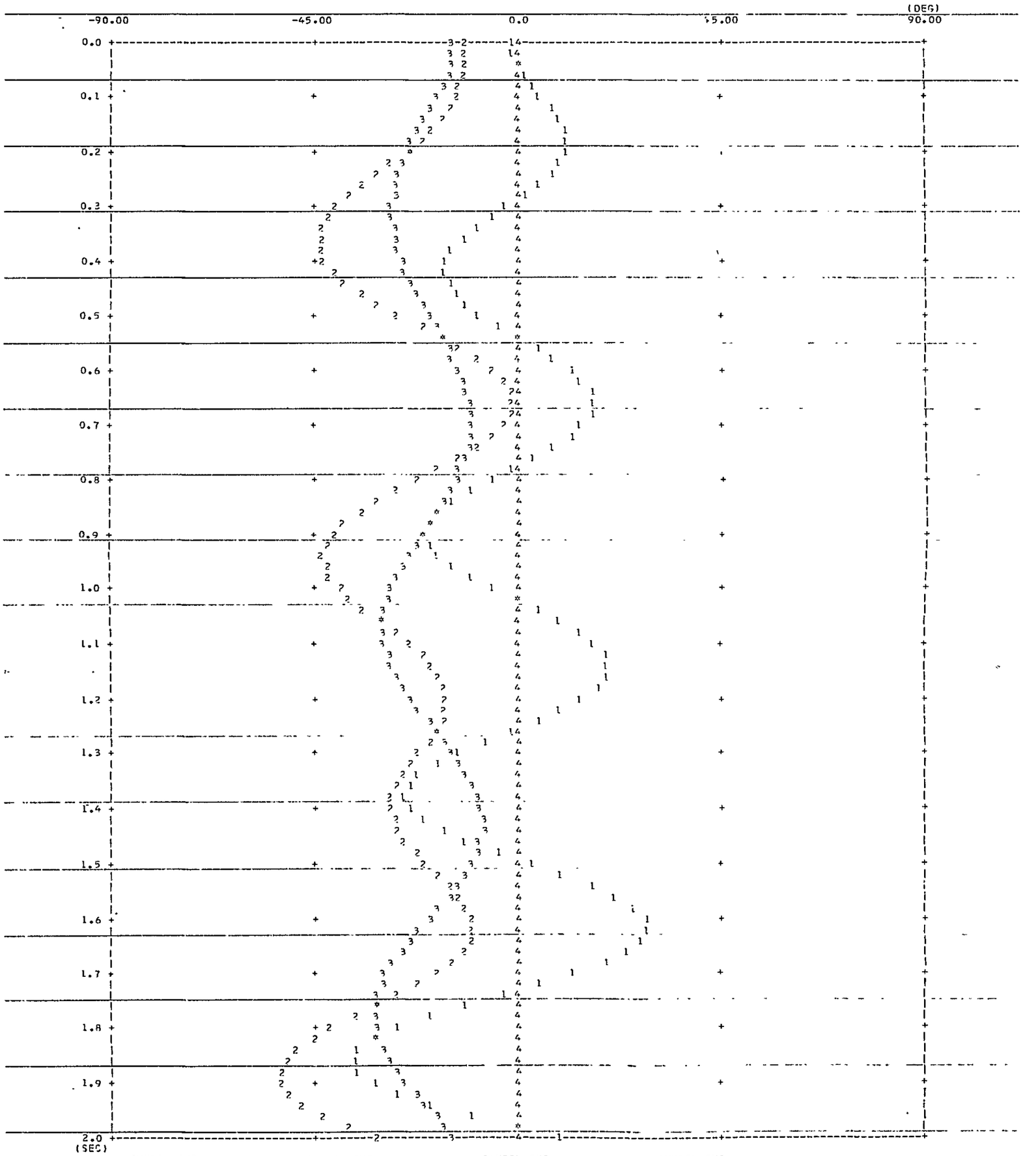
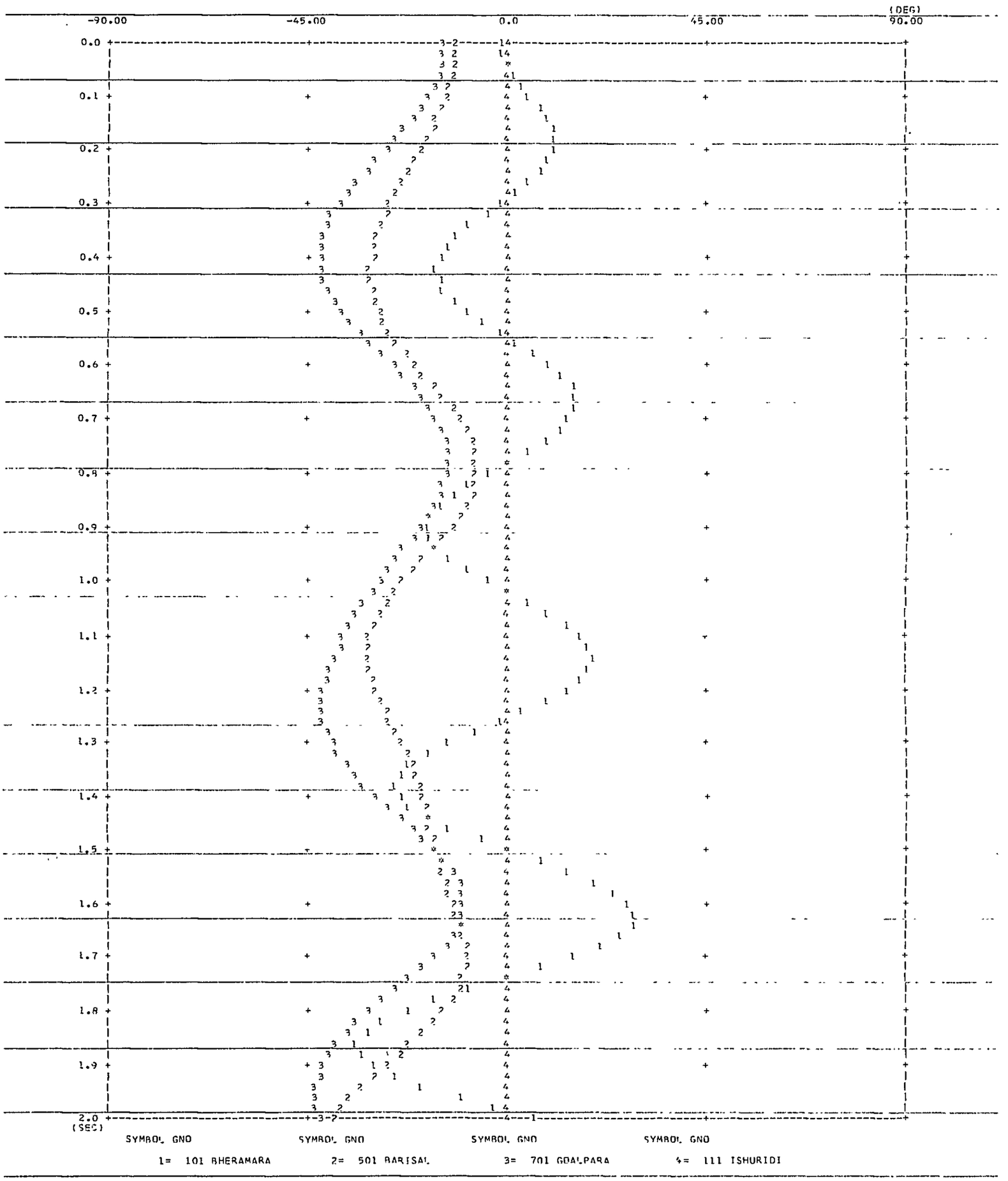
ANNEX III

CALCULATION RESULT OF SYSTEM STABILITY



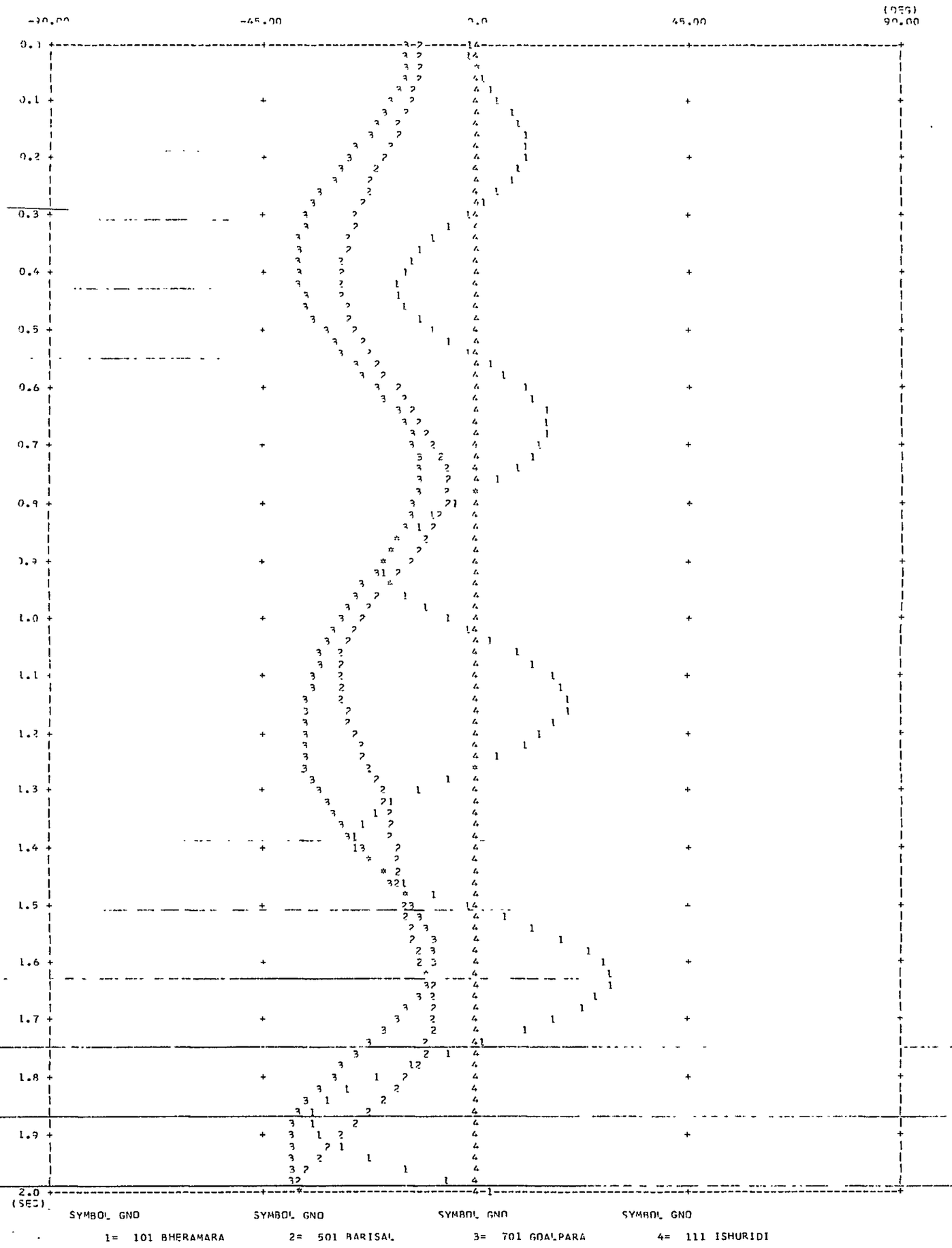
Annex III-1

CASE 1 ONE-CIRCUIT INTERRUPTION BY 3LG BETWEEN BHERAMARA & RAJBARI



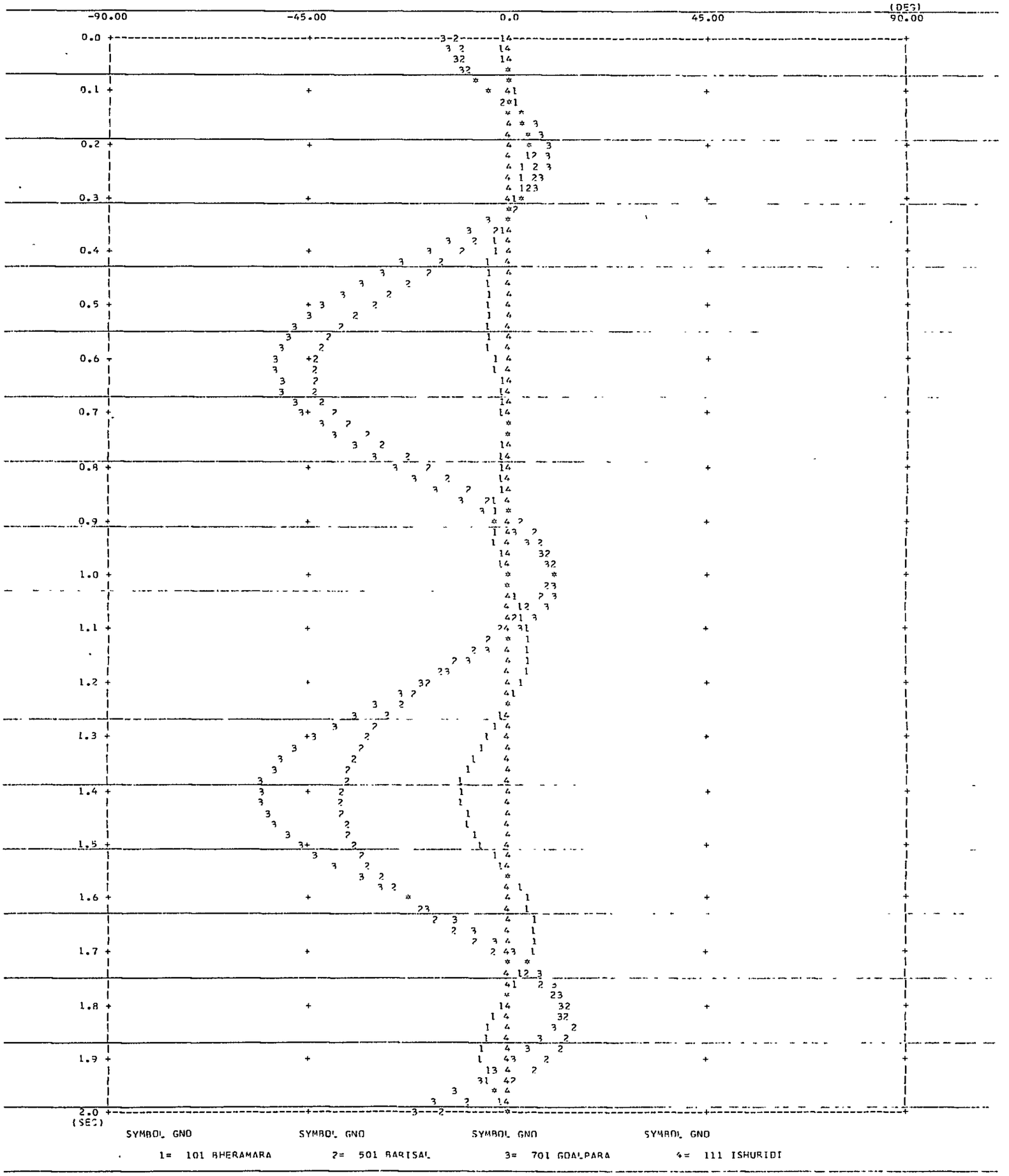
Annex III-2

CASE 2 ONE-CIRCUIT INTERRUPTION BY 3LG BETWEEN BHERAMARA & BOTTAIL



Annex III-3

CASE 3 ONE-CIRCUIT INTERRUPTION BY 3LG BETWEEN BHERAMARA & GOALPARA

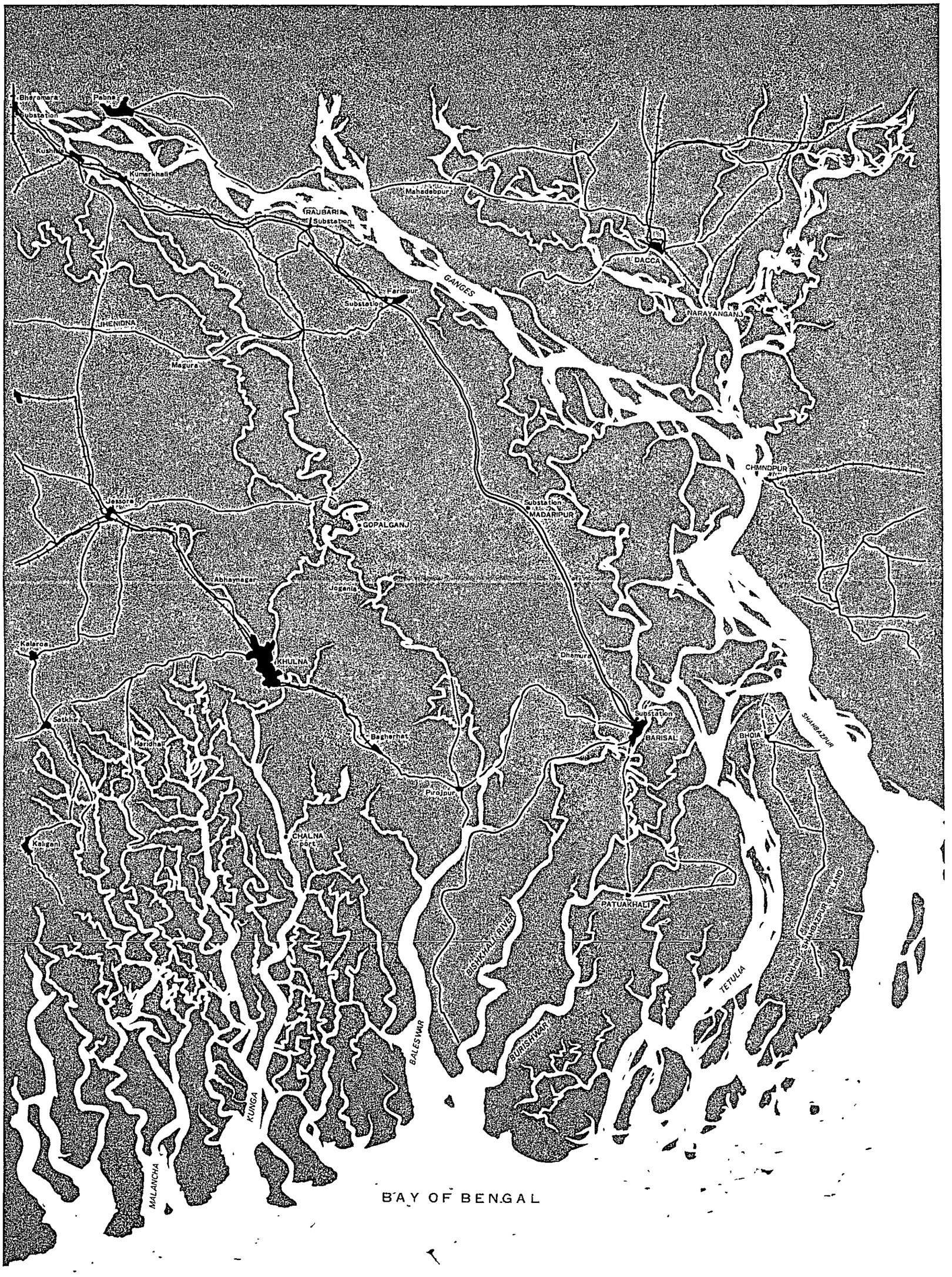


Annex III-4

CASE 4 ONE-CIRCUIT INTERRUPTION BY 3LG BETWEEN JESSORE & GOALPARA

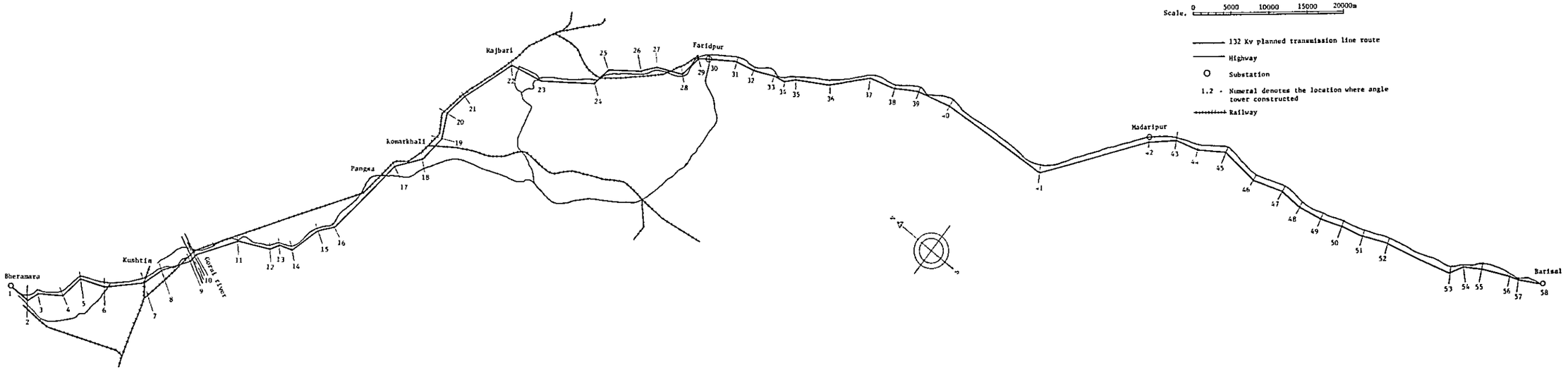
ANNEX IV

TRANSMISSION LINE ROUTE


Bheramara
Substation
Pabna
Kushtia
Kumarkhali
Mahadebpur
RAJBARI
Substation
GORAI R.
GANGES
DACCA
Faridpur
Substation
NARAYANGANJ
JHENIDNA
Magura
CHANDPUR
Jessore
Substation
MADARIPUR
GOPALGANJ
Abhaynagar
Jogania
Kaliaroa
KHULNA
Dhamura
Satkhira
Bagherhat
Substation
BARISAL
BHOLA
SHAHBAZPUR
Pirojpur
Koigani
CHALNA
port
PATUAKHALI
BISHKHALI RIVER
TETULIA
SHAHBAZPUR ISLAND
BURISHWAR
BALESWAR
KUNGA
MALANCHIA
BAY OF BENGAL

ANNEX IX-2

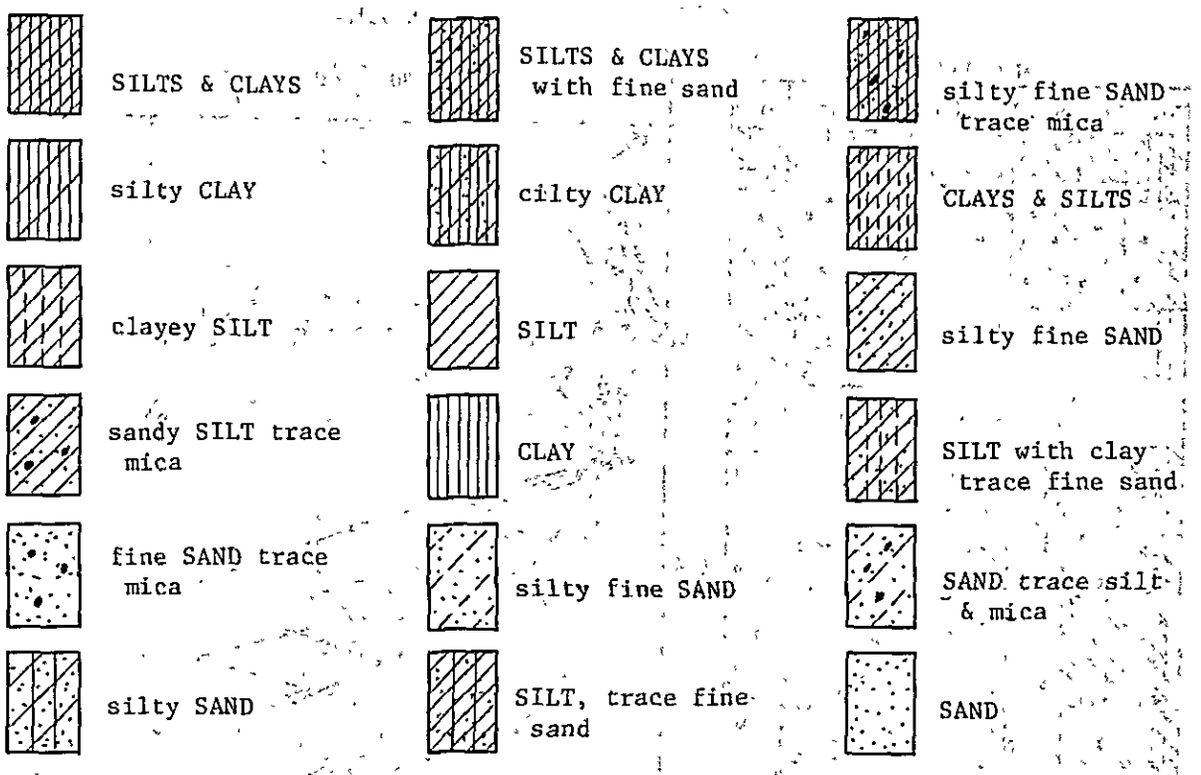
TRANSMISSION ROUTE (1/250,000)



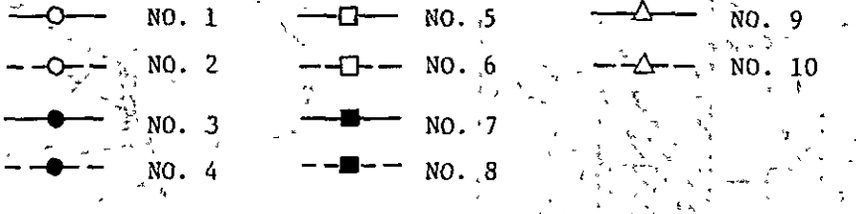
ANNEX V

BORING LOG

Explanation of soil symbol

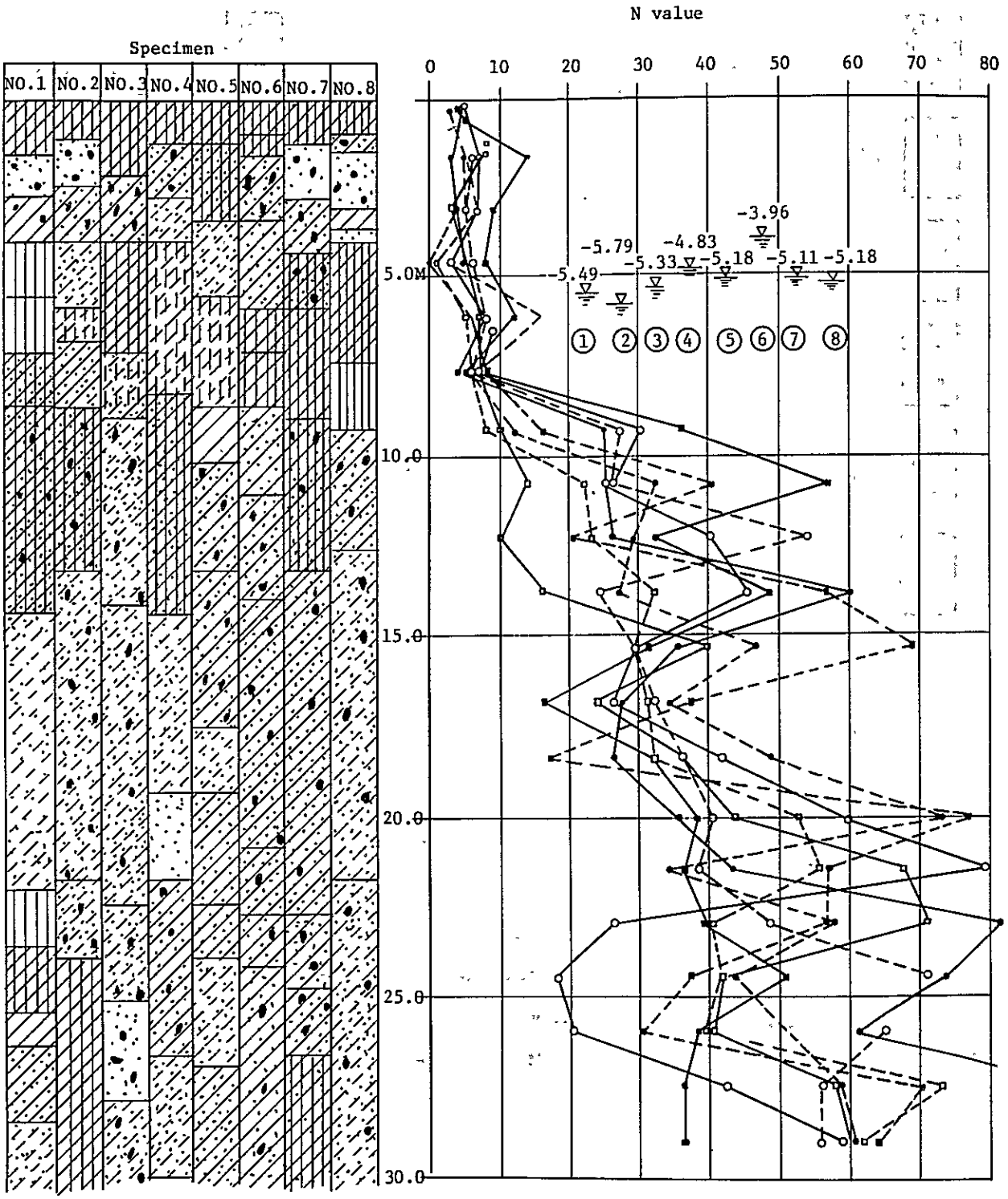


Classification of N value line



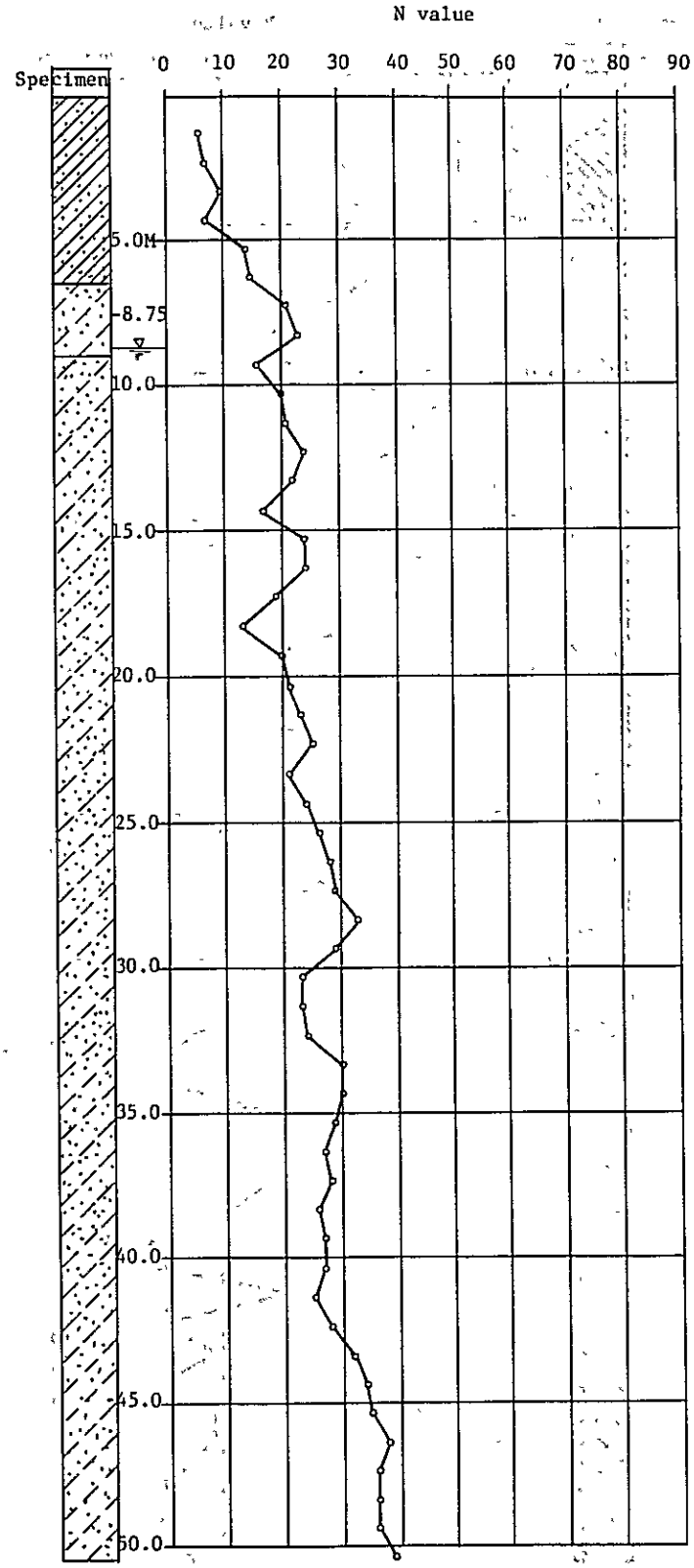
ANNEX V-1

BLOCK NO.1 BORING LOG



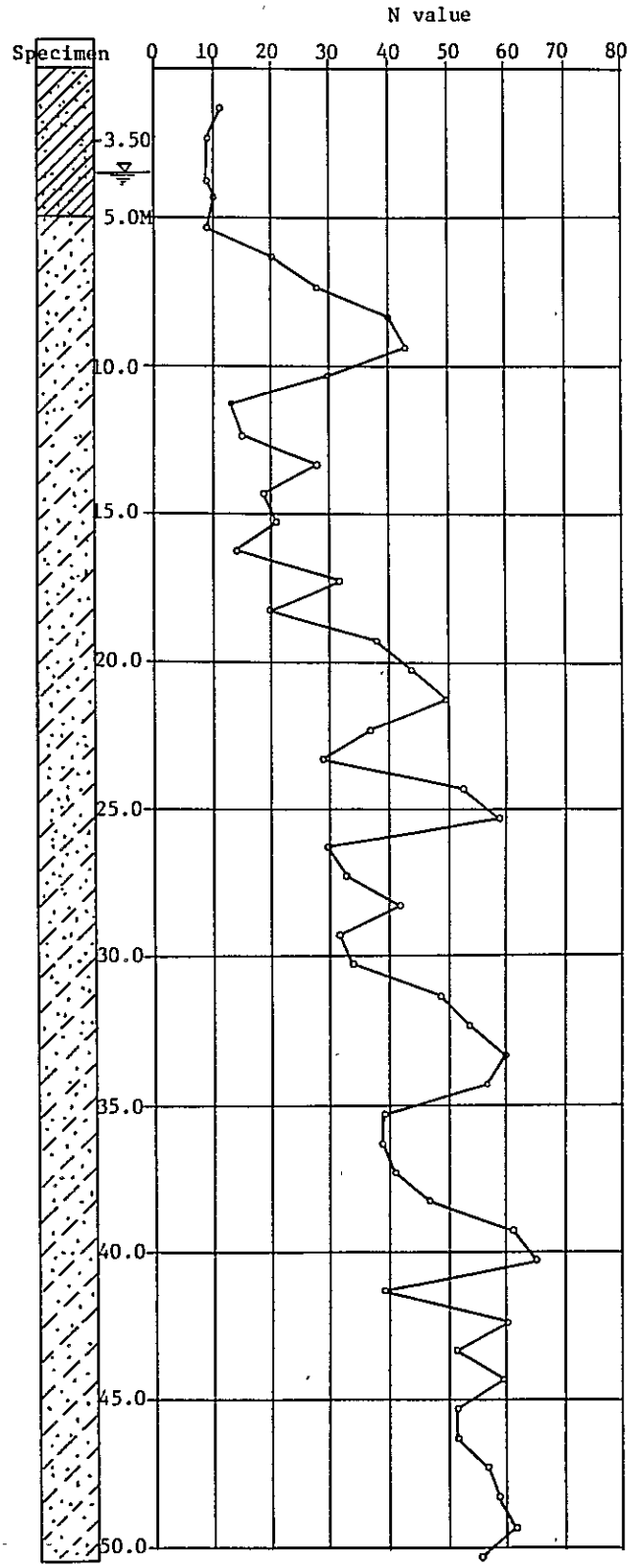
ANNEX V-2

BLOCK NO. 2 BORING LOG



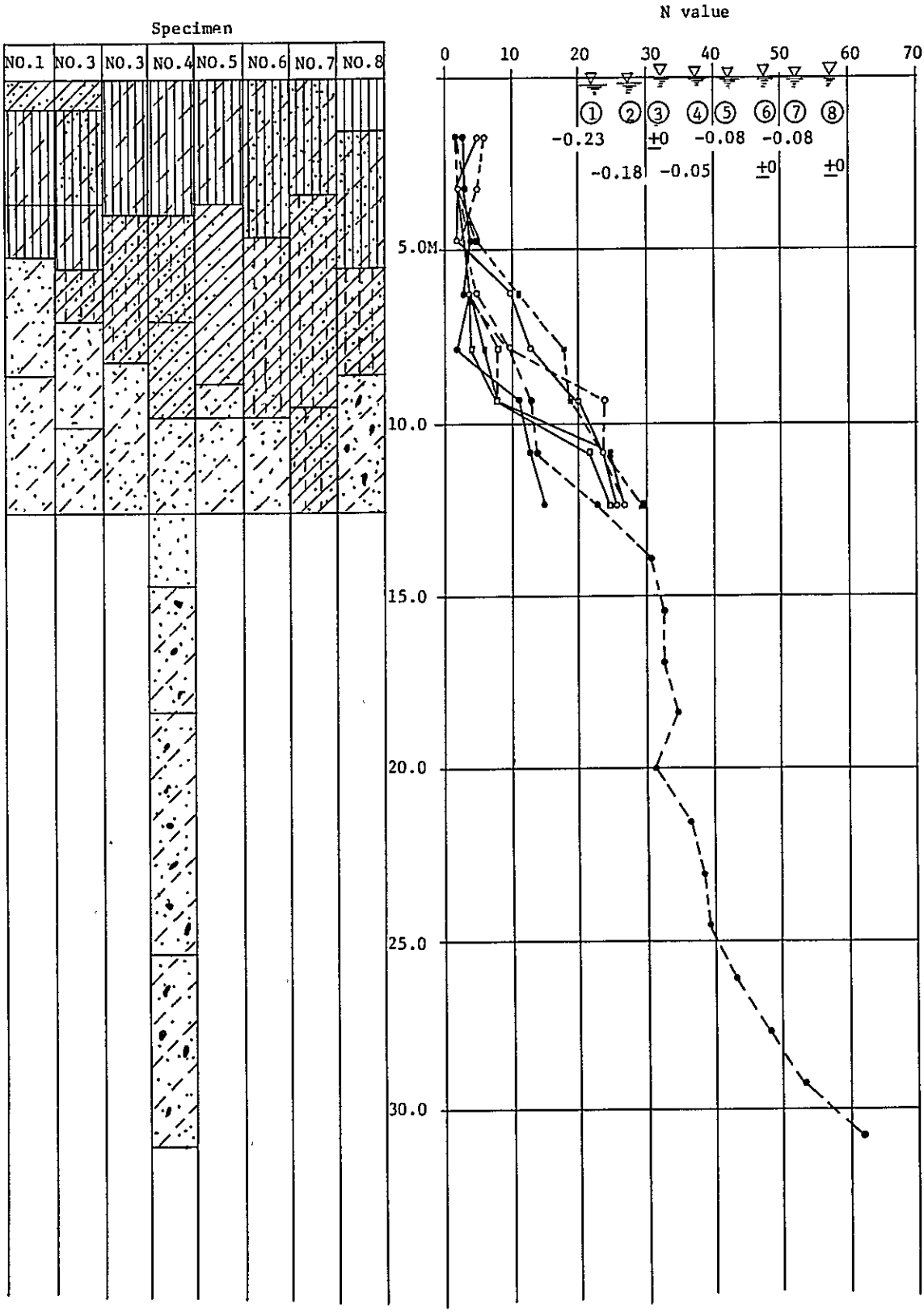
ANNEX V-3

BLOCK NO. 3. BORING LOG



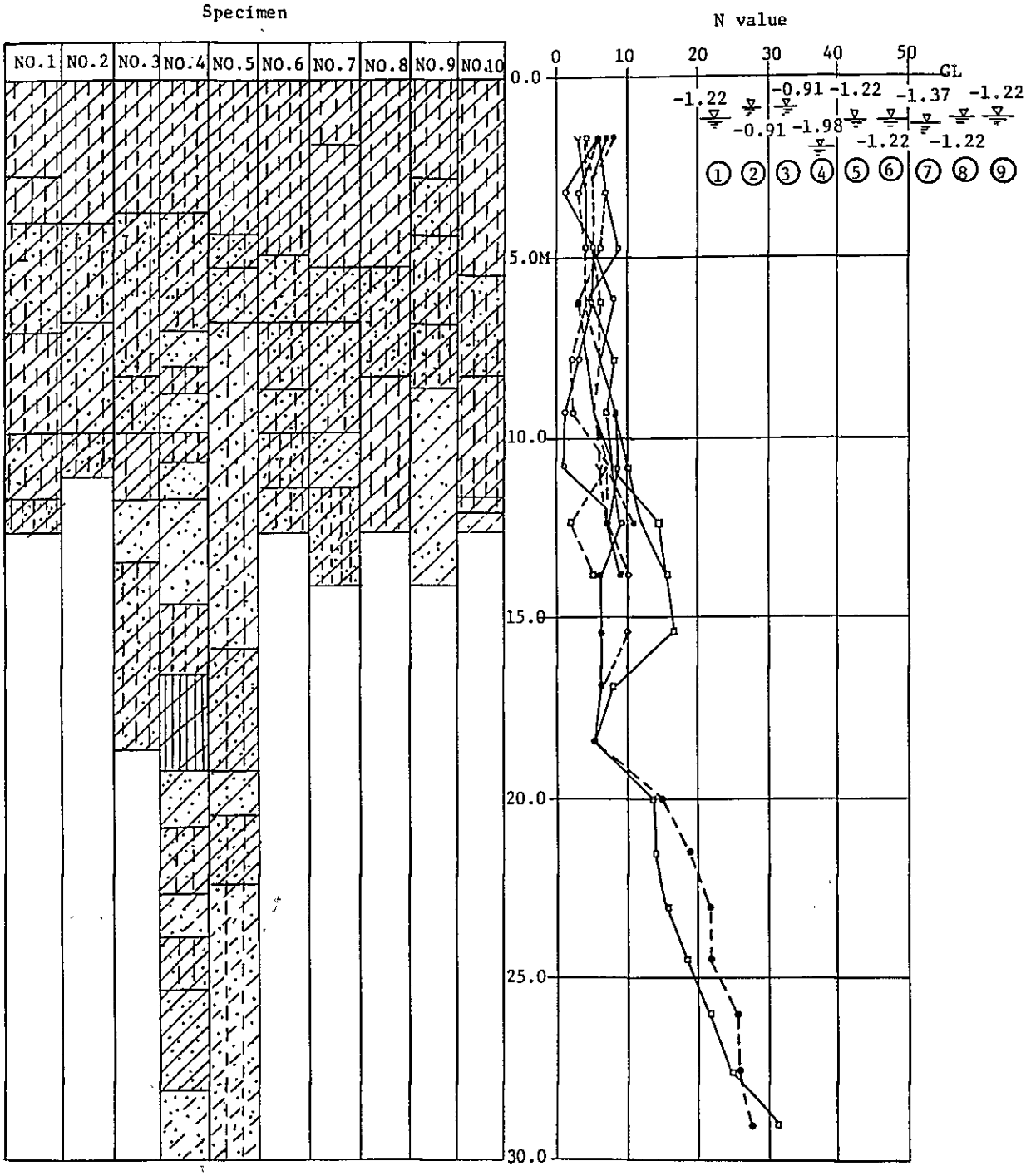
ANNEX V-4

BLOCK NO. 4 BORING LOG



Annex V-5

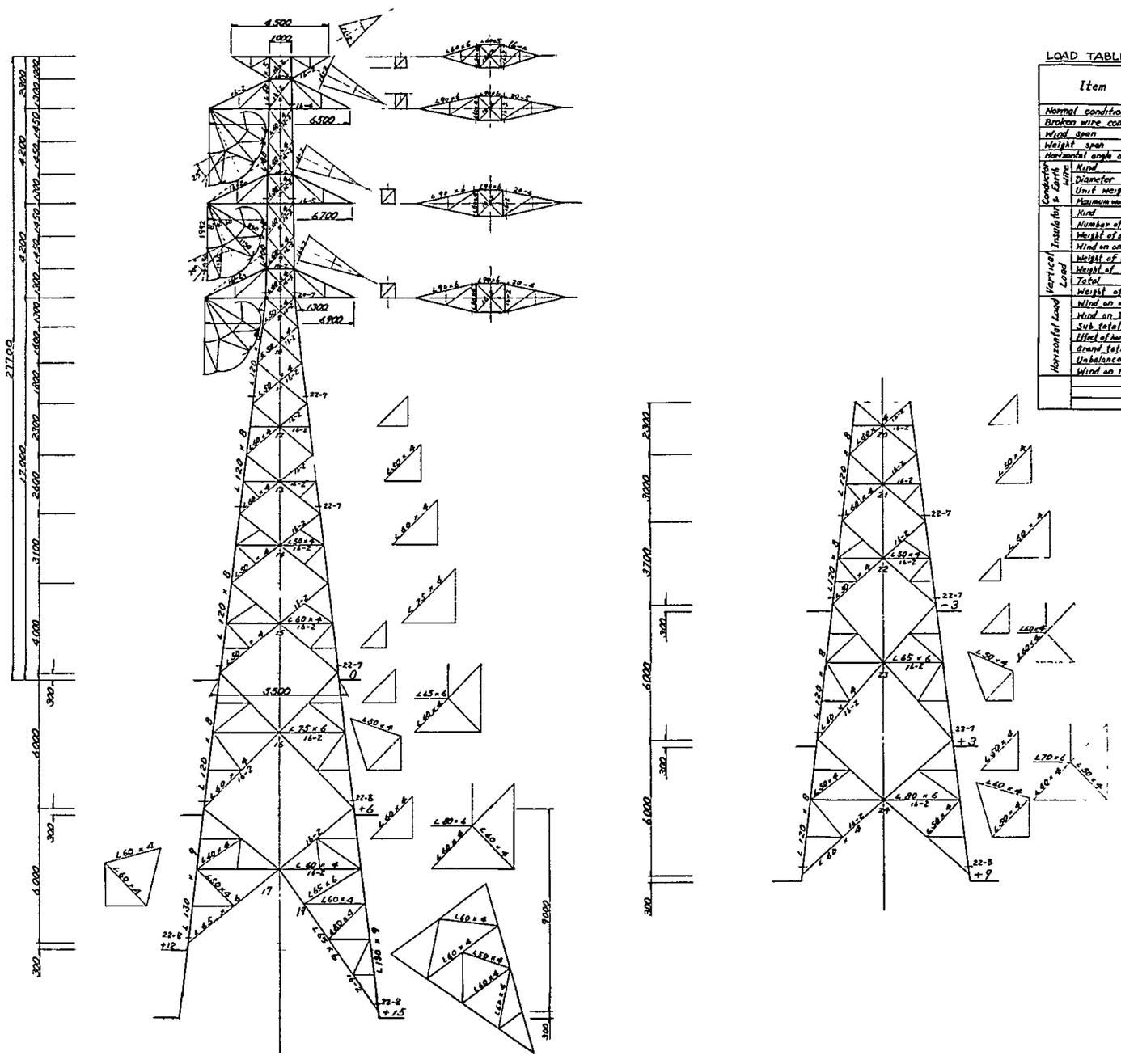
BLOCK NO. 5 BORING LOG



ANNEX VI

STRACTUAL DRAWING OF TRANSMISSON TOWER

TYPE "A" TOWER (S = 1/100)



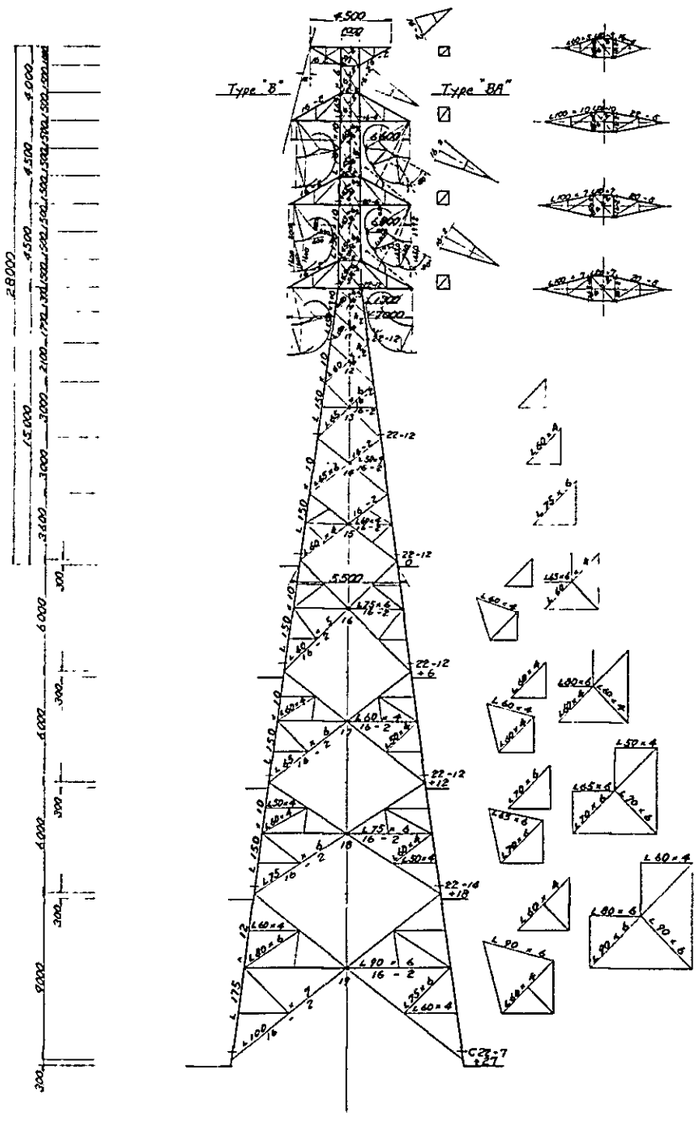
LOAD TABLE

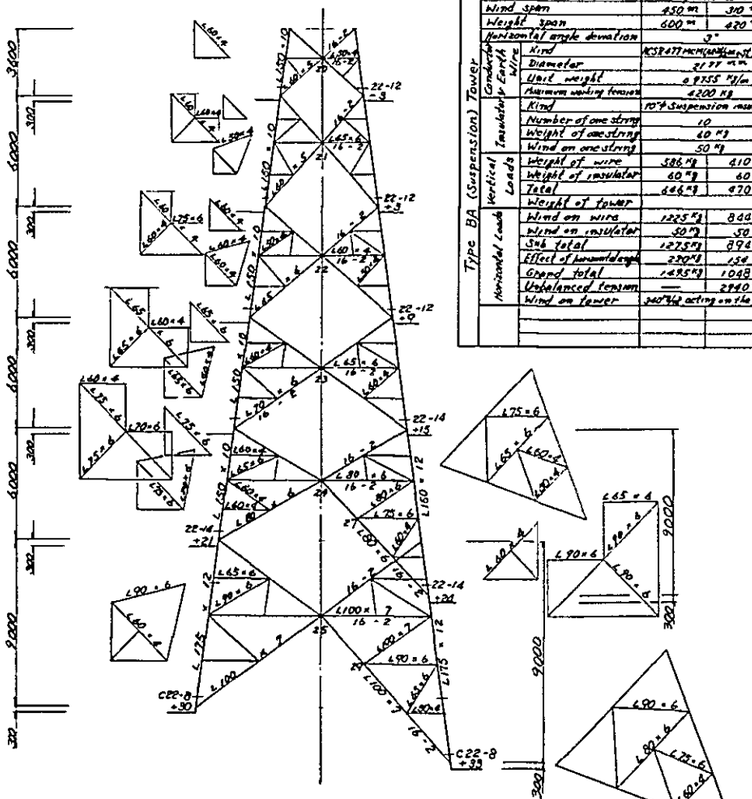
Item		Conductor		Earth Wire		Remarks
		Normal Condition	Broken Wire Condition	Normal Condition	Broken Wire Condition	
Normal condition		All wires intact				
Broken wire condition		Any one conductor or earth wire broken				
Wind span		300 m	210 m	300 m	210 m	(S)
Weight span		500 m	350 m	500 m	350 m	(S)
Horizontal angle deviation		3°		3°		(B)
Conductor & Earth wire	Kind	ACSR 477 MCM (26/4.5 + 7/2.5) mm²		G.S.W. 55" (7/3.2)		
	Diameter	21.77 mm		9.6 mm		(D)
	Unit weight	0.9755 kg/m		0.446 kg/m		(W)
	Maximum working tension	4200 kg		1.850 kg		Per one conductor (P)
Insulator	Kind	10" φ Suspension insulator		—		
	Number of one string	10		—		
	Weight of one string	60 kg		—		
	Wind on one string	30 kg		—		
Vertical Load	Weight of wire	488 kg	342 kg	223 kg	157 kg	W S'
	Height of Insulator	60 kg	60 kg	—	—	
	Total	548 kg	402 kg	223 kg	157 kg	At one acting point
	Weight of tower					
Horizontal Load	Wind on wire	817 kg	572 kg	360 kg	252 kg	125 kg/m² D S 10°
	Wind on Insulator	50 kg	50 kg	—	—	
	Sub total	867 kg	622 kg	360 kg	252 kg	
	Effect of horizontal angle	220 kg	154 kg	103 kg	73 kg	2 P sin θ/2
	Grand total	1087 kg	776 kg	463 kg	325 kg	At one acting point
	Unbalanced tension	—	2740 kg	—	1365 kg	At one acting point (W)
	Wind on tower	300 kg/m² acting on the projected area of one face member				

Notes:
1. Member
   Without mark : L45 × 4
2. Bolt
   Without mark : M16 ~ 1
3 Material
   SS 41 L45×4 ~ L100×10, M16
   SS 50 M20, M22
   SS 55 L120×8 Up

BANGLADESH POWER DEVELOPMENT BOARD		
APPROVED BY		132kV BHERAMARA-BARISAL TRANSMISSION LINE TYPE "A" TOWER (2CCT) STRUCTURAL DRAWING
CHECKED BY		
DESIGNED BY		
DRAWN BY		
DATE	May 11, '79	
DATE OF ISSUE		
FACTION	SCALE 1/100	DRG.NO. 7001

TYPE "B" & "BA" TOWER (S- 1/150)





LOAD TABLE

	Item	Conductor		Earth Wire		Remarks
		Normal Condition	Broken Wire Condition	Normal Condition	Broken Wire Condition	
Type 'B' (Angle) Tower	Normal Condition	All wires intact				
	Broken Wire Condition	Any one conductor or earth wire broken				
	Wind span	300 m	210 m	300 m	210 m	(S)
	Weight Span	500 m	350 m	500 m	350 m	(S')
	Horizontal angle deviation	15°		15°		(θ)
	Conductor & Earth Wire — Kind	ACSR 477 MCM (Hawk) (26/7)		6 S W 55° (7/3.2)		
	Conductor & Earth Wire — Diameter	21.77 mm		9.6 mm		(D)
	Conductor & Earth Wire — Unit Weight	0.9755 kg/m		0.446 kg/m		(W)
	Conductor & Earth Wire — Maximum working tension	4200 kg		1950 kg		Per one conductor (P)
	Insulator — Kind	10" Suspension insulator		—		
	Insulator — Number of one string	11		—		
	Insulator — Weight of one string	70 kg		—		
	Insulator — Wind on one string	35 kg		—		
	Vertical Loads — Weight of wire	488 kg	342 kg	223 kg	157 kg	W.S'
	Vertical Loads — Weight of insulator	140 kg	140 kg	—	—	
	Vertical Loads — Total	628 kg	482 kg	223 kg	157 kg	At one acting point
	Horizontal Loads — Weight of tower					
	Horizontal Loads — Wind on wire	817 kg	572 kg	360 kg	252 kg	$125\ kg/m^2 \cdot D \cdot S\ 10^{-3}$
	Horizontal Loads — Wind on insulator	110 kg	110 kg			
	Horizontal Loads — Sub total	927 kg	682 kg	360 kg	252 kg	
	Horizontal Loads — Effect of horizontal angle	1097 kg	768 kg	508 kg	357 kg	$2P \sin\theta/2$
	Horizontal Loads — Grand total	2024 kg	1450 kg	868 kg	609 kg	At one acting point
	Horizontal Loads — Unbalanced tension	—	4200 kg	—	1950 kg	At one acting point
	Horizontal Loads — Wind on tower	200 kg/m² acting on the projected area of one face members				
Type BA (Suspension) Tower	Normal condition	All wires intact				
	Broken wire condition	Any one conductor or earth wire broken				
	Wind Span	450 m	310 m	450 m	310 m	(S)
	Weight Span	600 m	420 m	600 m	420 m	(S')
	Horizontal angle deviation	3°		3°		(θ)
	Conductor & Earth Wire — Kind	ACSR 477 MCM (Hawk) (26/7)		6 S W 55° (7/3.2)		
	Conductor & Earth Wire — Diameter	21.77 mm		9.6 mm		(D)
	Conductor & Earth Wire — Unit weight	0.9755 kg/m		0.446 kg/m		(W)
	Conductor & Earth Wire — Maximum working tension	4200 kg		1950 kg		Per one conductor (P)
	Insulator — Kind	10" Suspension insulator		—		
	Insulator — Number of one string	10		—		
	Insulator — Weight of one string	60 kg		—		
	Insulator — Wind on one string	50 kg		—		
	Vertical Loads — Weight of wire	586 kg	410 kg	268 kg	188 kg	W.S
	Vertical Loads — Weight of insulator	60 kg	60 kg	—	—	
	Vertical Loads — Total	646 kg	470 kg	268 kg	188 kg	At one acting point
	Horizontal Loads — Weight of tower					
	Horizontal Loads — Wind on wire	1225 kg	860 kg	540 kg	372 kg	$125\ kg/m^2 \cdot D \cdot S\ 10^{-3}$
	Horizontal Loads — Wind on insulator	50 kg	50 kg			
	Horizontal Loads — Sub total	1275 kg	894 kg	540 kg	372 kg	
	Horizontal Loads — Effect of horizontal angle	220 kg	154 kg	103 kg	73 kg	$2P \sin\theta/2$
	Horizontal Loads — Grand total	1495 kg	1048 kg	643 kg	445 kg	At one acting point
	Horizontal Loads — Unbalanced tension	—	2940 kg	—	1365 kg	At one acting point (at 7°)
	Horizontal Loads — Wind on tower	360 kg/m² acting on the projected of one face member				Tower Height over 40m

Notes :
1. Member
   Without mark : L45 × 4
2. Bolt
   Without mark : M16 ~ 1
3. Material
   SS 41 — L45 × 4 ~ L100 × 10 , M16
   SS 50 — M20, M22
   SS 55 — L120 × 8 Up
   SCr 4 — CM22

BANGLADESH POWER DEVELOPMENT BOARD

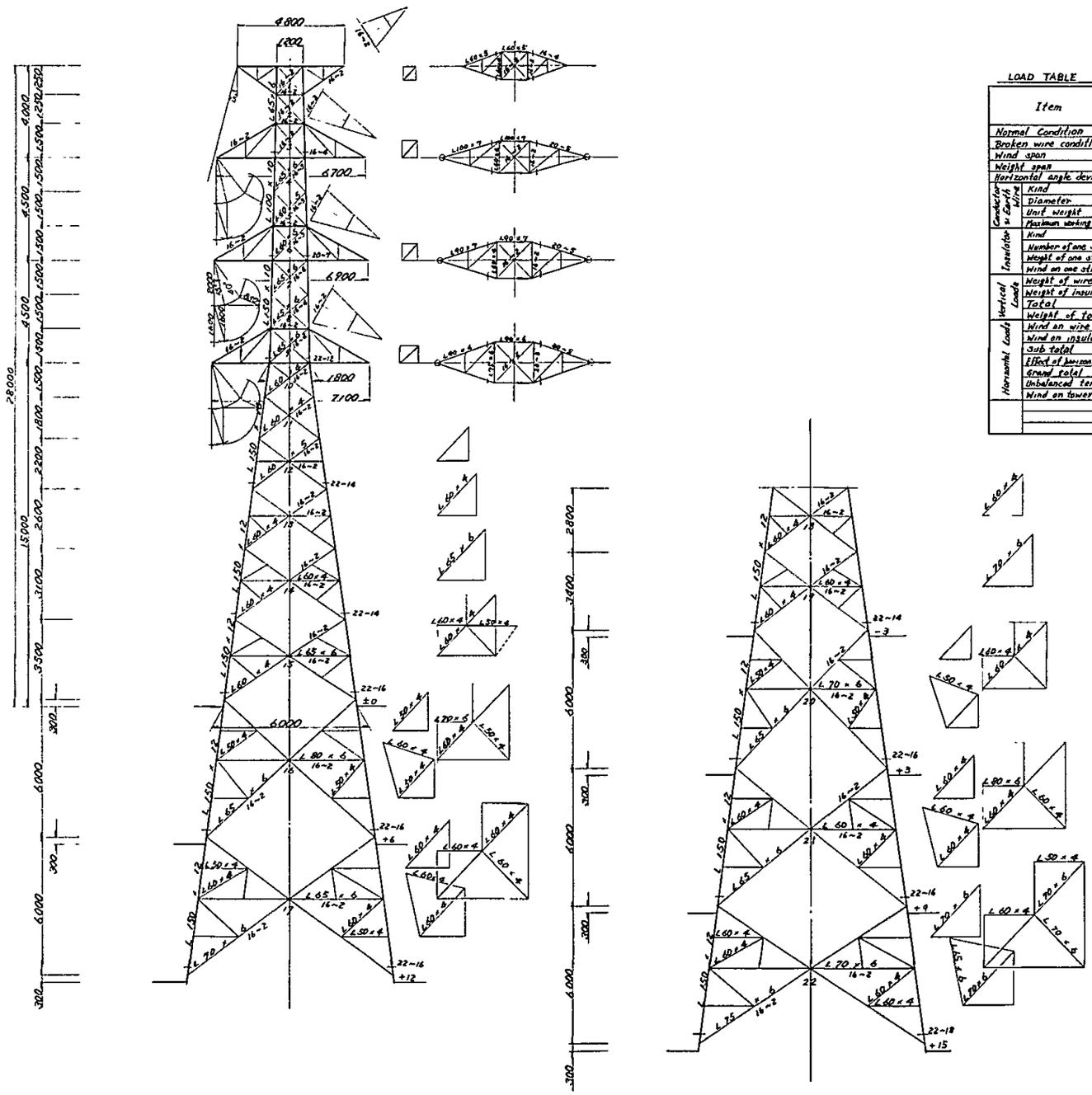
APPROVED BY	
CHECKED BY	
DESIGNED BY	
DRAWN BY	
DATE	May 13, '79
DATE OF ISSUE	
HISTORY	

132KV BHERAMARA-BARISAL TRANSMISSION LINE
TYPE "B" & "BA" TOWER (2CCT)
STRUCTURAL DRAWING

SCALE 1/150

DRG. NO. 7002

TYPE "C" TOWER (S - 1/100)



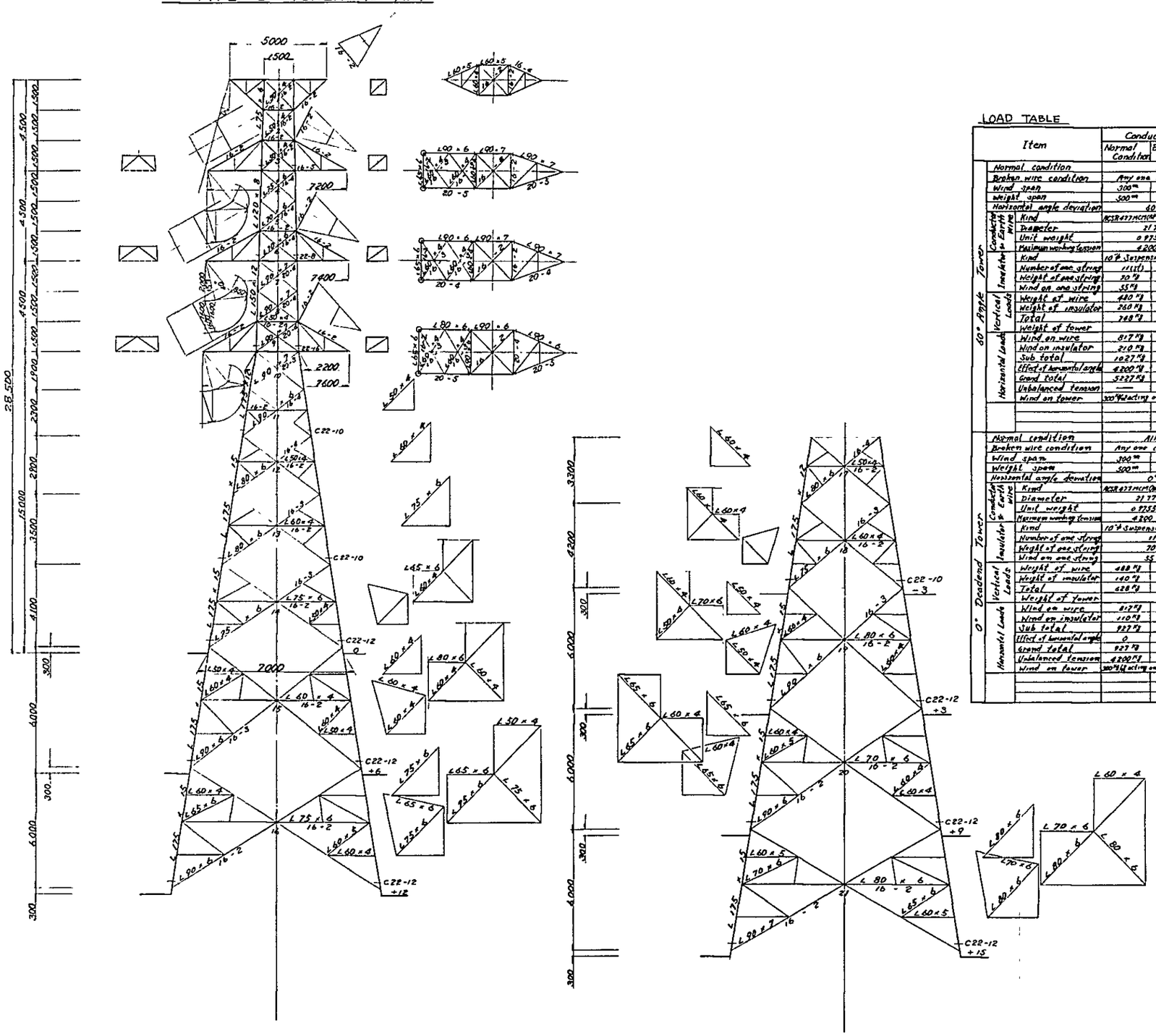
LOAD TABLE

Item		Conductor		Earth Wire		Remarks
		Normal Condition	Broken Wire Condition	Normal Condition	Broken Wire Condition	
Normal Condition		All wires intact				
Broken wire condition		Any one conductor or earth wire broken				
Wind span		300 m	210 m	300 m	210 m	(S)
Weight span		500 m	350 m	500 m	350 m	(S)
Horizontal angle deviation		30°		30°		(θ)
Conductor & Earth Wire	Kind	ACSR 477 MCM (Hawk) 54/7		G.S.W. 55% (3/2.6)		
	Diameter	21.77 mm		9.5 mm		(D)
	Unit weight	0.9558 kg/m		0.446 kg/m		(W)
	Maximum working tension	6200 kg		1950 kg		Per one conductor (T)
Insulator	Kind	10"ϕ suspension insulator		—		
	Number of one string	11 (15")	10 (18")	—		
	Weight of one string	70	60	—		
	Wind on one string	55	50	—		
Vertical Loads	Weight of wire	488	342	223	157	W.S.
	Weight of insulator	200	200	—	—	
	Total	688	542	223	157	At one acting point
	Weight of tower					
Horizontal Loads	Wind on wire	917	573	360	252	$125 \times V^2 \times D \times S \times 10^{-3}$
	Wind on insulator	160	160	—	—	
	Sub total	977	733	360	252	
	Effect of horizontal angle	2175	1573	1010	707	$T \times \sin \theta/2$
	Grand total	3152	2256	1370	959	At one acting point
	Unbalanced tension	—	6200	—	1950	At one acting point
	Wind on tower	300 kg/m² acting on the projected area of one face members				

Notes :
1 Member
Without mark : L 45 × 4
2 Bolt
Without mark : M16 ~ 1
3 Material
SS41 L 45 × 4 ~ L 100 × 10, M16
SS50 M20, M22
SS55 L 120 × 8 Up

BANGLADESH POWER DEVELOPMENT BOARD		
APPROVED BY		132 kV BHRAMAPA - BARISAL TRANSMISSION LINE
CHECKED BY		TYPE "C" TOWER (2CCT)
DESIGNED BY		STRUCTURAL DRAWING
DRAWN BY		
DATE	May 11'79	
DATE OF ISSUE		
FACTORY		SCALE 1/100 — DRG NO. 7003

TYPE "D" TOWER (S = 1/100)



LOAD TABLE

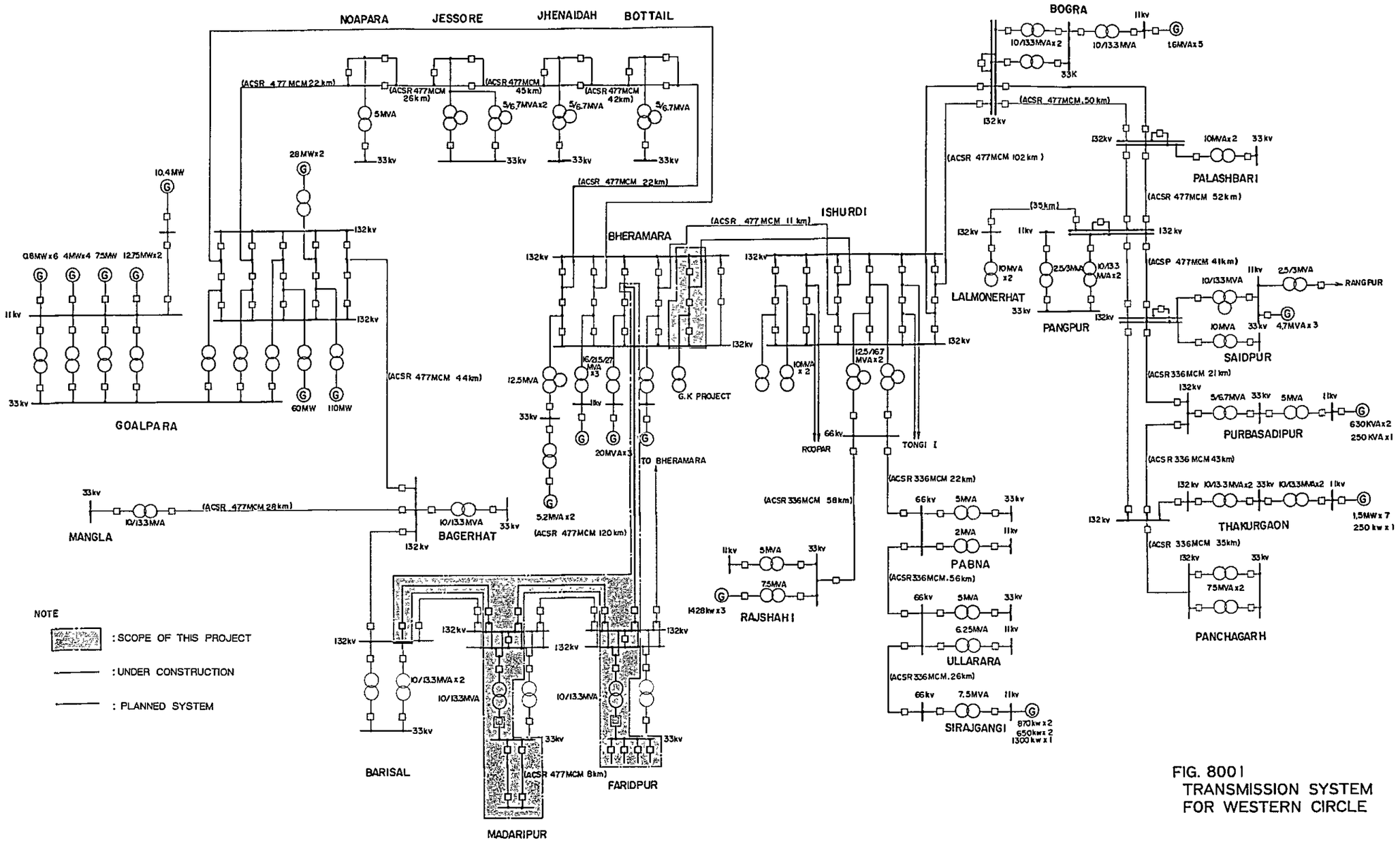
	Item		Conductor		Earth Wire		Remarks
			Normal Condition	Broken wire Condition	Normal Condition	Broken wire Condition	
60° Angle Tower		Normal condition	All wires intact				
		Broken wire condition	Any one conductor or earthwire broken				
		Wind span	300 m	210 m	300 m	210 m	(S)
		Weight span	500 m	350 m	500 m	350 m	(S')
		Horizontal angle deviation	60°		60°		(θ)
	Conductor & Earth wire	Kind	ACSR 477 mcm (54/7) "Hawk"		GSW 55% (7/12)		
		Diameter	21.77 mm		9.6 mm		(D)
		Unit weight	0.9755 kg/m		0.446 kg/m		(W)
		Maximum working tension	4200 kg		1950 kg		Per one conductor (P)
	Insulator	Kind	10" Suspension insulator		—		
		Number of one string	11 (11)	10 (10)	—		
		Weight of one string	70 kg	60 kg	—		
		Wind on one string	55 kg	50 kg	—		
	Vertical Loads	Weight of wire	440 kg	342 kg	223 kg	157 kg	W.S'
		Weight of insulator	260 kg	260 kg	—	—	
		Total	748 kg	602 kg	223 kg	157 kg	At one acting point
		Weight of tower					
	Horizontal Loads	Wind on wire	817 kg	572 kg	360 kg	252 kg	125 kg/m² D:S 10⁻³
		Wind on insulator	210 kg	210 kg	—	—	
		Sub total	1027 kg	782 kg	360 kg	252 kg	
		Effect of horizontal angle	4200 kg	2940 kg	1950 kg	1365 kg	2 P sin θ/2
		Grand total	5227 kg	3722 kg	2310 kg	1617 kg	At one acting point
		Unbalanced tension	—	4200 kg	—	1950 kg	At one acting point
		Wind on tower	300 kg acting on the projected area of one face members				
0° Deadend Tower		Normal condition	All wires intact				
		Broken wire condition	Any one conductor or earth wire broken				
		Wind span	300 m	210 m	300 m	210 m	(S)
		Weight span	500 m	350 m	500 m	350 m	(S')
		Horizontal angle deviation	0°		0°		(θ)
	Conductor & Earth wire	Kind	ACSR 477 mcm (54/7) "Hawk"		GSW 55% (7/12)		
		Diameter	21.77 mm		9.6 mm		(D)
		Unit weight	0.9755 kg/m		0.446 kg/m		(W)
		Maximum working tension	4200 kg		1950 kg		Per one conductor (P)
	Insulator	Kind	10" Suspension insulator		—		
		Number of one string	11		—		
		Weight of one string	70 kg		—		
		Wind on one string	55 kg		—		
	Vertical Loads	Weight of wire	488 kg	342 kg	223 kg	157 kg	W.S'
		Weight of insulator	140 kg	140 kg	—	—	
		Total	628 kg	482 kg	223 kg	157 kg	At one acting point
		Weight of tower					
	Horizontal Loads	Wind on wire	817 kg	572 kg	360 kg	252 kg	125 kg/m² D:S 10⁻³
		Wind on insulator	110 kg	110 kg	—	—	
		Sub total	927 kg	682 kg	360 kg	252 kg	
		Effect of horizontal angle	0	0	0	0	2 P Sin θ/2
		Grand total	927 kg	682 kg	360 kg	252 kg	At one acting point
		Unbalanced tension	4200 kg	0	1950 kg	0	At one acting point
		Wind on tower	300 kg acting on the projected area of one face members				

Notes:
1. Member
   Without mark : L 45 × 4
2. Bolt
   Without mark : M16 ~ 1
3. Material
   SS 41 L 45×4 ~ L 100×10 , M16
   SS 50 M20 M22
   SS 55 L 120×8 Up
   SC-4 CM22

BANGLADESH POWER DEVELOPMENT BOARD	
APPROVED BY	
CHECKED BY	
DESIGNED BY	
DRAWN BY	
DATE	May 11, '79
DATE OF ISSUE	
FACTORY	
132 kV BHERAMARA-BARISAL TRANSMISSION LINE TYPE "D" TOWER (2 CCT) STRUCTURAL DRAWING	
SCALE	1/100
DRG NO.	7004

ANNEX VII

TRANSMISSION SYSTEM FOR WESTERN GRID AND DRAWINGS CONCERNED WITH SUBSTATION



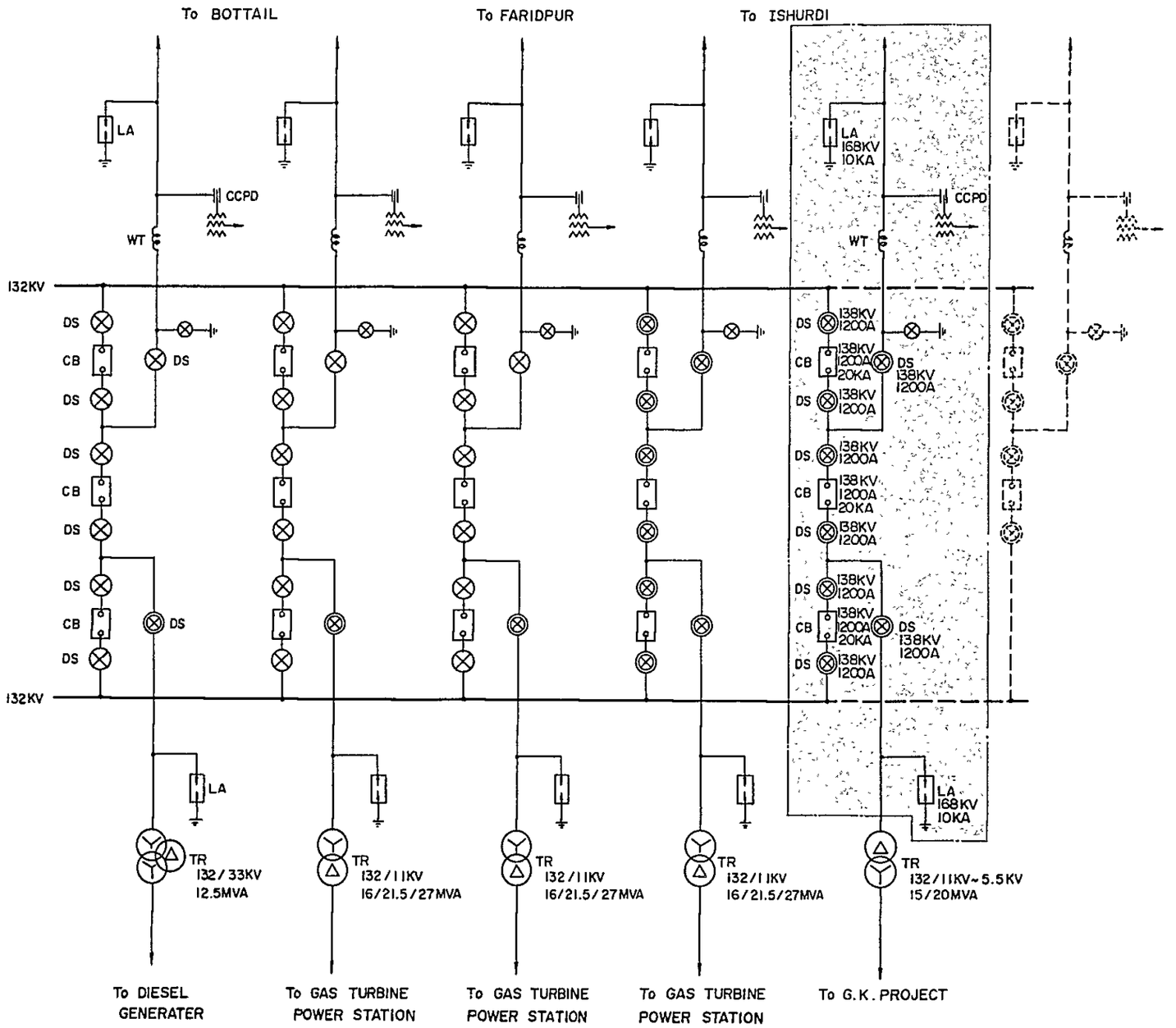
NOTE

: SCOPE OF THIS PROJECT

: UNDER CONSTRUCTION

: PLANNED SYSTEM

FIG. 8001
TRANSMISSION SYSTEM
FOR WESTERN CIRCLE



LEGEND

TR	TRANSFORMER
C B	CIRCUIT BREAKER
DS	DISCONNECTING SWITCH
CCPD	COUPLLG CAPACITOR POTENTIAL DEVICE
LA	LIGHTNING ARRESTER
WT	WAVE TRAP

NOTE

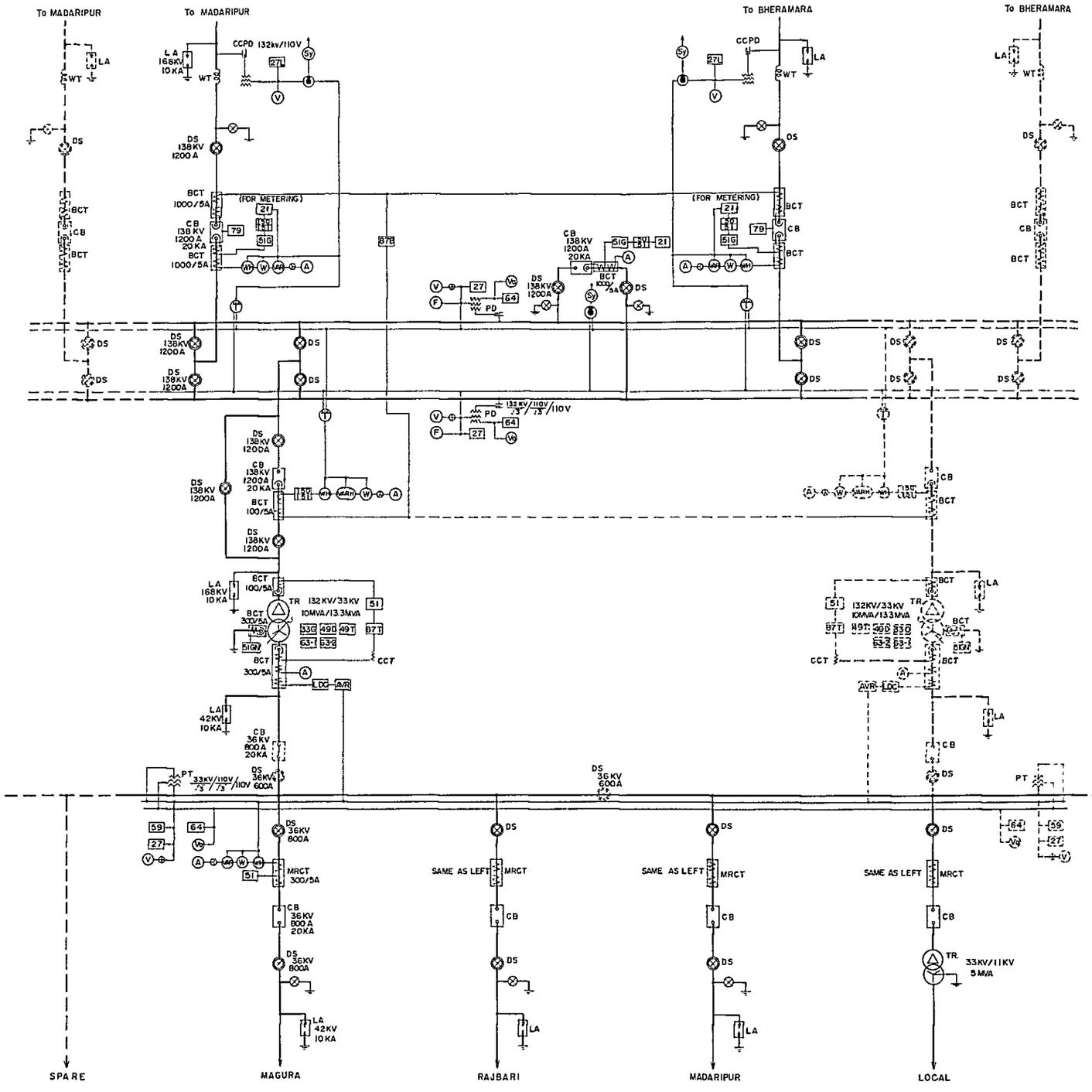
: SCOPE OF THIS PROJECT

DOTTED LINE DENOTES THE FUTURE EXTENSION.

FIG. 8002

BHEARMARA SUBSTATION

SINGLE LINE DIAGRAM



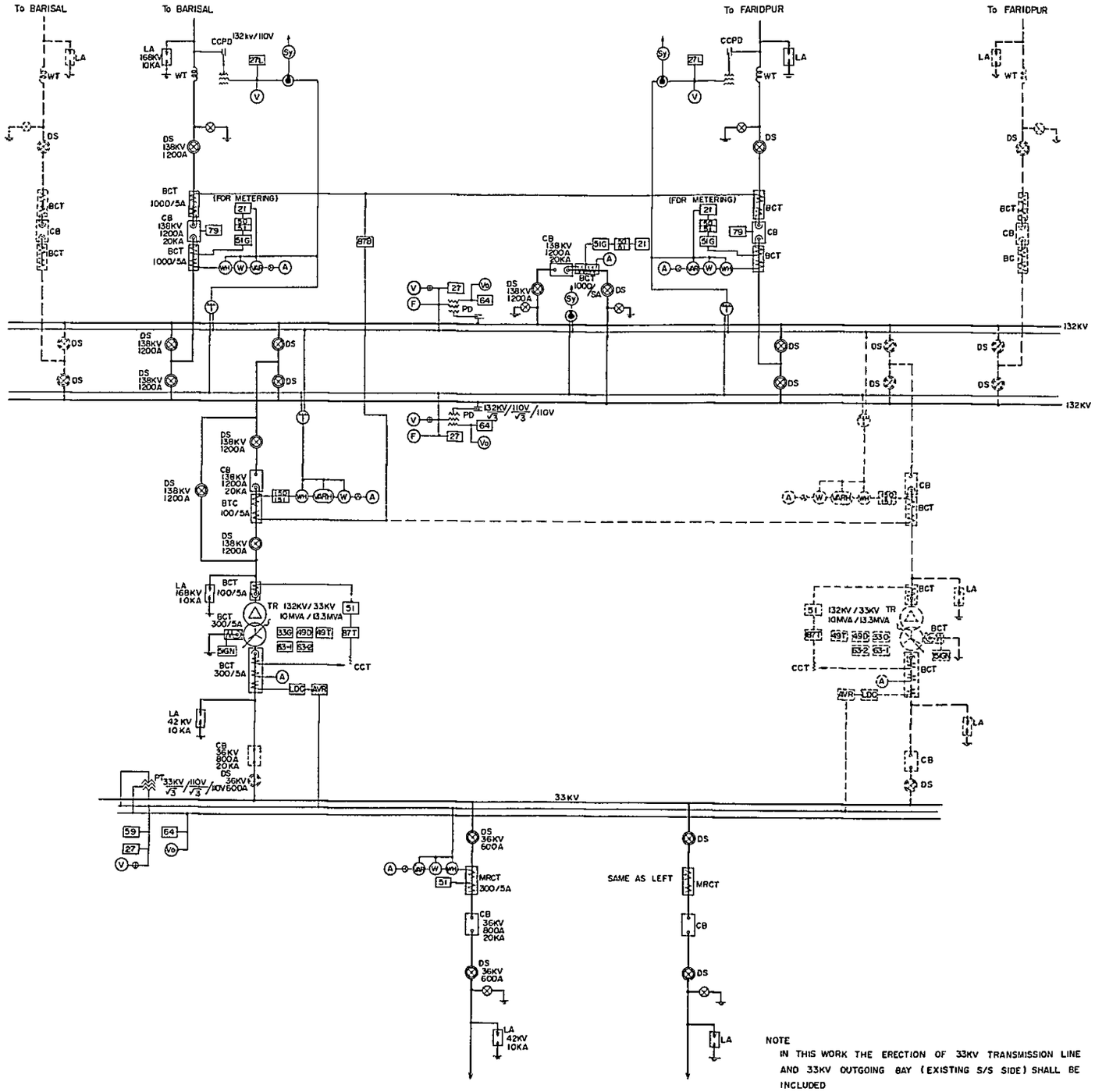
LEGEND

SYMBOL	DESCRIPTION
V	VOLTMETER
V_0	ZERO PHASE SEQUENCE VOLTMETER
A	AMMETER
W	WATTMETER
WH	WATT-HOUR METER
VAR	VARMETER
F	FREQUENCY METER
Sy	SYNCHROSCOPE
S	SYNCHRONISING SWITCH
Y	RESETTING MULTI CONTRACT RELAY
O	VOLTMETER CHANGE-OVER SWITCH
O	AMMETER CHANGE-OVER SWITCH
TR	TRANSFORMER
CB	CIRCUIT BREAKER
DS	DISCONNECTING SWITCH
MRCT	MULTI RATIO CURRENT TRANSFORMER
BCT	BUSHING TYPE CURRENT TRANSFORMER
PD	CAPACITOR TYPE POTENTIAL DEVICE
PT	POTENTIAL TRANSFORMER
CCPD	COUPLING CAPACITOR POTENTIAL DEVICE
LA	LIGHTNING ARRESTER
WT	WAVE TRAP
LDC	LINE DROP COMPENSATER
CCT	CURRENT COMPENSTING TRANSFORMER
21	DISTANCE RELAY
25	SYNCHRONIZING CHECK RELAY
27	UNDERVOLTAGE RELAY
330	OIL LEVEL GAUGE FOR TRANSFORMER
49D	DIAL TYPE THERMOMETER FOR TRANSFORMER OIL
49T	DIAL TYPE THERMOMETER FOR TRANSFORMER WINDING
50	INSTANTANEOUS OVERCURRENT RELAY
51	A.C TIME OVER CURRENT RELAY
51G	OVER CURRENT GROUND RELAY
59	OVER VOLTAGE RELAY
63-1	BUCHHOLTZ'S RELAY 1ST STAGE
63-2	BUCHHOLTZ'S RELAY 2ND STAGE
64	OVER VOLTAGE GROUND RELAY
79	RECLOSING RELAY
87	DIFFERENTIAL CURRENT RELAY

NOTE

DOTTED LINE DENOTES
THE FUTURE EXTENTION

FIG. 8003
FARIDPUR SABSTATION
SINGLE LINE DIAGRAM



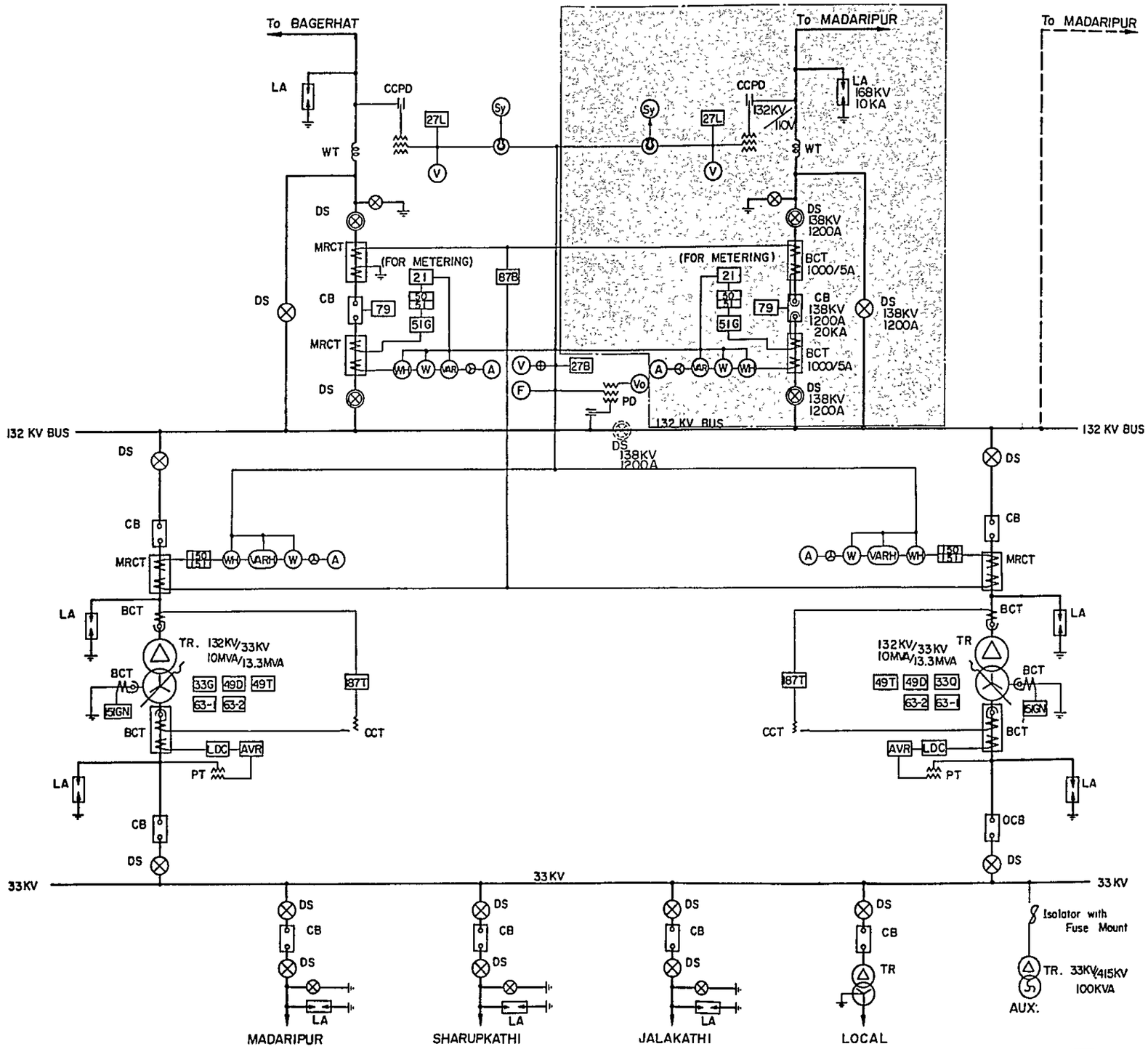
LEGEND

SYMBOL	DESCRIPTION
(V)	VOLTMETER
(Vo)	ZERO PHASE SEQUENCE VOLTMETER
(A)	AMMETER
(W)	WATTMETER
(Wh)	WATT-HOUR METER
(VAR)	VARMETER
(F)	FREQUENCY METER
(Sy)	SYNCHROSCOPE
(S)	SYNCHRONISING SWITCH
(T)	RESETTING MULTI-CONTRACT RELAY
O	VOLTMETER CHANGE-OVER SWITCH
O	AMMETER CHANGE-OVER SWITCH
TR	TRANSFORMER
CB	CIRCUIT BREAKER
DS	DISCONNECTING SWITCH
MRCT	MULTI RATIO CURRENT TRANSFORMER
BCT	BUSHING TYPE CURRENT TRANSFORMER
PD	CAPACITOR TYPE POTENTIAL DEVICE
PT	POTENTIAL TRANSFORMER
CCPD	COUPLING CAPACITOR POTENTIAL DEVICE
LA	LIGHTNING ARRESTER
WT	WAVE TRAP
LDC	LINE DROP COMPENSATER
CCT	CURRENT COMPENSTNG TRANSFORMER
21	DISTANCE RELAY
25	SYNCHRONIZING CHECK RELAY
27	UNDERVOLTAGE RELAY
330	OIL LEVEL GAUGE FOR TRANSFORMER
49D	DIAL TYPE THERMOMETER FOR TRANSFORMER OIL
49T	DIAL TYPE THERMOMETER FOR TRANSFORMER WINDING
50	INSTANTANEOUS OVERCURRENT RELAY
51	AC TIME OVER CURRENT RELAY
51G	OVER CURRENT GROUND RELAY
59	OVER VOLTAGE RELAY
63-1	BUCHHOLTZ'S RELAY 1ST STAGE
63-2	BUCHHOLTZ'S RELAY 2ND STAGE
64	OVER VOLTAGE GROUND RELAY
79	RECLOSING RELAY
87	DIFFERENTIAL CURRENT RELAY

NOTE
DOTTED LINE DENOTES
THE FUTURE EXTENTION

NOTE
IN THIS WORK THE ERECTION OF 33KV TRANSMISSION LINE AND 33KV OUTGOING BAY (EXISTING S/S SIDE) SHALL BE INCLUDED

FIG. 8004
MADARIPUR SUBSTATION
SINGLE LINE DIAGRAM



LEGEND

SYMBOL	DESCRIPTION
V	VOLTMETER
A	AMMETER
W	WATTMETER
WH	WATT-HOUR METER
AR	VARMETER
F	FREQUENCY METER
Sy	SYNCHROSCOPE
⊕	VOLTMETER CHANGE-OVER SWITCH
⊛	AMMETER CHANGE-OVER SWITCH
TR	TRANSFORMER
CB	CIRCUIT BREAKER
DS	DISCONNECTING SWITCH
MRCT	MULTI RATIO CURRENT TRANSFORMER
BCT	BUSHING TYPE CURRENT TRANSFORMER
PD	CAPACITOR TYPE POTENTIAL DEVICE
PT	POTENTIAL TRANSFORMER
CCPD	COUPLING CAPACITOR POTENTIAL DEVICE
LA	LIGHTNING ARRESTER
WT	WAVE TRAP
LDC	LINE DROP COMPENSATER
CCT	CURRENT COMPENSTING TRANSFORMER
21	DISTANCE RELAY
25	SYNCHRONIZING CHECK RELAY
27	UNDERVOLTAGE RELAY
33O	OIL LEVEL GAUGE FOR TRANSFORMER
49D	DIAL TYPE THERMOMETER FOR TRANSFORMER OIL
49T	DIAL TYPE THERMOMETER FOR TRANSFORMER WINDING
50	INSTANTANEOUS OVERCURRENT RELAY
51	A.C TIME OVER CURRENT RELAY
51G	OVER CURRENT GROUND RELAY
63-1	BUCHHOLTZ'S RELAY IST STAGE
63-2	BUCHHOLTZ'S RELAY 2ND STAGE
79	RECLOSING RELAY
87	DIFFERENTIAL CURRENT RELAY
Vo	ZERO PHASE SEQUENCE VOLTMETER
	SYNCHRONISING SWITCH

NOTE

: SCOPE OF THIS PROJECT

DOTTED LINE DENOTES THE FUTURE EXTENSION.

FIG. 8005

BARISAL SUBSTATION

SINGLE LINE DIAGRAM

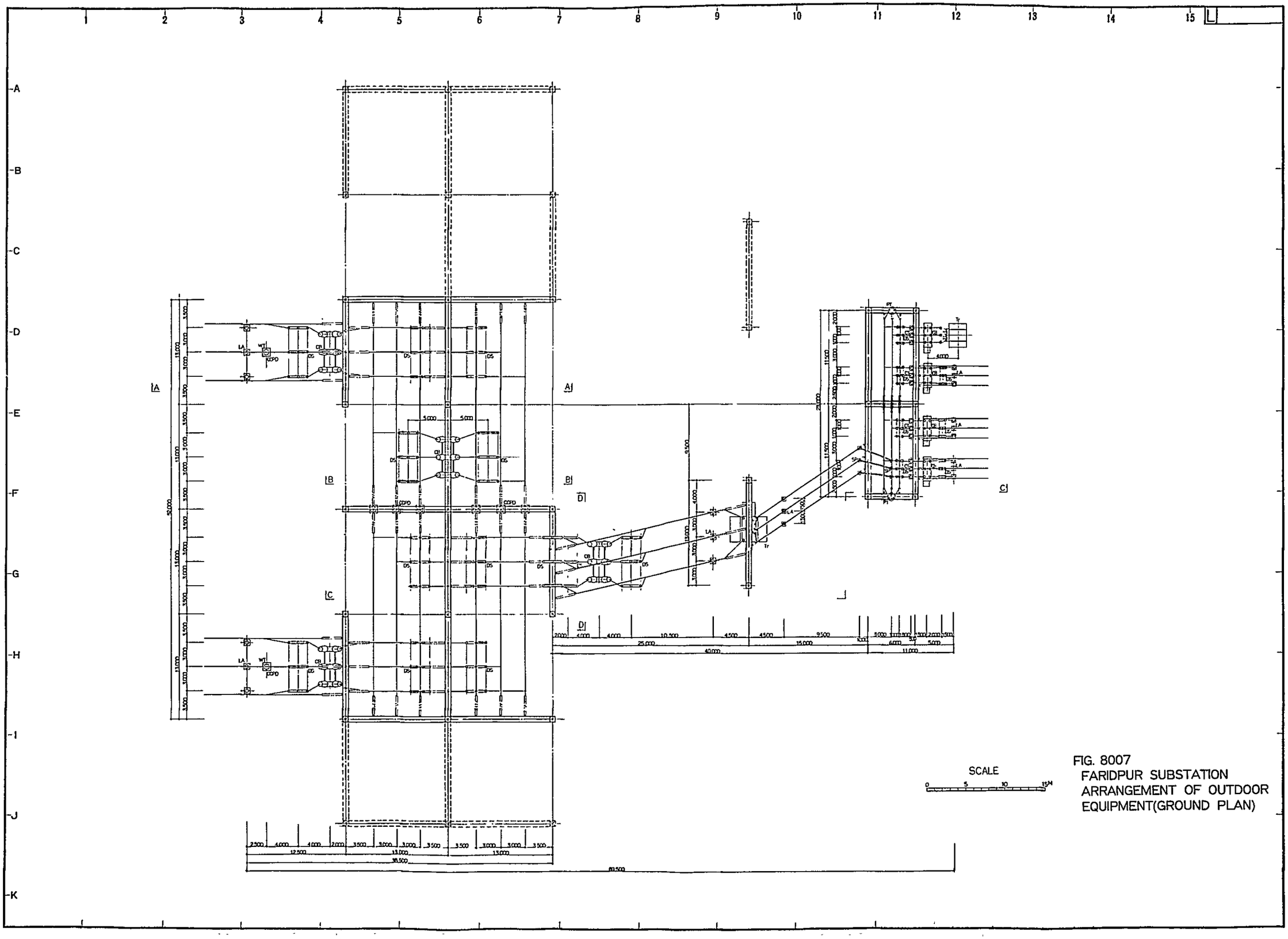
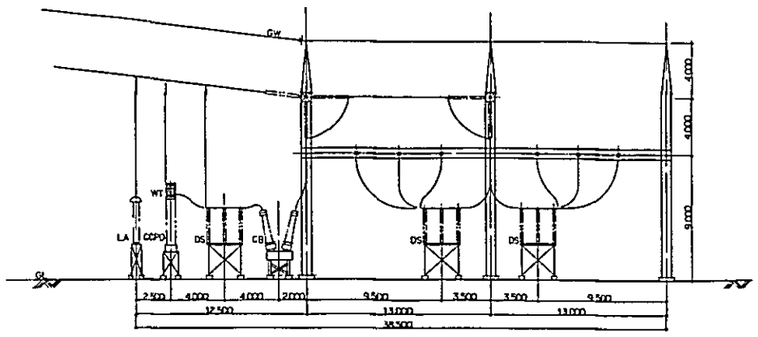
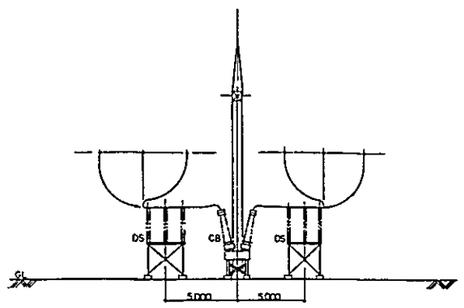


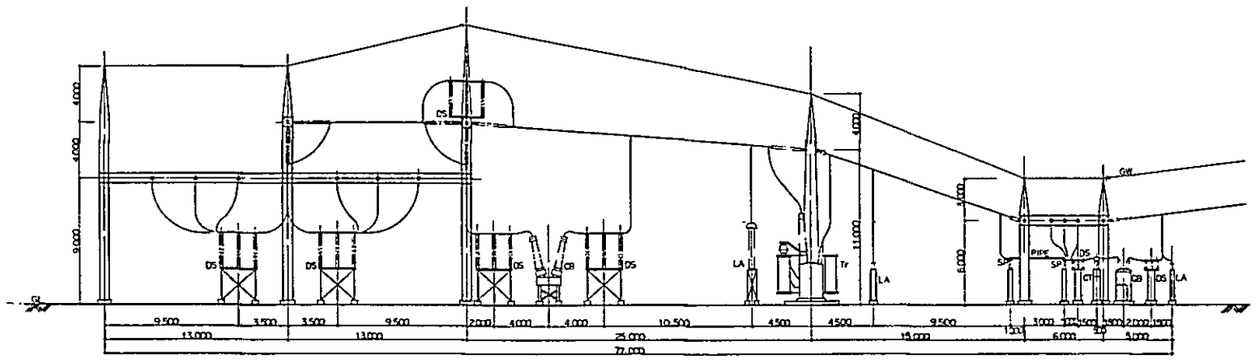
FIG. 8007
FARIDPUR SUBSTATION
ARRANGEMENT OF OUTDOOR
EQUIPMENT(GROUND PLAN)



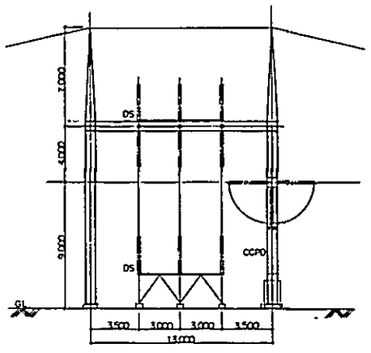
A-A Section



B-B Section



C-C Section



D-D Section

SCALE
0 5 10 15M

FIG. 8008
FARIDPUR SUBSTATION
ARRANGEMENT OF OUTDOOR
EQUIPMENT(CROSS SECTION)

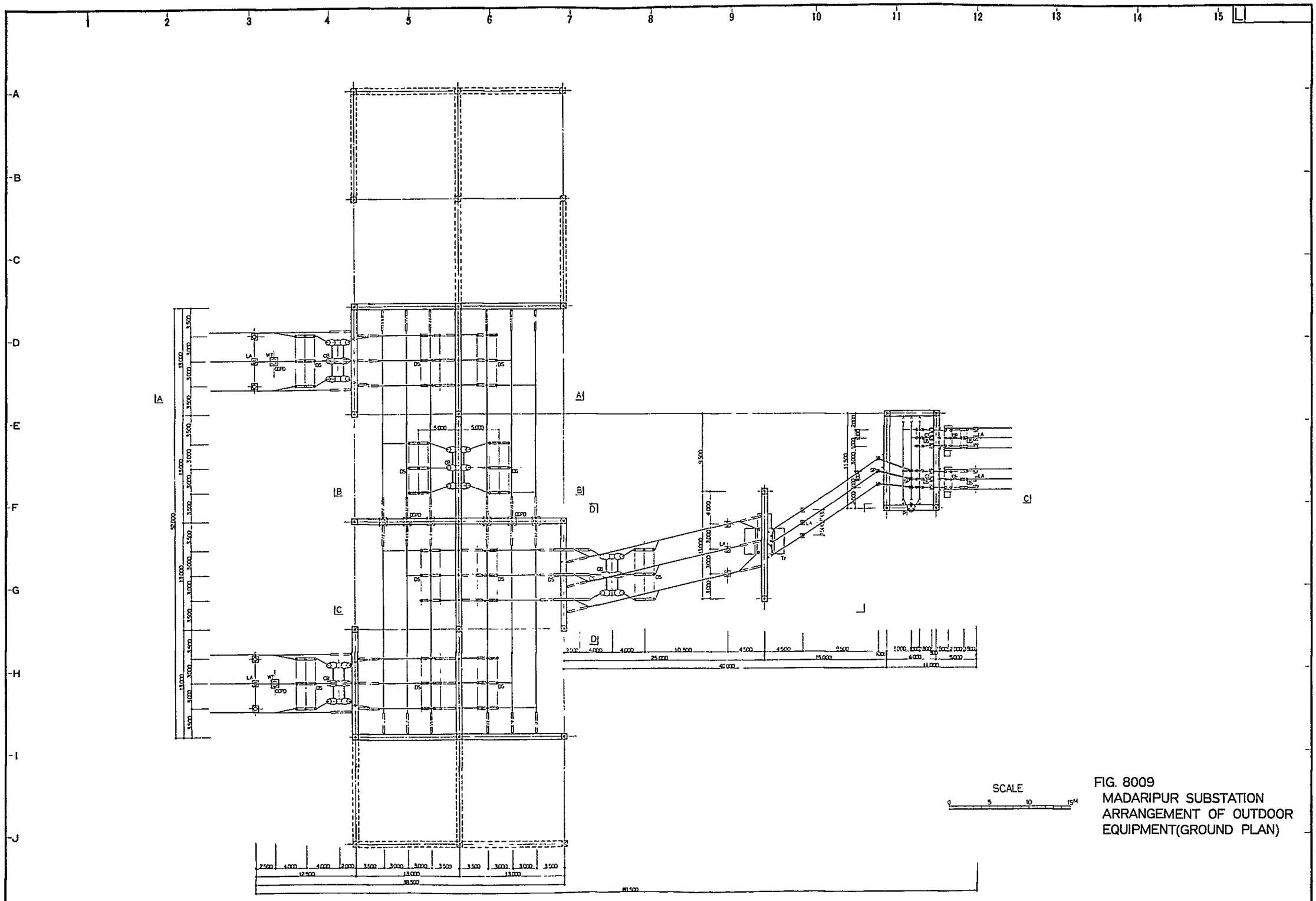
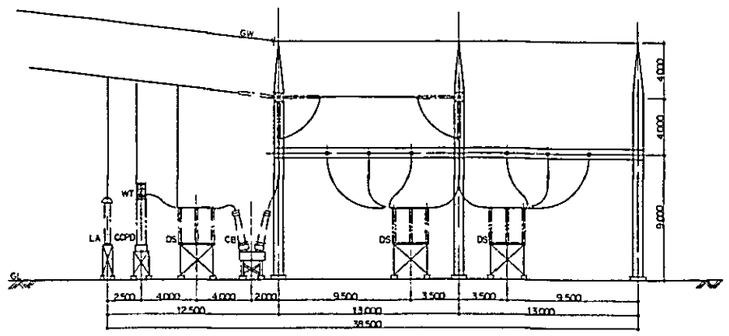
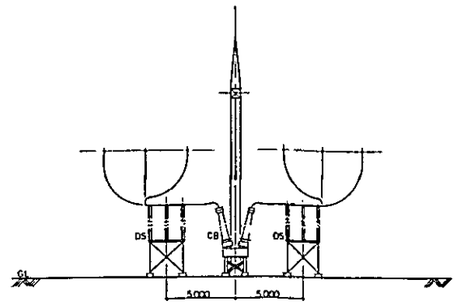


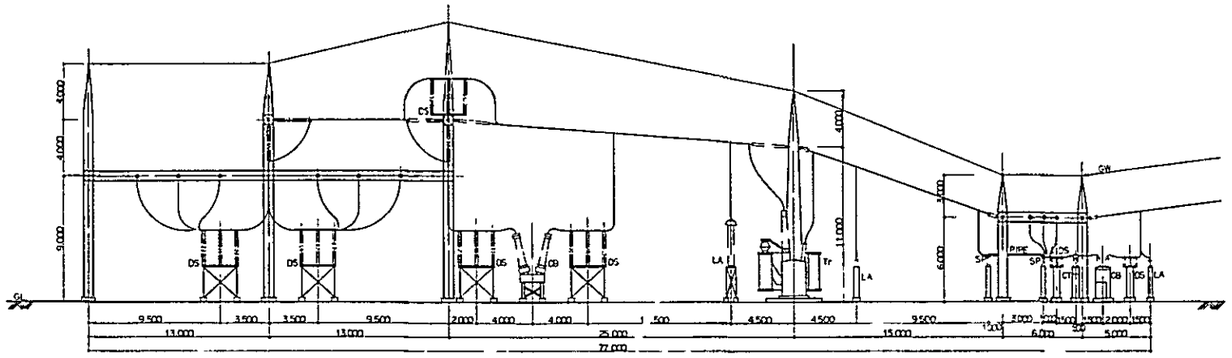
FIG. 8009
MADARIPUR SUBSTATION
ARRANGEMENT OF OUTDOOR
EQUIPMENT(GROUND PLAN)



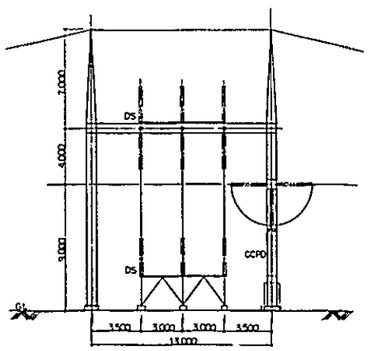
A-A Section



B-B Section



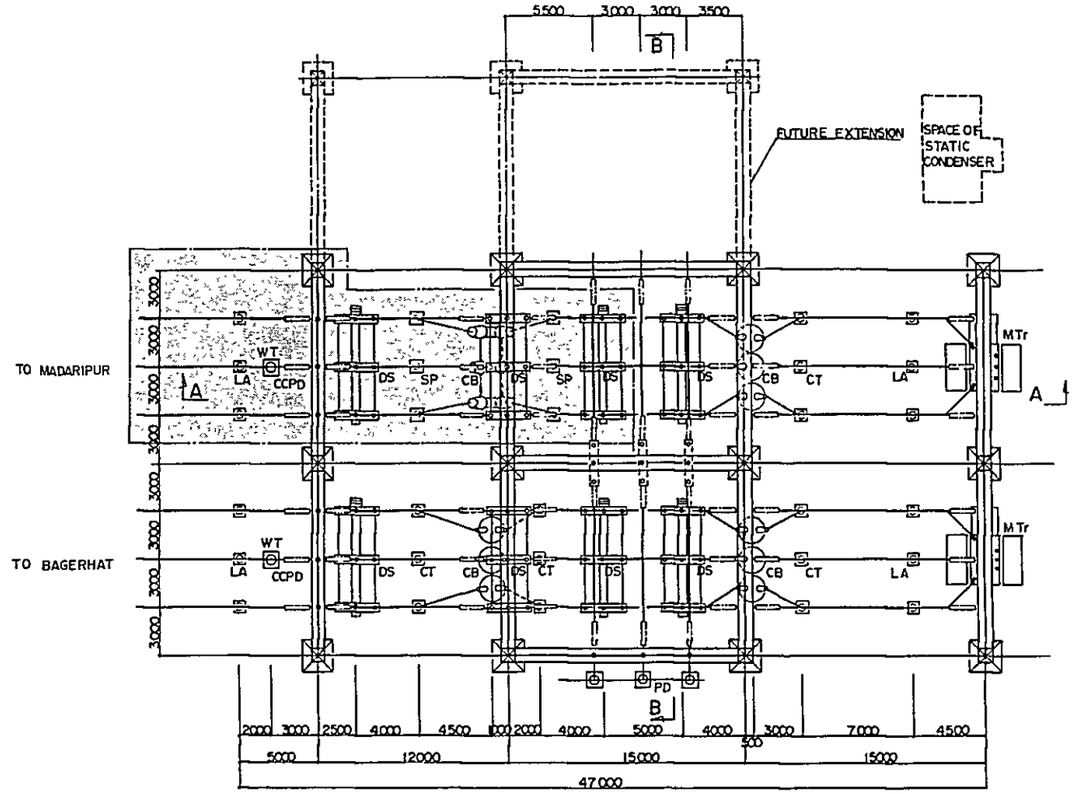
C-C Section

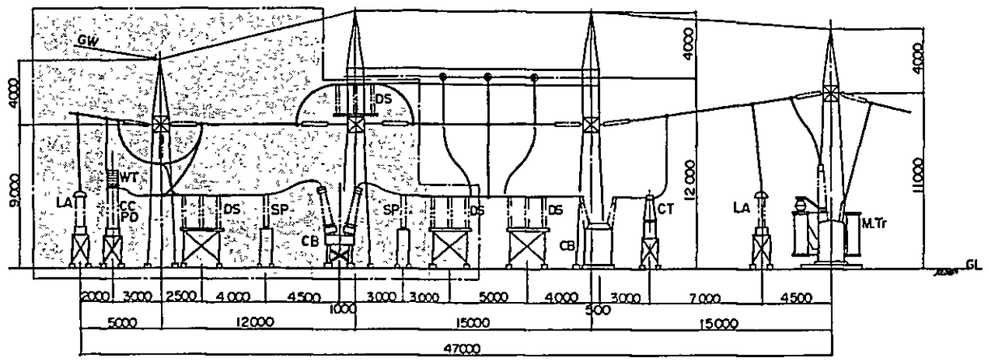


D-D Section

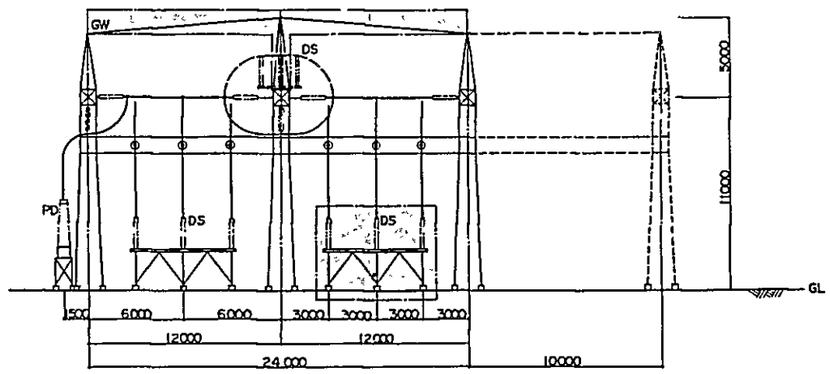
SCALE
0 5 10 15M

FIG. 8010
MADARIPUR SUBSTATION
ARRANGEMENT OF OUTDOOR
EQUIPMENT(CROSS SECTION)





A - A SECTION



B - B SECTION

NOTE

□ : SCOPE OF THIS PROJECT

DOTTED LINE DENOTES THE FUTURE EXTENSION

SCALE

0 5 10 15M

FIG. 8011
BARISAL SUBSTATION
ARRANGEMENT OF OUTDOOR EQUIPMENT