           *
 *   DUE TO 3-PHASE TO GROUND FAULT AT ANY LINES CONNECTING THE     *
 *   BUSES OR AT ANY BUS OR DUE TO SUDDEN LOAD REJECTION            *
 *------------------------------------------------------------------*
 *         PROGRAMME DEVELOPED BY MD. EASIN KHAN                    *
 *         LECTURER. DEPT. OF EEE. FOR M.SC. THESIS UNDER THE       *
 *         SUPERVISION OF DR.JAMALUDDIN AHMED                       *
 *------------------------------------------------------------------*
      INTEGER  STBUS.ENDBUS.ST.END.SB.ER
      DIMENSION STBUS(90).ENDBUS(90).T(150).DD(15.150).PS(30).AC(15).
     +THETA1(15.15).THETA2(15.15).V(15.150).DEL(15.150).DIV(30).E(30).
     +BZR(15.15).CZR(15.15).H(13).NAME(100.3).MS(400).ME(400).SM(400).
     +EX(400).DZR(15.15).THETA3(15.15).DV(15.150).AB(15)
      COMPLEX YLD(36).AMTXK(13.13).PR1(13).GCUR.
     +ZL( 90).YL( 90).BL(36).BV(36).BZR1(13.13).CZR1(13.13).DZR1(13.13).
     +AMTXL(13.36).AMTXLT(36.13).A(36.36).Y(36.72).TLOAD.FLOAD.XD(13)
      COMMON /ANGLE/ DEL
      COMMON /EA2/ GRAP(2000).KEK.PCODE
      COMMON /EA1/ E.PS.NG
      COMMON /EA4/ TT(13).TG(13).DC(13).BT1(13).R(13).PGMAX(13).
     +IGOVRN(13).X3(13).X4(13)
      COMMON /EA3/ V.DIV.DT.F.WO.CON.DD.DV
      COMMON /EA5/ MS.ME.SM.EX
      COMMON /EA6/ NAME.KKM.IFAULT.IFB1.IFB2
      COMMON /EA7/ PGR(15.150)
      COMMON /EA8/ A.Y
      READ(1.101) LBUS.NG.NLB
  101 FORMAT(3I2)
      READ(1.5) ((NAME(I.J).J=1.3).I=1.LBUS)
 5    FORMAT(6(3A4))
      READ (1.103)(STBUS(I).ENDBUS(I).ZL(I).YL(I).I=1.NLB)
 103  FORMAT(2I2.4F6.1)
  121 FORMAT(12F6.1)
      READ(1.121)(BV(I).BL(I).I=1.LBUS)
      READ(1.991)(PR1(I).H(I).XD(I).I=1.NG)
  991 FORMAT(10F6.3)
      READ(1.129)(TT(I).TG(I).DC(I).BT1(I).R(I).PGMAX(I).IGOVRN(I).
     +I=1.NG)
      LTBUS=LBUS+NG
      NL=NLB+NG
 129  FORMAT(6F10.5.I2)
 1002 FORMAT('1'/////T57.' * * * T A B L E - 6 * * * '///.
     +41X.'* * *  LINE  PARAMETER FOR THE SYSTEM UNDER STUDY * * *'///.
     +18X.100('-')//.T20.'SERIAL '.
     +T45.'BUS CODE '.T68.'LINE IMPEDANCE '.T95.'CHARGING ADMITTANCE '
     +/.T22.'NO.'T47.'P-Q'.T72.'ZL-PQ-'.T99.'YL-P & YL-Q
     + '/.T73.'(PU)'.T103.'(PU)'//18X.100('-'))
 1004 FORMAT(/20X.I2.T45.I2.'-'I2.T65.F8.5.'+J'F8.5.T94.F8.5.'+J'F8.5)
      PRINT 407
 407  FORMAT('1'.//T56.'T A B L E - 5 '/T55.15('-')//T41.'* * * VOLTAGE
     +& LOADS OF DIFFERENT BUSES * * *'//T30.68('-')//T31.'BUS'.T39.'BUS
     +'.T57.'BUS VOLTAGE'.T81.'---BUS LOAD---'./.T31.'NO.'.T39.'NAME'.
     +T54.'MAGNITUDE'.T66.'ANGLE'.T81.'MW'.T91.'MVAR'./T56.'(PU)'.T66.
     +'(DEG)'/T30.68('-'))
      TLOAD=(0.0.0.0)
      DO 403 I=1.LBUS
      FLOAD=BL(I)
      TLOAD=FLOAD+TLOAD
```

```
403   PRINT 404.I.(NAME(I.J).J=1.3).BV(1).FLOAD
404   FORMAT(/.T31.I2.T37.3A4.T54.F6.4.T65.F7.3.T79.F6.2.T90.F6.2)
      PRINT 410.TLOAD
410   FORMAT(/.T30.68('-')/.T62.'TOTAL LOAD = '.T78.F8.3.T89.F8.3)
      CON=180./3.142857
      DO 501 I=1.LBUS
      V1=REAL(BV(I))
      V2=AIMAG(BV(I))
      V3=V1*COS(V2/CON)
      V4=V1*SIN(V2/CON)
      BV(I)=CMPLX(V3.V4)
501   CONTINUE
      DO 255 I=1.LBUS
255   BL(I)=BL(I)/100.0
      DO 552 I=1.LBUS
552   YLD(I)=CONJG(BL(I))/(CABS(BV(I))**2)
      DO 1001 I=1.NG
      GCUR=CONJG(PR1(I))/CONJG(BV(I))
1001  BV(I)=BV(I)+GCUR*XD(I)
      DT=0.02
      F=50.
      WO=2.0*3.141593*F
      DO 1017 I=1.NG
      DIV(I)=DT*(WO/2.0)/H(I)
      DEL(I.1)=ATAN(AIMAG(BV(I))/REAL(BV(I)))*CON
      E(I)=CABS(BV(I))
      V(I.1)=WO
      PS(I)=REAL(PR1(I))
1017  PGR(I.1)=PS(I)
      PRINT 1003
      PRINT 11.(I.(NAME(I.J).J=1.3).PR1(I).E(I).DEL(I.1).ZL(I).H(I).
     +I=1.NG)
11    FORMAT(T25.I2.T31.3A4.T47.F5.3.T56.F5.3.T69.F6.4.T78.F6.2.
     +T89.F3.1.'+J'F7.4.T106.F7.4//)
      PRINT 401
401   FORMAT(1X.T25.89('-')/)
1003  FORMAT('1'.////T65.'TABLE-7'/1X.T64. 9('-')///T40.'* * * VOLTAGE B
     +ACK OF TRANSIENT REACTANCE OF MACHINES * * * '///T25.89('-')///
     +T25.'BUS'.T33.'BUS'.T47.'TOTAL CENARATION'.T68.'INERNAL VOLTACE'
     +.T90.'EQUIVALENT'.T106.'INETIA'./.T25.'NO.'.T33.'NAME'.T47.'REAL'.
     +T53.'REACTIVE'.T67.'MAGNITUDE'.T79.'ANCLE'.T91.'REACTAMCE'.T106.
     +'CONSTANT'./.T47.'POWER'.T54.'POWER'/.T47.'(PU)'.T54.'(PU)'/.
     +T69.'(PU)'.T79.'(DEG)'.T93.'(PU)'.T25.89('-').//)
      PRINT 1002
914   PRINT 1004.(I.STBUS(I).ENDBUS(I).ZL(I).YL(I).I=1.NLB)
      PRINT 402
402   FORMAT(19X.100('-')/)
      DO 9909 I=1.NG
9909  DEL(I.1)=DEL(I.1)/CON
      READ(1.1006)NDATA
      KK1=1
195   CONTINUE
      READ(1.153)IFB1.IFB2.IFAULT.KNL.PCODE.FCT1.FCT2.FCT3.TM
      DO 503 I=1.NG
      DO 503 J=1.NG
 503  AMTXK(I.J)=(0.0.0.0)
      DO 600 I=1.NG
 600  AMTXK(I.I)=1.0/XD(I)
      II=0
      KKM=-2
190   II=II+1
```

```
      DO 306 I=1.NG
      DO 306 J=1.LBUS
306   AMTXL(I.J)=(0..0.)
      DO 506 I=1.NG
 506  AMTXL(I.I)=-1.0/XD(I)
      DO 8 I=1,LBUS
      DO 8 J=1.LBUS
 8    A(I.J)=(0.0.0.0)
      DO 700 I=1.NLB
      N1=STBUS(I)
      N2=ENDBUS(I)
      A(N1.N2)=-1./ZL(I)+A(N1.N2)
      A(N2.N1)=A(N1.N2)
      A(N1.N1)=YL(I)+A(N1.N1)
  700 A(N2,N2)=YL(I)+A(N2.N2)
      DO 608 I=1.LBUS
      A(I.I)=A(I.I)+YLD(I)
      DO 609 J=1.LBUS
      IF(I.EQ.J)GO TO 609
      A(I.I)=A(I.I)-A(I.J)
609   CONTINUE
608   CONTINUE
 4    FORMAT(4X////4X.'MATRIX FROM GIVEN DATA AS FOLLOWS'
     +    ///4X.5(1X. F9.4.'+J' F9.4    )//)
      DO 77 I=1.NG
 77   A(I.I)=A(I.I)-AMTXL(I.I)
      GO TO (900.901.902).II
900   GO TO (606.972.972.972).IFAULT
972   KI=0
      DO 316 I=1.LBUS
      IF(IFB1.EQ.I) GO TO 316
      KI=KI+1
      KJ=0
      DO 318 J=1.LBUS
      IF(IFB1.EQ.J)GO TO 318
      KJ=KJ+1
      A(KI.KJ)=A(I.J)
318   CONTINUE
316   CONTINUE
      KI=0
      DO 320 I=1.NG
      IF(I.EQ.IFB1)GO TO 320
      KI=KI+1
      KJ=0
      DO 322 J=1.LBUS
      IF(J.EQ.IFB1)GO TO 322
      KJ=KJ+1
      AMTXL(KI.KJ)=AMTXL(I.J)
322   CONTINUE
320   CONTINUE
      LBUN=LBUS-1
      GO TO 902
901   GO TO (1936.1936.607.903).IFAULT
606   A1=0.5
      GO TO 1010
1936  A1=1.0
1010  A2=FLOAT(KNL)
      A(IFB1.IFB1)=A(IFB1.IFB1)+A(IFB1.IFB2)*A1/A2
      A(IFB2.IFB2)=A(IFB2.IFB2)+A(IFB1.IFB2)*A1/A2
      A(IFB1.IFB2)=A(IFB1.IFB2)*(1.0-1.0/A2)
      A(IFB2.IFB1)=A(IFB1.IFB2)
```

```
      LBUN=LBUS
      GO TO 902
 607  DO 191 I=1.LBUS
 191  A(I.I)=A(I.I)+A(I.IFB1)
      GO TO 972
 903  A(IFB1.IFB1)=A(IFB1.IFB1)-YLD(IFB1)
      LBUN=LBUS
 1006 FORMAT(I2)
 153  FORMAT(4I2.5F4.2)
   2  FORMAT(10X.'YLD='//3X .6(F9.3.'+J'.F9.3))
 902  DO 310 I=1.LBUN
      DO 310 J=1.NG
      AMTXLT(I.J)=AMTXL(J.I)
  310 CONTINUE
      CALL AINMTX(LBUN)
  106 FORMAT('1'.4X.///' INVERSE MATRIX '///(8X.6(  F8.5.'+J'F 8.5.2X
     +)))
C    ==========================================================
      DO 981 I=1.LBUN
      DO 981 J=1.NG
      Y(I.J)=(0..0.)
      DO 981 K=1.LBUN
  981 Y(I.J)=Y(I.J)+A(I.K)*AMTXLT(K.J)
C    ==========================================================
      DO 945 I=1.NG
      DO 945 J=1.NG
      A(I.J)=(0..0.)
      DO 945 K=1.LBUN
      AAA=REAL(AMTXL(I.K))
      B=AIMAG(AMTXL(I.K))
      C=REAL(Y(K.J))
      D=AIMAG(Y(K.J))
      IF(ABS(AAA).LE.0.1E-55)AAA=0.
      IF(ABS(B).LE.0.1E-55)B=0.
      IF(ABS(C).LE.0.1E-55)C=0.
      IF(ABS(D).LE.0.1E-55)D=0.
      AMTXL(I.K)=CMPLX(AAA.B)
      Y(K.J)=CMPLX(C.D)
  945 A(I.J)=A(I.J)+AMTXL(I.K)*Y(K.J)
C    ==========================================================
      DO 33 I=1.NG
      DO 33 J=1.NG
  33  A(I.J)=AMTXK(I.J)-A(I.J)
      GO TO (904.104.905).II
 904  DO 105 I=1.NG
      DO 105 J=1.NG
 105  BZR1(I.J)=A(I.J)
      KK1=KK1+1
      GO TO 190
 104  DUMY=1.
      DO 109 I=1.NG
      DO 109 J=1:NG
 109  CZR1(I.J)=A(I.J)
  108 FORMAT('1'.4X.//.T58.'YBUS DURING FAULT'/.T57.19('-')/.T25.'FAULTE
     +D BUS IS '3A4.T99.'FAULT TYPE ='I2/T24.28('-').T98.16('-')/.5(14X.
     +'MAG',3X,'ANGLE')/3X.126('-')//.5(1X,'Y('I2.'.'I2.')='F8.2.F8.2)/)
  151 FORMAT('1'.4X.//.T50.'YBUS AFTER CLEARING THE FAULT'/.T49.31('-')/
     +,T25.'FAULTED BUS IS '3A4.T99.'FAULT TYPE ='I2/T24.28('-').T98.16(
     +'-')/.5(14X.'MAG'.3X.'ANGLE ')./.3X.126('-')
     +//.5(1X.'Y('I2.'.'I2.')='.F8.2.F8.2)/)
      KK1=KK1+1
```

```
      GO TO 190
  905 DO 906 I=1.NG
      DO 906 J=1.NG
  906 DZR1(I.J)=A(I.J)
      T(1)=0.0
      DO 1018 I=2.150
 1018 T(I)=T(I-1)+DT
      JS=1
      X1=FCT3/DT+2.5
      IR=X1
      X1=FCT1/DT+2.5
      JE=X1
      X1=FCT2/DT+2.5
      IS=X1
      X1=TM/DT+1.5
      IE=X1
      DO 1019 I=1.NG
      DO 1019 J=1.NG
      BZR(I,J)=CABS(BZR1(I.J))
      CZR(I.J)=CABS(CZR1(I.J))
      IF(REAL(BZR1(I.J)).NE.0.0)GO TO 10
      IF(ABS(AIMAG(BZR1(I.J)))-AIMAG(BZR1(I.J)))26.26.24
   26 THETA1(I.J)=3.141593/2.0
      GO TO 12
   24 THETA1(I,J)=-3.141593/2.0
      GO TO 12
   10 THETA1(I,J)=ATAN(AIMAG(BZR1(I.J))/REAL(BZR1(I.J)))
   12 IF(REAL(CZR1(I.J)).NE.0.0)GO TO 13
      IF(ABS(AIMAG(CZR1(I.J)))-AIMAG(CZR1(I.J)))31.31.32
   31 THETA2(I.J)=3.141593/2.0
      GO TO 907
   32 THETA2(I.J)=-3.141593/2.0
      GO TO 907
   13 THETA2(I,J)=ATAN(AIMAG(CZR1(I.J))/REAL(CZR1(I.J)))
  907 DZR(I.J)=CABS(DZR1(I.J))
      IF(REAL(DZR1(I.J)).NE.0.0)GO TO 908
      IF(ABS(AIMAG(DZR1(I.J)))-AIMAG(DZR1(I.J)))909.909.910
  909 THETA3(I.J)=3.141593/2.0
      GO TO 1019
  910 THETA3(I.J)=-3.141593/2.0
      GO TO 1019
  908 THETA3(I,J)=ATAN(AIMAG(DZR1(I.J))/REAL(DZR1(I.J)))
 1019 CONTINUE
      M=0
      DO 18 I=1.NG
      DO 18 J=1.NG
      IF(ABS(BZR(I.J)).LE.0.1E-40)GO TO 18
      M=M+1
      MS(M)=I
      ME(M)=J
      SM(M)=BZR(I.J)
      EX(M)=THETA1(I.J)*CON
   18 CONTINUE
      PRINT 108.(NAME(IFB1.J).J=1.3).IFAULT.(MS(I).ME(I).SM(I).EX(I).I=1
     +.M)
      M=0
      DO 22 I=1.NG
      DO 22 J=1.NG
      IF(ABS(CZR(I.J)).LE.0.1E-40)GO TO 22
      M=M+1
      MS(M)=I
```

```
      ME(M)=J
      SM(M)=CZR(I.J)
      EX(M)=THETA2(I.J)*CON
 22   CONTINUE
      PRINT 151.(NAME(IFB1.J).J=1.3).IFAULT.(MS(I).ME(I).SM(I).EX(I).I=1
     +.M)
      LEA=1
      DO 1088 I=1.NG
      PS(I)=REAL(PR1(I))
      X3(I)=PS(I)
1088  X4(I)=PS(I)
      KEK=1
      CALL SWING(JS.JE.BZR.THETA1.LEA)
      LEA=2
      CALL SWING(JE.IE.CZR.THETA2.LEA)
      PRINT 344
      DO 341 I=1.IE
      DO 342 J=1.NG
      AC(J)=V(J.I)
342   AB(J)=PGR(J.I)
341   PRINT 343.T(I).(AC(J).J=1.NG).(AB(J).J=1.NG)
343   FORMAT(1X.F4.2.2X.'SPEED'13(F8.2.1X)/T8.'POWER'13(F8.2.1X))
340   KK=0
      PRINT 1022
      DO 1020 I=1.IE
      DO 1021 J=1.NG
      KK=KK+1
      AC(J)=DEL(J.I)*CON
1021  GRAP(KK)=DEL(J.I)*CON
1020  WRITE(3.1023) T(I).(AC(J).J=1.NG)
1022  FORMAT('1'//1X.T50.'DATA FOR TIME VS. ANGLE(DEG)PLOTTING'/1X.
     +T49.38('-')//1X.'TIME'.T12.'KAPTAI'.T21.'SIKAL-'.T30.'HALI-'.
     +T39,'ASUGANG'.T48.'SHAHJI-'.T56.'ASUGANG'.T65.'GHORASAL'.
     +T75,'SIDDIR-'.T84.'GHORA-'.T93.'GOAL-'.T102.'BHERA-'.
     +T111,'BOGRA'.T119.'SAIDPUR'/T21.'BAHA'.T30.'SAHAR'.T40.'-132-'.
     +T48.'BAZAR'.T57,'-230-'.T66.'-230-'.T75.'GANG'.T84.'SAL-132'.
     +T93.'PARA'.T102.'MARA'//)
1023  FORMAT(1X.F5.3.2X.13(F8.2.1X))
344   FORMAT('1'//1X.T50.'DATA FOR SPEED VS. POWER(PU) FOR GOVERNOR ACTI
     +ON'/1X.T49.50('-')//1X.'TIME'.T15.'KAPTAI'.T25.'SIKAL-'.T34.'HALI-
     +'.T41.'ASUGANG'.T52.'SHAHJI-'.T61.'ASUGANG'.T70.'GHORASAL'.
     +T79.'SIDDIR-'.T88.'GHORA-'.T97.'GOAL-'.T106.'BHERA-'.
     +T115.'BOGRA'.T124.'SAIDPUR'/T25.'BAHA'.T34.'SAHAR'.T42.'-132-'.
     +T52.'BAZAR'.T62.'-230-'.T71.'-230-'.T80.'GANG'.T89.'SAL-132'.
     +T97.'PARA'.T106.'MARA'//)
      J5=IE*NG
      CALL GRAPH(J5.DT.NG)
      LEA=3
      DO 1090 I=1.NG
      PS(I)=REAL(PR1(I))
      X3(I)=PS(I)
1090  X4(I)=PS(I)
      CALL SWING(IS.IE.DZR.THETA3.LEA)
      PRINT 344
      DO 346 I=1.IE
      DO 347 J=1.NG
      AC(J)=V(J.I)
 347  AB(J)=PGR(J.I)
 346  PRINT 343.T(I).(AC(J).J=1.NG).(AB(J).J=1.NG)
345   KK=0
      PRINT 1022
```

```
      DO 1081 I=1.IE
      DO 1082 J=1.NG
      KK=KK+1
      AC(J)=DEL(J.I)*CON
 1082 GRAP(KK)=DEL(J.I)*CON
 1081 PRINT 1023.T(I).(AC(J).J=1.NG)
      J5=IE*NG
      CALL GRAPH(J5.DT.NG)
      DO 1091 I=1.NG
      PS(I)=REAL(PR1(I))
      X3(I)=PS(I)
 1091 X4(I)=PS(I)
      KEK=5
      CALL SWING(IS.IR.BZR.THETA1.LEA)
      CALL SWING(IR.IE.CZR.THETA2.LEA)
      PRINT 344
      DO 348 I=1.IE
      DO 349 J=1.NG
      AC(J)=V(J.I)
  349 AB(J)=PGR(J.I)
  348 PRINT 343.T(I).(AC(J).J=1.NG).(AB(J).J=1.NG)
  350 KK=0
      PRINT 1022
      DO 911 I=1.IE
      DO 912 J=1.NG
      KK=KK+1
      AC(J)=DEL(J.I)*CON
  912 GRAP(KK)=DEL(J.I)*CON
  911 PRINT 1023.T(I).(AC(J).J=1.NG)
      J5=IE*NG
      CALL GRAPH(J5.DT.NG)
      IF(KK1.GT.(2*NDATA))GO TO 1005
      GO TO 195
 1005 STOP
      END
```

```
      SUBROUTINE SWING(IS.IE.Z.ALP.LEA)
      DIMENSION Z(15.15).ALP(15.15).DEL(15.150).E(30).DIV(30).
     1T(150),DD(15.150).V(15.150).DV(15.150).PS(30).NAME(100.3).
     1MS(400).ME(400).SM(400).EX(400)
      COMMON /EA1/ E.FS.NG
      COMMON /EA2/ GRAF(2000).KEK.PCODE
      COMMON /EA3/ V,DIV,DT,F,WO.CON.DD.DV
      COMMON /ANGLE/ DEL
      COMMON /EA4/ TT(13),TG(13).DC(13).BT1(13).R(13).PGMAX(13).
     +IGOVRN(13).X3(13).X4(13)
      COMMON /EA5/ MS.ME.SM.EX
      COMMON /EA7/ PGR(15.150)
      COMMON /EA6/ NAME.KKM.IFAULT.IFB1.IFB2
    8 FORMAT('1'.4X.//T58.'Z-BUS DURING FAULT '/T57.20('-')/.T25.'FAULTE
     +D BUS IS '3A4.T99.'FAULT TYPE ='I2/T24.28('-').T90.16('-')/
     +.5(14X.'MAG'.3X.'ANGLE')/.3X.126('-'))
    9 FORMAT('1'.4X.//T55.'Z-BUS AFTER CLEARING THE FAULT'/T54.32('-')/.
     +T25.'FAULTED BUS IS '3A4.T99.'FAULT TYPE ='I2/T24.28('-').T98.16('
     +-')/.5(14X.'MAG'.3X.'ANGLE ')/.3X.126('-'))
      PHI=3.141593
      D=0.01
      IF(KEK.EQ.5) GO TO 100
      DO 190 I=1.NG
      DO 190 J=1.NG
      IF(I-J)191.192.191
  191 ALP(I.J)=(PHI-ALP(I.J))*CON
      GO TO 190
  192 ALP(I.J)=-ALP(I.J)*CON
  190 CONTINUE
      GO TO (5,6,7).LEA
    5 PRINT 8.(NAME(IFB1.J).J=1.3).IFAULT
      GO TO 10
    6 PRINT 9,(NAME(IFB1.J),J=1,3).IFAULT
      GO TO 10
    7 GO TO 11
   10 M=0
      DO 12 I=1.NG
      DO 12 J=1.NG
      IF(ABS(Z(I.J)).LE.0.1E-40)GO TO 12
      M=M+1
      MS(M)=I
      ME(M)=J
      SM(M)=1.0/Z(I.J)
      EX(M)=ALP(I.J)
   12 CONTINUE
      PRINT 14.(MS(I).ME(I).SM(I).EX(I).I=1.M)
   14 FORMAT(/1X.5(1X.'Z('I2.'.'I2.')='F8.2.F8.2)/)
   11 DO 15 I=1.NG
      DO 15 J=1.NG
      ALP(I.J)=PHI/2.0-ALP(I.J)/CON
   15 CONTINUE
C     ==================================================
  100 DO 201 K=IS.IE
      DO 202 I=1.NG
      B1=(V(I.K)-WO)*DT
      CALL TELEC(I.0.0.PM.ALP.Z.K.XA)
      Y1=XA*DIV(I)
      B2=(V(I.K)+Y1/2.0-WO)*DT
      X=B1/2.0
      CALL TELEC(I,X,PM.ALP,Z.K.XA)
      Y2=XA*DIV(I)
      B3=(V(I.K)+Y2/2.0-WO)*DT
      X=B2/2.0
```

```
      CALL TELEC(I.X.PM.ALP.Z.K.XA)
      Y3=XA*DIV(I)
      B4=(V(I.K)+Y3-WO)*DT
      CALL TELEC(I.B3.PM.ALP.Z.K.XA)
      Y4=XA*DIV(I)
      DV(I.K)=(Y1+2.0*Y2+2.0*Y3+Y4)/6.0
      DD(I.K)=(B1+2.0*B2+2.0*B3+B4)/6.0
      V(I.K+1)=V(I.K)+DV(I.K)
      DEL(I.K+1)=DEL(I.K)+DD(I.K)
      IF(IGOVRN(I).NE.1)GO TO 202
      CALL GOVERN(I.K)
 202  PGR(I.K+1)=PS(I)
 201  CONTINUE
      RETURN
      END
```

```
      SUBROUTINE TELEC(I.DX.PM.ALP.Z.K.XA)
      DIMENSION DEL(15.150).ALP(15.15).E(30).Z(15.15).PS(30)
      COMMON /EA1/ E.PS.NG
      COMMON /EA4/ TT(13).TG(13).DC(13).BT1(13).R(13).PGMAX(13).
     +IGOVRN(13).X3(13).X4(13)
      COMMON /ANGLE/ DEL
      PM=0.0
      DO 203 J=1.NG
      IF(I-J)111.112.111
 111  DE=DEL(I.K)-DEL(J.K)+DX
      PM=PM+E(I)*E(J)*Z(I.J)*SIN(DE-ALP(I.J))
      GO TO 203
 112  ANG=ALP(I.J)
      PM=PM+E(I)*E(J)*Z(I.J)*SIN(ANG)
 203  CONTINUE
      XA=PS(I)-PM
      RETURN
      END
```

```
      SUBROUTINE GRAPH(J5,DT,N)
      DIMENSION T(150),NAME(100,3),LP(13)
      COMMON /EA2/ GRAP(2000),KEK,PCODE
      COMMON /TA6/ NAME,KKM,IFAULT,IFB1,IFB2
      INTEGER BLANK,DOT,STAR(13),LINE(121),ST
      DATA BLANK,STAR,DOT,ST/' ','1','2','3','4','5','6','7','8','9',
     +'A','B','C','D','.','*'/
  6   FORMAT('1',T45,'GRAPH FOR UNSUSTAINED FAULT WITHOUT AUTORECLOSER'
     +/,T44,50('-')/,T49,'REFFERENCE MACHINE 9 IS GHORASAL-132'/,T48,
     +38('-')//T15,'3-PHASE FAULT BETWEEN '3A4,' & '3A4,' LINE AT '3A4,'
     + END',T97,'FAULT TYPE ='I2 /T14,76('*'),T96,16('-')//T63,'ANGLE IN
     +DEGREE'/T62,17('-'))
  8   FORMAT('1',T17,'GRAPH FOR SUSTAINED FAULT CLEARED AT 8 CYCLES LATE
     +R,RECLOSES AFTER 28 CYCLES & THEN OPEN AFTER 36 CYCLES'/T18,
     +106('-')/T45,'REFFERENCE MACHINE 9 IS GHORASAL-132 '/T48,38('-')//
     +T15,'3-PHASE FAULT BETWEEN '3A4,' & '3A4,' LINE AT '3A4,' END',T97
     +,'FAULT TYPE ='I2 /T14,76('-'),T96,16('-')//T63,'ANGLE IN DEGREE'/
     +T62,17('-'))
  7   FORMAT('1',T40,'GRAPH FOR FAULT CLEARED AT 8 CYCLES LATER & RECLOS
     +E AFTER 28 CYCLES'/,T39,69('-')//,T53,'REFFERENCE MACHINE 9 IS GHO
     +RASAL-132'/,T52,38('-')//T15,'3-PHASE FAULT BETWEEN '3A4,' & '3A4,
     +' LINE AT '3A4,' END',T97,'FAULT TYPE ='I2/T14,76('-'),T96,16('-')
     +//T63,'ANGLE IN DEGREE'/,T62,17('-'))
 66   FORMAT('1',T45,'GRAPH FOR UNSUSTAINED FAULT WITHOUT AUTORECLOSER'
     +/,T44,50('-')/,T49,'REFFERENCE MACHINE 9 IS GHORASAL-132'/,T48,
     +38('-')//T15,'3-PHASE FAULT BETWEEN '3A4,' & '3A4,' LINE AT MIDDLE
     + POINT',T97,'FAULT TYPE ='I2 /T14,71('-'),T96,16('-')//T63, 'ANGLE
     + IN DEGREE'/T62,17('-'))
 88   FORMAT('1',T17,'GRAPH FOR SUSTAINED FAULT CLEARED AT 8 CYCLES LATE
     +R,RECLOSES AFTER 28 CYCLES & THEN OPEN AFTER 36 CYCLES'/T18,
     +106('-')/T45,'REFFERENCE MACHINE 9 IS GHORASAL-132 '/T48,38('-')//
     +T15,'3-PHASE FAULT BETWEEN '3A4,' & '3A4,' LINE AT MIDDLE POINT',
     +T97,'FAULT TYPE ='I2 /T14,71('-'),T96,16('-')//T63,'ANGLE IN DEGRE
     +E'/T62,17('-'))
 77   FORMAT('1',T40,'GRAPH FOR FAULT CLEARED AT 8 CYCLES LATER & RECLOS
     +E AFTER 28 CYCLES'/,T39,69('-')//,T53,'REFFERENCE MACHINE 9 IS GHO
     +RASAL-132'/,T52,38('-')//T15,'3-PHASE FAULT BETWEEN '3A4,' & '3A4,
     +' LINE AT MIDDLE POINT',T97,'FAULT TYPE ='I2/T14,71('-'),T96,
     +16('-')//T63,'ANGLE IN DEGREE'/,T62,17('-'))
666   FORMAT('1',T45,'GRAPH FOR UNSUSTAINED FAULT WITHOUT AUTORECLOSER'
     +/,T44,50('-')/,T49,'REFFERENCE MACHINE 9 IS GHORASAL-132'/,T48,
     +38('-')//T15,'3-PHASE FAULT AT '3A4,
     +      T97,'FAULT TYPE ='I2 /T14,31('-'),T96,16('-')//T63,'ANGLE IN
     +DEGREE'/T62,17('-'))
888   FORMAT('1',T17,'GRAPH FOR SUSTAINED FAULT CLEARED AT 8 CYCLES LATE
     +R,RECLOSES AFTER 28 CYCLES & THEN OPEN AFTER 36 CYCLES'/T18,
     +106('-')/T45,'REFFERENCE MACHINE 9 IS GHORASAL-132 '/T48,38('-')//
     +T15,'3-PHASE FAULT AT '3A4,T97
     +,'FAULT TYPE ='I2 /T14,31('-'),T96,16('-')//T63,'ANGLE IN DEGREE'/
     +T62,17('-'))
777   FORMAT('1',T40,'GRAPH FOR FAULT CLEARED AT 8 CYCLES LATER & RECLOS
     +E AFTER 28 CYCLES'/,T39,69('-')//,T53,'REFFERENCE MACHINE 9 IS GHO
     +RASAL-132'/,T52,38('-')//T15,'3-PHASE FAULT AT '3A4,
     +                        T97,'FAULT TYPE ='I2/T14,31('-'),T96,16('-')
     +//T63,'ANGLE IN DEGREE'/,T62,17('-'))
      KKM=KKM+1
      IF(KKM)1,2,3
  1   GO TO (503,504,505,505),IFAULT
504   PRINT 6,(NAME(IFB1,J),J=1,3),(NAME(IFB2,J),J=1,3),(NAME(IFB1,J),J=
     +1,3),IFAULT
      GO TO 10
503   PRINT 66,(NAME(IFB1,J),J=1,3),(NAME(IFB2,J),J=1,3),IFAULT
      GO TO 10
505   PRINT 666,(NAME(IFB1,J),J=1,3),IFAULT
      GO TO 10
  2   GO TO (603,604,605,605),IFAULT
604   PRINT 7,(NAME(IFB1,J),J=1,3),(NAME(IFB2,J),J=1,3),(NAME(IFB1,J),J=
     +1,3),IFAULT
```

```
      GO TO 10
603   PRINT 77.(NAME(IFB1.J).J=1.3).(NAME(IFB2.J).J=1.3).IFAULT
      GO TO 10
605   PRINT 777.(NAME(IFB1.J).J=1.3).IFAULT
      GO TO 10
  3   GO TO (703.704.705.705).IFAULT
704   PRINT 8.(NAME(IFB1.J).J=1.3).(NAME(IFB2.J).J=1.3).(NAME(IFB1.J).J=
     +1,3).IFAULT
      GO TO 10
703   PRINT 88.(NAME(IFB1.J).J=1.3).(NAME(IFB2.J).J=1.3).IFAULT
      GO TO 10
705   PRINT 888.(NAME(IFB1.J).J=1.3).IFAULT
 10   CONTINUE
999   FORMAT(3X.'GRAP=', 6(F10.4.5X)/)
      ICODE=PCODE
      DO 89 I=1.13
 89   LP(I)=(I-7)*ICODE
      PRINT 105.(LP(I).I=1.13)
105   FORMAT(2X.'TIME'.1X.I4.T18.I4.T28.I4.T38.I4.T48.I4.T58.I4.T67.I4.
     +T78.I4.T88.I4.T98.I4.T108.I4.T118.I4.T129.I3)
      T(1)=0.0
      DO 101 J=1.121
101   LINE(J)=DOT
      IPP=-9
      DO 203 I=1.13
      IPP=IPP+10
203   LINE(IPP)=ST
      PRINT 107.T(1).LINE
      T(1)=DT
102   FORMAT(9X.121A1)
      DO 103 J=1.121
103   LINE(J)=BLANK
      LINE(61)=DOT
      LIMIT=J5
      NN=N
      JT=0
      MMM=0
      DO 11 J1=1.LIMIT.N
      MMM=MMM+1
      III=1
      JM=J1+8
      JT=JT+1
      DO 15 JJ=J1.NN
      A2=((GRAP(JJ)-GRAP(JM))*1.00+6.0*PCODE)*(120./(12.*PCODE))+0.5
      JS=A2+1
      IF(JS.LT.1.OR.JS.GT.121)GO TO 19
      LINE(JS)=STAR(III)
 19   III=III+1
 15   CONTINUE
      NN=NN+N
      LINE(1)=DOT
      LINE(121)=DOT
      IF((JT/5)*5.EQ.JT)GO TO 110
      PRINT 102.LINE
      GO TO 106
110   IPP=-9
      DO 204 I=1.13
      IPP=IPP+10
204   LINE(IPP)=ST
      PRINT 107.T(MMM).LINE
107   FORMAT(2X.F6.3.1X.121A1)
106   DUMY=1.0
      DO 16 I=1.121
 16   LINE(I)=BLANK
      LINE(61)=DOT
 11   T(MMM+1)=T(MMM)+DT
      DO 100 I=1.121
100   LINE(I)=DOT
      PRINT 108.LINE
108   FORMAT(9X.121A1)
      PRINT 104.(STAR(I).(NAME(I.J).J=1.3).I=1.N)
104   FORMAT(///T45.'* * * MEANING OF THE CODES * * *'.//

     +2X.A1.'='3A4.2(2X.A1.'='3A4.3X.A1.'='3A4.3X.A1.'='3A4)//)
      RETURN
      END
```

```
      SUBROUTINE COVERN(I.K)
      DIMENSION V(15.150).DIV(30).DD(15.150).E(30).PS(30).DV(15.150)
      COMMON /EA3/ V.DIV.DT.F.WO.CON.DD.DV
      COMMON /EA1/ E.PS.NG
      COMMON /EA7/ PGR(15.150)
      COMMON /EA4/ TT(13).TG(13).DC(13).BT1(13).R(13).PGMAX(13).
     +IGOVRN(13).X3(13).X4(13)
      AKK=X3(I)-1.0/R(I)*((V(I.K)-WO)/WO)
      A1=AKK-X4(I)
      A2=AKK-(X4(I)+0.5*A1)
      A3=AKK-(X4(I)+0.5*A2)
      A4=AKK-(X4(I)+A3)
      X4(I)=X4(I)+(A1+2.0*A2+2.0*A3+A4)*DT*(1.0/6.0)*(1.0/TG(I))
      IF(X4(I).LE.0.0)GO TO 5
      IF(X4(I).GT.PGMAX(I))GO TO 6
      GO TO 9
5     X4(I)=0.0
      GO TO 9
6     X4(I)=PGMAX(I)
9     A1=X4(I)-PS(I)
      A2=X4(I)-(PS(I)+0.5*A1)
      A3=X4(I)-(PS(I)+0.5*A2)
      A4=X4(I)-(PS(I)+A3)
      PS(I)=PS(I)+(A1+A2*2.+A3*2.+A4)*(1./TT(I))*(1./6.)*DT
      RETURN
      END
```

```
      SUBROUTINE AINMTX(N)
      COMPLEX A(36.36).B(36.72).TEMP
      COMMON /EA8/ A.B
      DO 1 I=1.N
      DO 1 J=1.N
1     B(I.J)=A(I.J)
      J1=N+1
      J2=2*N
      DO 2 I=1.N
      DO 2 J=J1.J2
2     B(I.J)=(0..0.)
      DO 3 I=1.N
      J=I+N
3     B(I.J)=(1..0.)
      DO 610 K=1.N
      KP1=K+1
      IF (K.EQ.N)GO TO 500
      L=K
      DO 400 I=KP1.N
      C=CABS(B(I.K))
      D=CABS(B(L.K))
400   IF(C.GT.D)L=I
      IF (L.EQ.K)GO TO 500
      DO 410 J=K.J2
      TEMP=B(K,J)
      B(K.J)=B(L.J)
410   B(L,J)=TEMP
500   DO 501 J=KP1.J2
501   B(K,J)=B(K,J)/B(K,K)
      IF (K.EQ.1)GO TO 600
      KM1=K-1
      DO 510 I=1.KM1
      DO 510 J=KP1.J2
510   B(I.J)=B(I.J)-B(I.K)*B(K,J)
      IF(K.EQ.N)GO TO 700
600   DO 610 I=KP1.N
      DO 610 J=KP1.J2
610   B(I,J)=B(I.J)-B(I.K)*B(K.J)
700   DO 701 I=1.N
      DO 701 J=1.N
      K=J+N
701   A(I.J)=B(I.K)
      RETURN
      END
```