PN-ABL-582

ESMAP

Energy Sector Management Assistance Programme

India

Mini-Hydro Development on Irrigation Dams and Canal Drops Pre-Investment Study
Volume II: Technical Supplement

Report No. 139B/91

JOINT UNDP/WORLD BANK

ENERGY SECTOR MANAGEMENT ASSISTANCE PROGRAMME (ESMAP)

PURPOSE

The Joint UNDP/World Bank Energy Sector Management Assistance Programme (ESMAP) was launched in 1983 to complement the Energy Assessment Programme which had been established three years earlier. An international Commission was convened in 1990 to address the creation of ESMAP's role in the Nineties. It concluded that the Programme had a crucial part to play over the next decade in assisting the developing countries to better manage their energy sectors given that the supply of energy at reasonable prices is a critical determinant of the pace and magnitude of the growth process. The Commission's recommendations received broad endorsement at the November 1990 ESMAP Annual Meeting. Today, ESMAP is carrying out energy assessments, preinvestment and prefeasibility activities and is providing institutional and policy advice. The program aims to strengthen the impact of bilateral and multilateral resources and private sector investment through providing technical assistance to the energy sector of developing countries. The findings and recommendations emerging from ESMAP activities provide governments, donors, and potential investors with the information needed to identify economically and environmentally sound energy projects and to accelerate their preparation and implementation.

ESMAP's operational activities are managed by two Divisions within the Industry and Energy Department at the World Bank and an ESMAP Secretariat.

- The Programme's activities are governed by the ESMAP Consultative Group which consists of its co-sponsors, the UNDP and the World Bank, the governments which provide financial support and representatives of the recipients of its assistance. The Chairman of the Group is the World Bank's Vice President, Sector Policy and Research. He is assisted by a Secretariat headed by the Group's Executive Secretary who is also responsible for relations with the donors and securing funding for the Programme's activities. The Secretariat also gives support and advice to a Technical Advisory Group of independent energy experts which meets periodically to review and scrutinize the Programme's strategic agenda, its work program and other issues related to ESMAP's functioning.

- The ESMAP Strategy and Programs Division is responsible for advising on which countries should receive ESMAP assistance, preparing relevant ESMAP programs of technical assistance to these countries and supports the Secretariat on funding issues. It also carries out broadly based studies such as energy assessments.

- The ESMAP Operations Division is responsible for the detailed design and implementation of tasks consisting mainly of sub-sectoral strategy formulation, preinvestment work, institutional studies, technical assistance and training within the framework of overall ESMAP country assistance programs.

FUNDING

The ESMAP represents a cooperative international effort supported by the World Bank, the United Nations Development Programme and other United Nations agencies, the European Community, Organization of American States (OAS), Latin American Energy Organization (OLADE), and a number of countries including Australia, Belgium, Canada, Denmark, Germany, Finland, France, Iceland, Ireland, Italy, Japan, the Netherlands, New Zealand, Norway, Portugal, Sweden, Switzerland, the United Kingdom and the United States.

FURTHER INFORMATION

For further information or copies of completed ESMAP reports, contact:

Office of the Director
Industry and Energy Department
The World Bank
1818 H Street N.W.
Washington, D.C. 20433
U.S.A.

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The Executive Secretary
ESMAP Consultative Group
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U.S.A.

INDIA

Mini-Hydro Development

on

Irrigation Dams and Canal Drops

Pre-Investment Study

Volume II: Technical Supplement

July 1991

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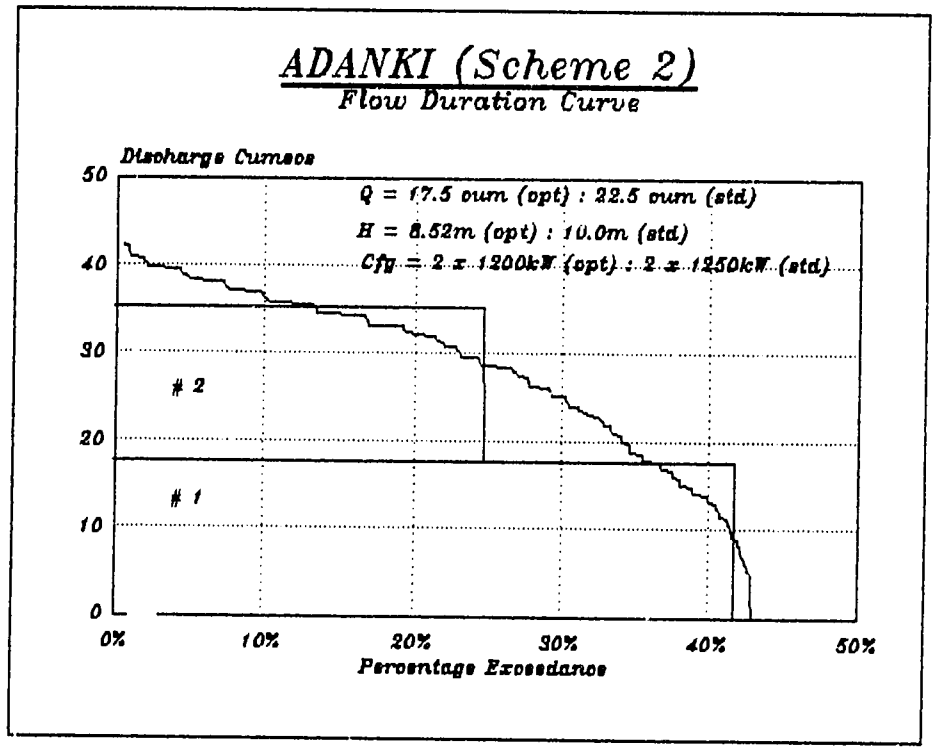
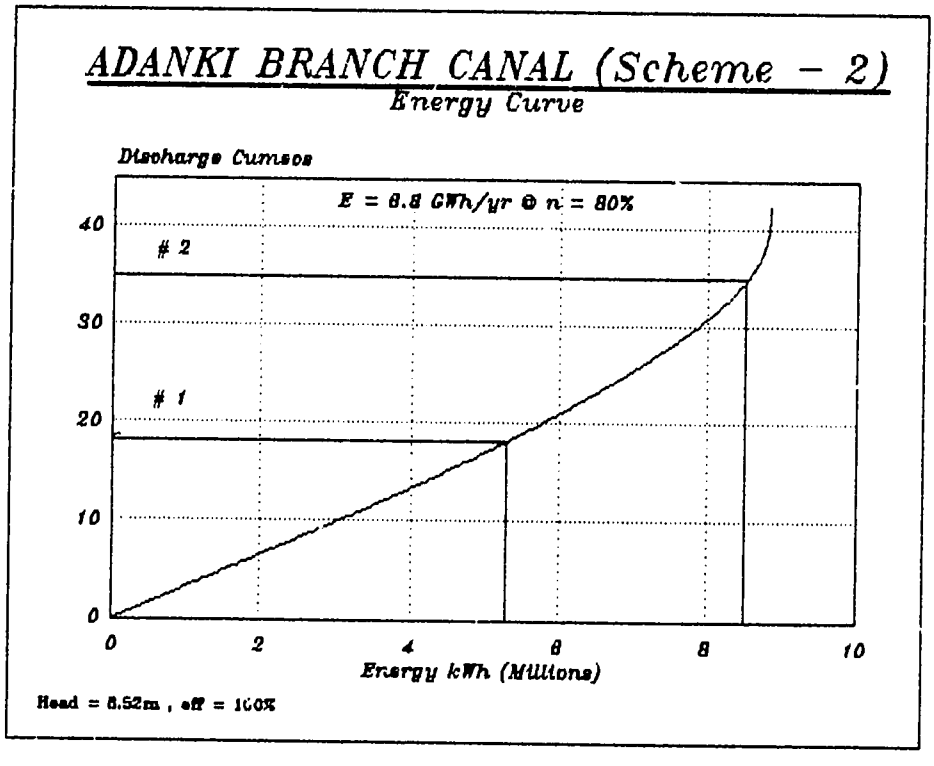
SECTION I - ANDHRA PRADESH

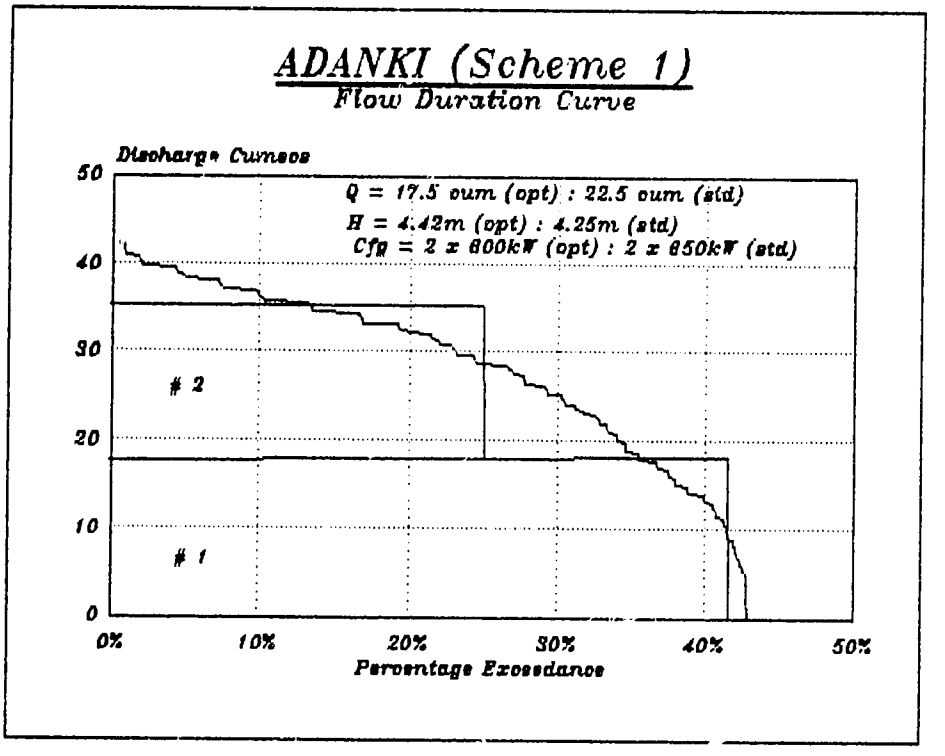
Guntur Branch Canal Cluster
Addanki Branch Canal Cluster
Lock-In-Sala
Lower Manair Reservoir

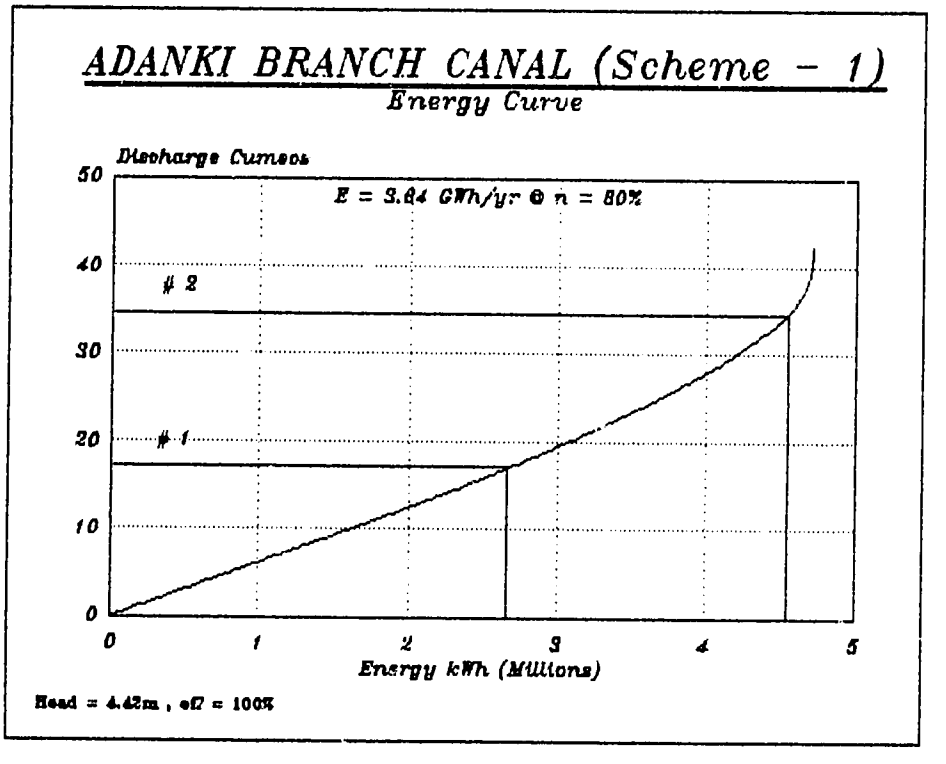
Contents:

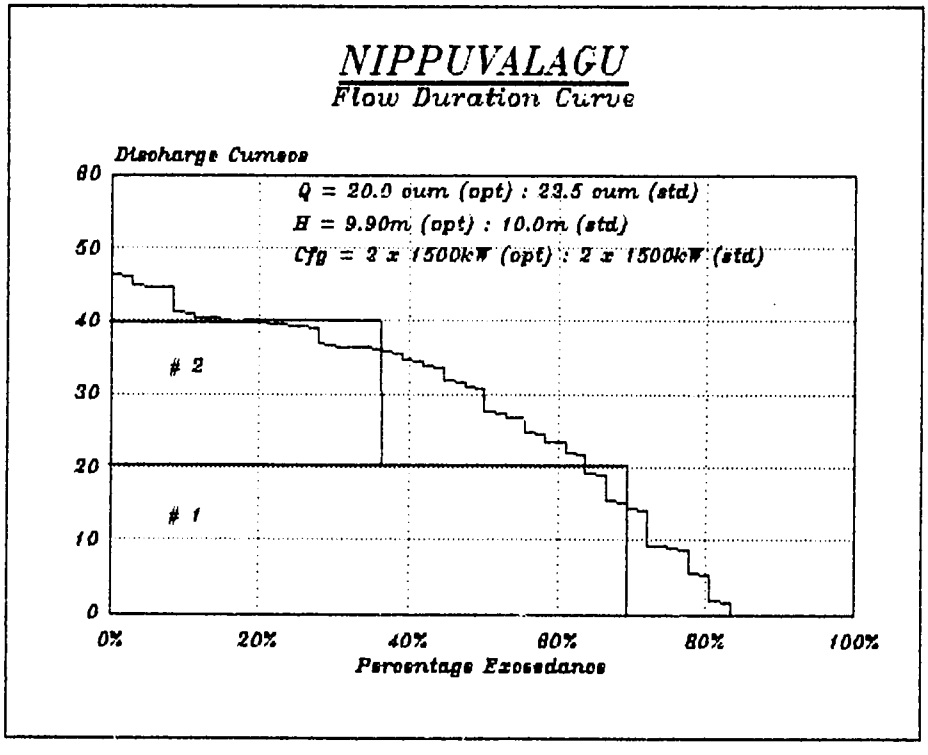
1. ***Design Graphs***
   (Flow duration curves, Energy curves)
2. ***Technical Drawings***
   (Layouts, Electrical Schemes, Grid-Tie Arrangements)

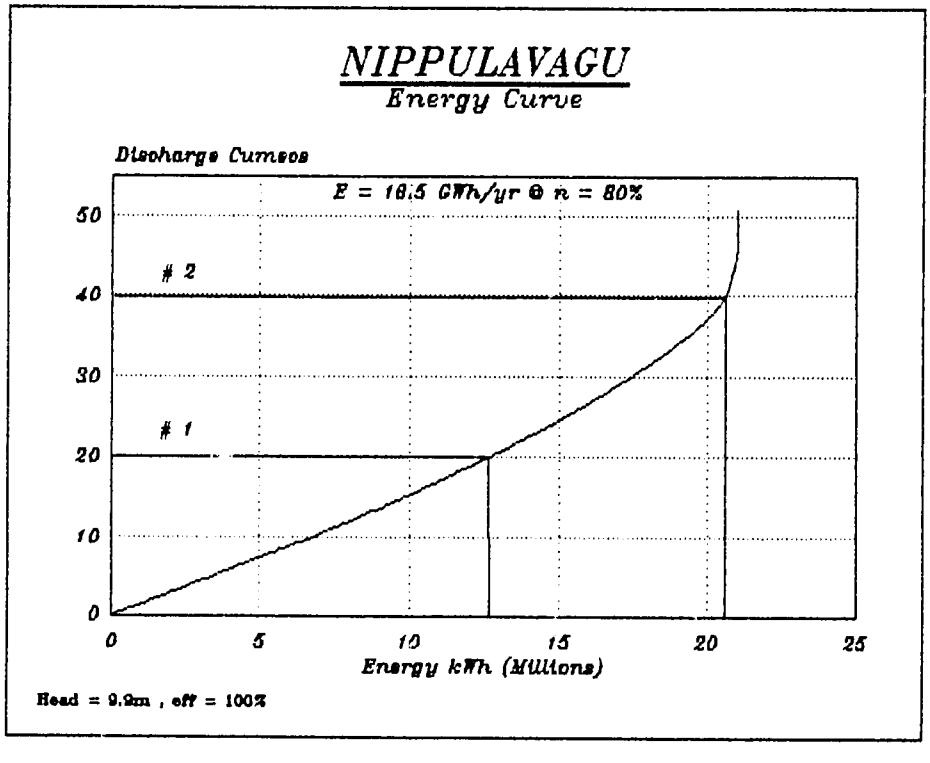

ADANKI (Scheme 2)
Flow Duration Curve
Discharge Cumecs
Q = 17.5 cum (opt) : 22.5 cum (std)
H = 8.52m (opt) : 10.0m (std)
Cfg = 2 x 1200kW (opt) : 2 x 1250kW (std)
# 2
# 1
50
40
30
20
10
0
0%
10%
20%
30%
40%
50%
Percentage Exceedance

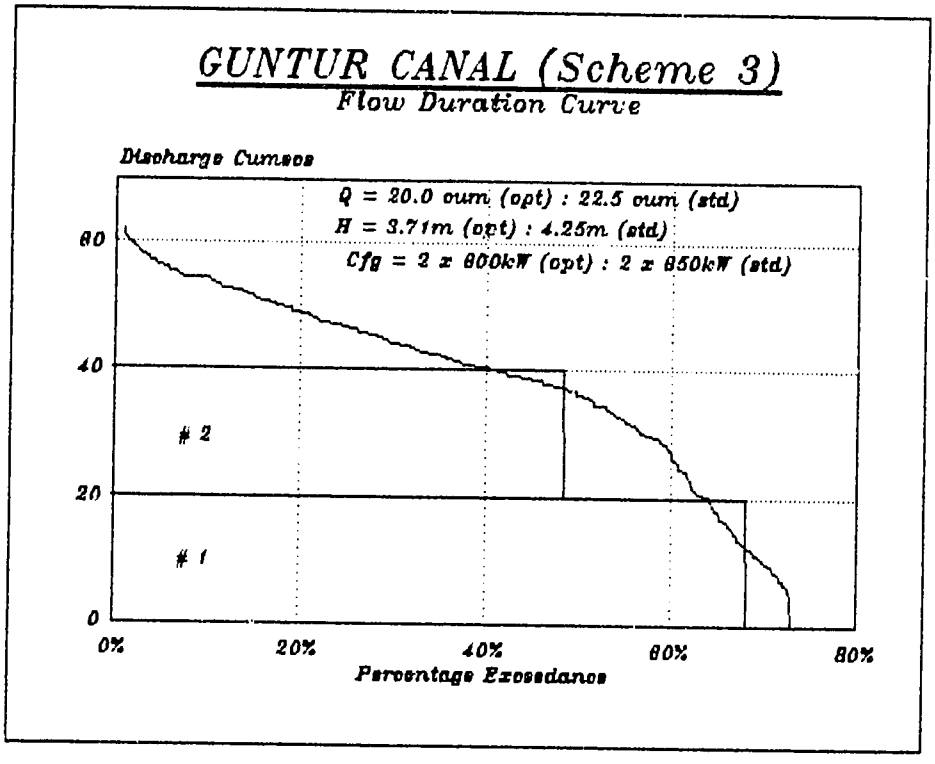

ADANKI BRANCH CANAL (Scheme - 2)
Energy Curve
Discharge Cumecs
E = 8.8 GWh/yr @ n = 80%
# 2
# 1
40
30
20
10
0
0
2
4
6
8
10
Energy kWh (Millions)
Head = 8.52m , eff = 100%

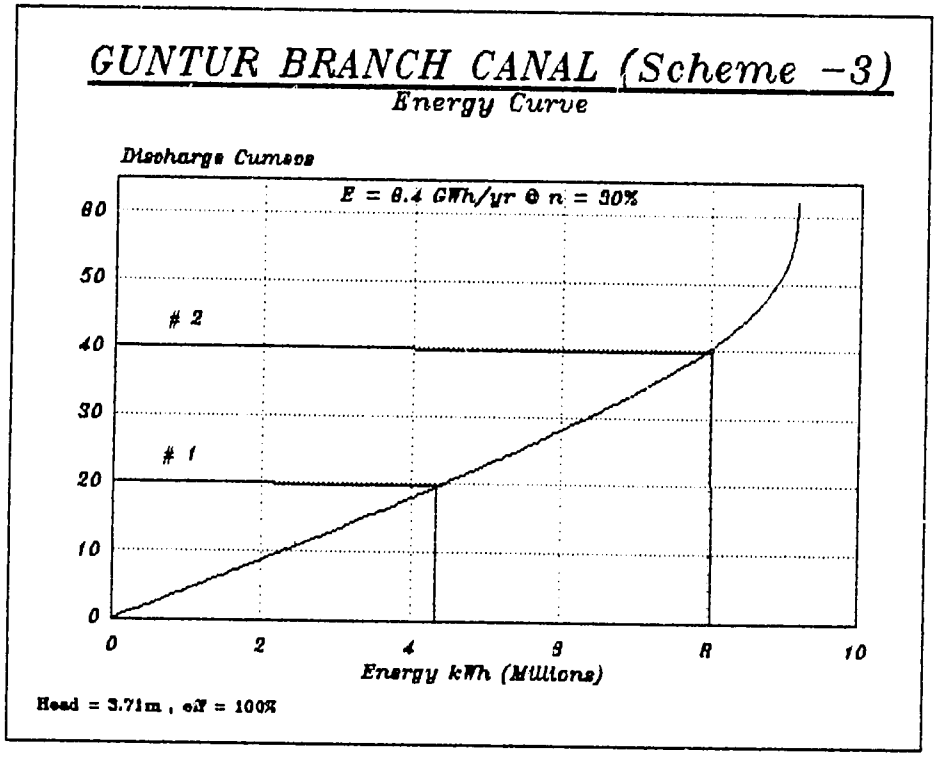

ADANKI (Scheme 1)
Flow Duration Curve
Discharge Cumecs
Q = 17.5 cum (opt) : 22.5 cum (std)
H = 4.42m (opt) : 4.25m (std)
Cfg = 2 x 800kW (opt) : 2 x 850kW (std)
# 2
# 1
50
40
30
20
10
0
0%
10%
20%
30%
40%
50%
Percentage Exceedance

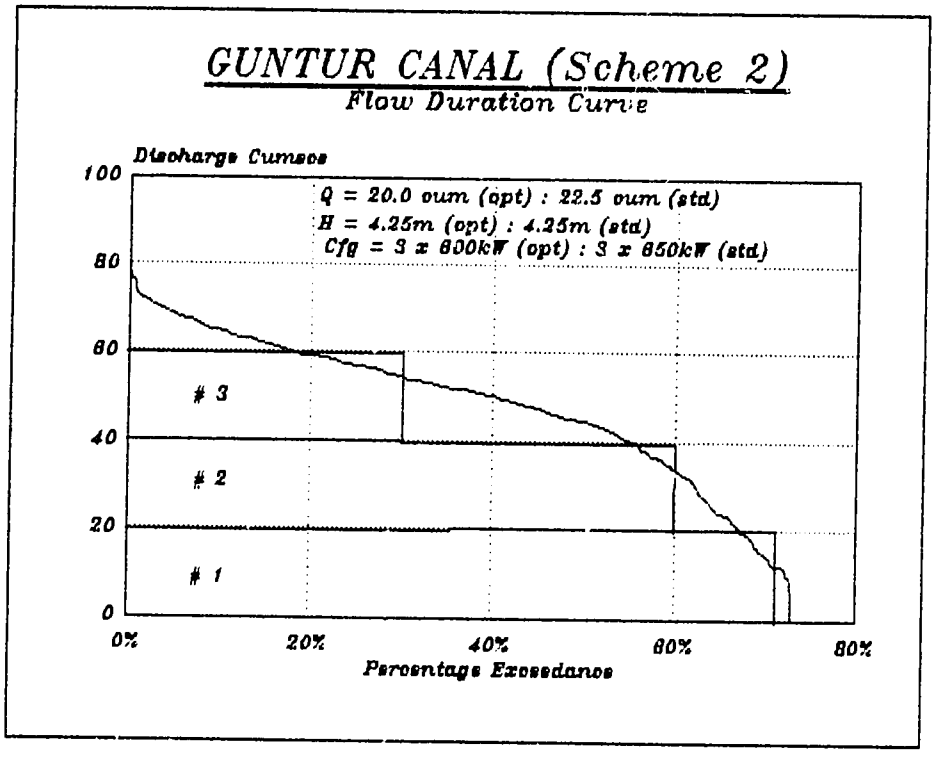

ADANKI BRANCH CANAL (Scheme - 1)
Energy Curve
Discharge Cumecs
E = 3.84 GWh/yr @ n = 80%
# 2
# 1
50
40
30
20
10
0
0
1
2
3
4
5
Energy kWh (Millions)
Head = 4.42m , eff = 100%

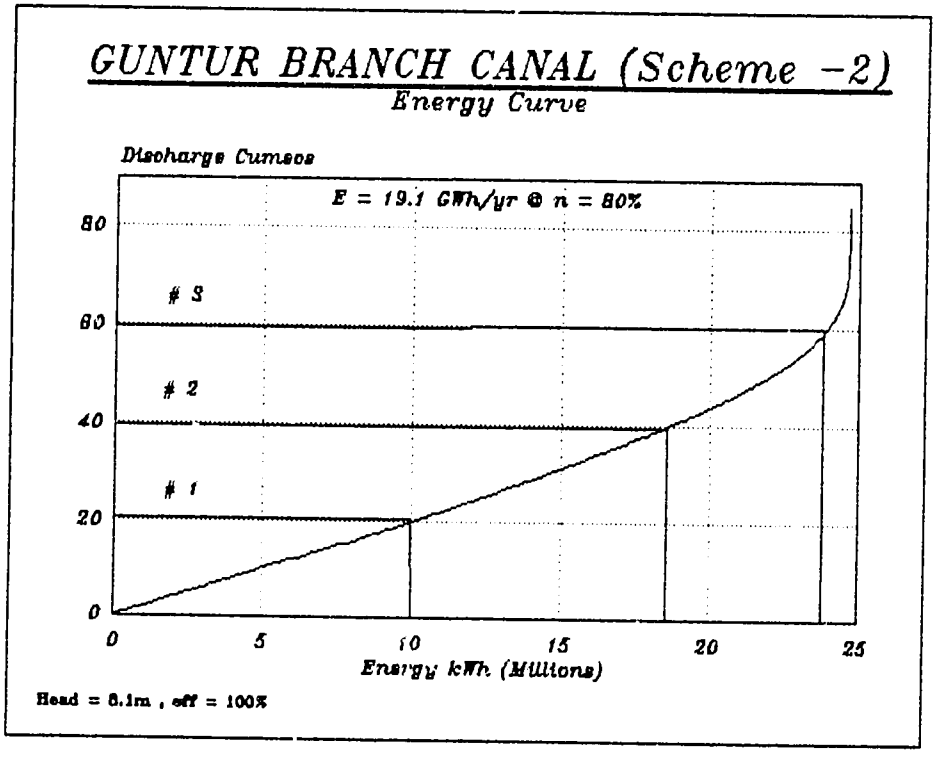

NIPPUVALAGU
Flow Duration Curve
Discharge Cumecs
Q = 20.0 cum (opt) : 23.5 cum (std)
H = 9.90m (opt) : 10.0m (std)
Cfg = 2 x 1500kW (opt) : 2 x 1500kW (std)
# 2
# 1
0
10
20
30
40
50
60
0%
20%
40%
60%
80%
100%
Percentage Exceedance

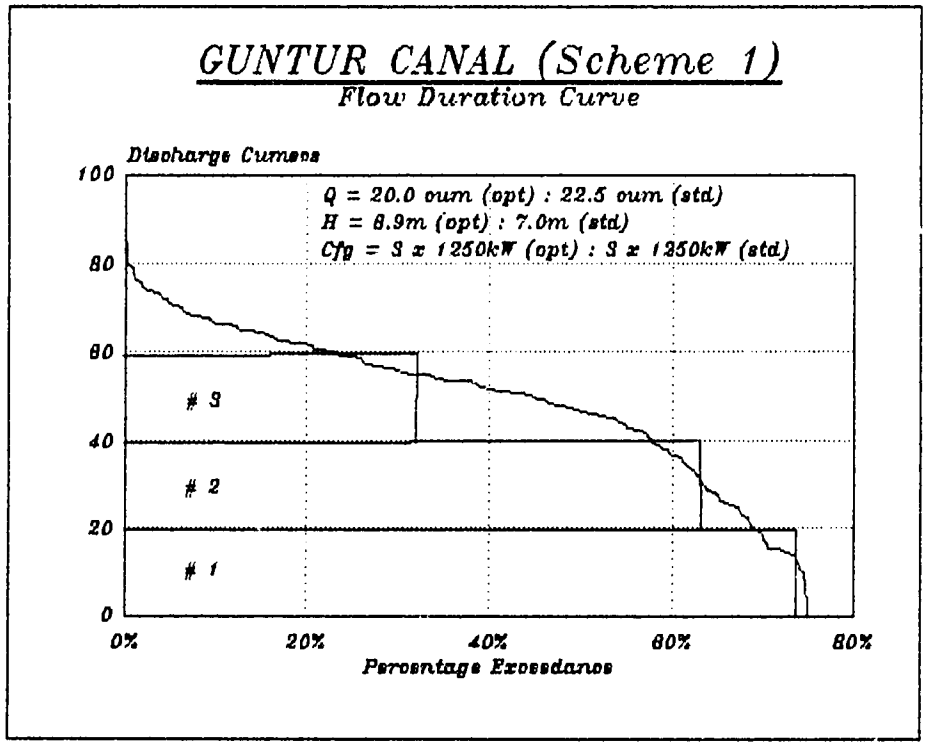

NIPPULAVAGU
Energy Curve
Discharge Cumecs
E = 18.5 GWh/yr @ n = 80%
# 2
# 1
0
10
20
30
40
50
0
5
10
15
20
25
Energy kWh (Millions)
Head = 9.2m , eff = 100%

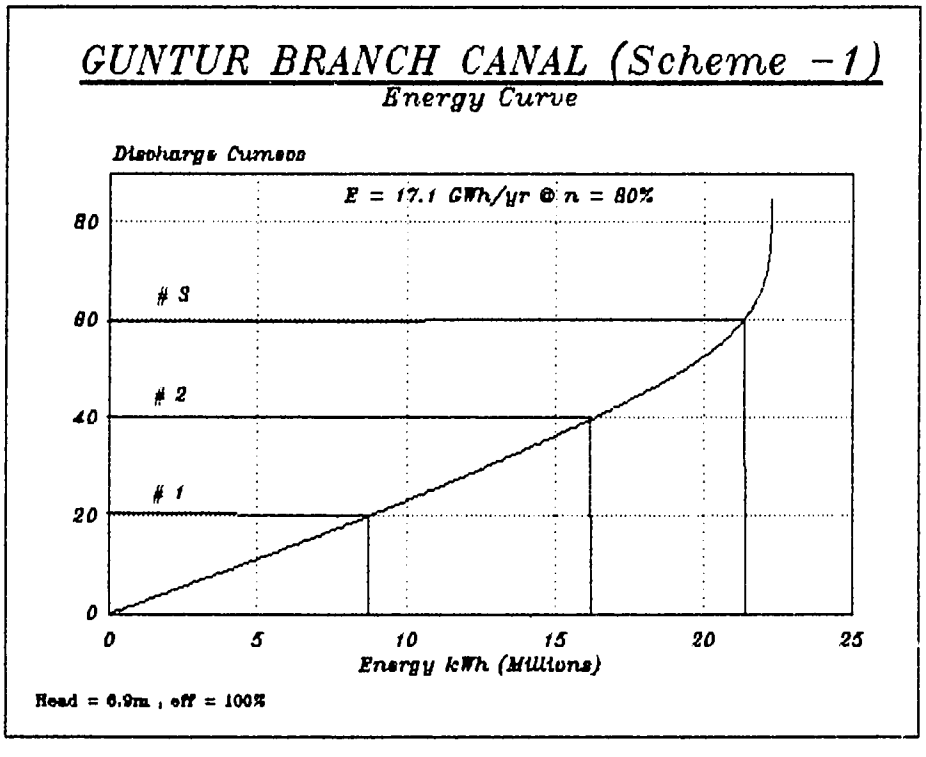

GUNTUR CANAL (Scheme 3)
Flow Duration Curve
Discharge Cumecs
Q = 20.0 cum (opt) : 22.5 cum (std)
H = 3.71m (opt) : 4.25m (std)
Cfg = 2 x 800kW (opt) : 2 x 850kW (std)
60
40
20
0
2
1
0%
20%
40%
60%
80%
Percentage Exceedance

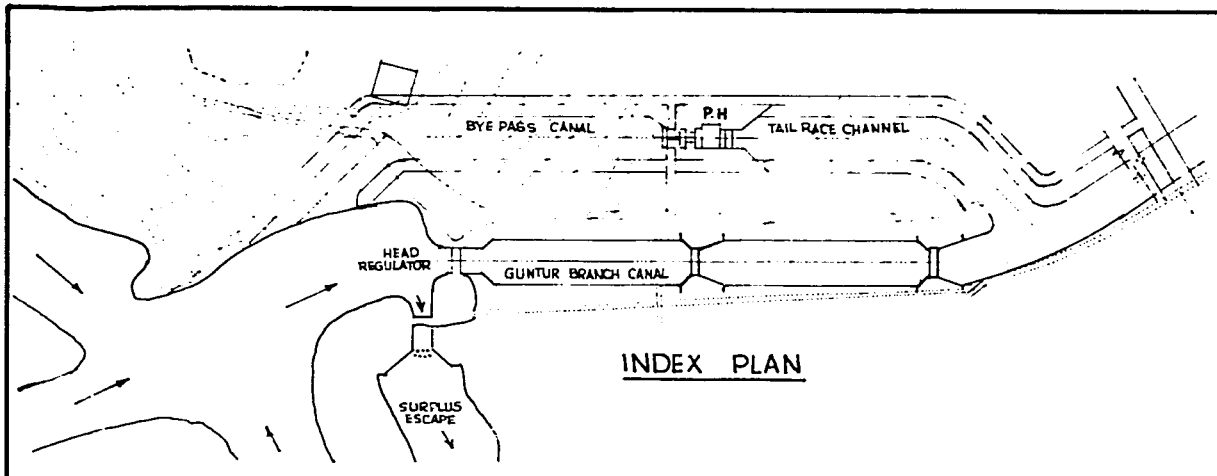

GUNTUR BRANCH CANAL (Scheme -3)
Energy Curve
Discharge Cumecs
E = 8.4 GWh/yr @ n = 90%
60
50
40
30
20
10
0
2
1
0
2
4
6
8
10
Energy kWh (Millions)
Head = 3.71m , eff = 100%


GUNTUR CANAL (Scheme 2)
Flow Duration Curve
Discharge Cumecs
Q = 20.0 cum (opt) : 22.5 cum (std)
H = 4.25m (opt) : 4.25m (std)
Cfg = 3 x 800kW (opt) : 3 x 850kW (std)
100
80
60
40
20
0
3
2
1
0%
20%
40%
60%
80%
Percentage Exceedance

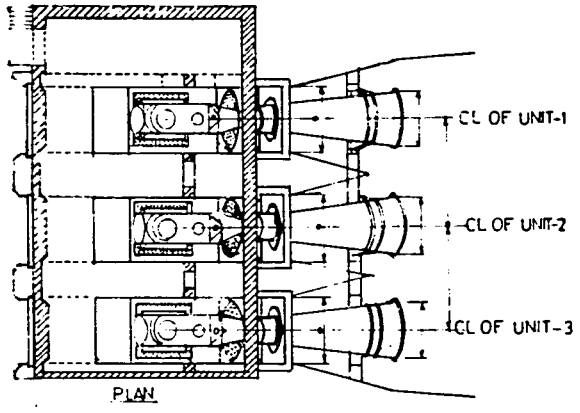

GUNTUR BRANCH CANAL (Scheme -2)
Energy Curve
Discharge Cumecs
E = 19.1 GWh/yr @ n = 80%
80
60
40
20
0
3
2
1
0
5
10
15
20
25
Energy kWh (Millions)
Head = 6.1m , eff = 100%


GUNTUR CANAL (Scheme 1)
Flow Duration Curve
Discharge Cumecs
Q = 20.0 cum (opt) : 22.5 cum (std)
H = 8.9m (opt) : 7.0m (std)
Cfg = 3 x 1250kW (opt) : 3 x 1250kW (std)
# 3
# 2
# 1
100
80
60
40
20
0
0%
20%
40%
60%
80%
Percentage Exceedance

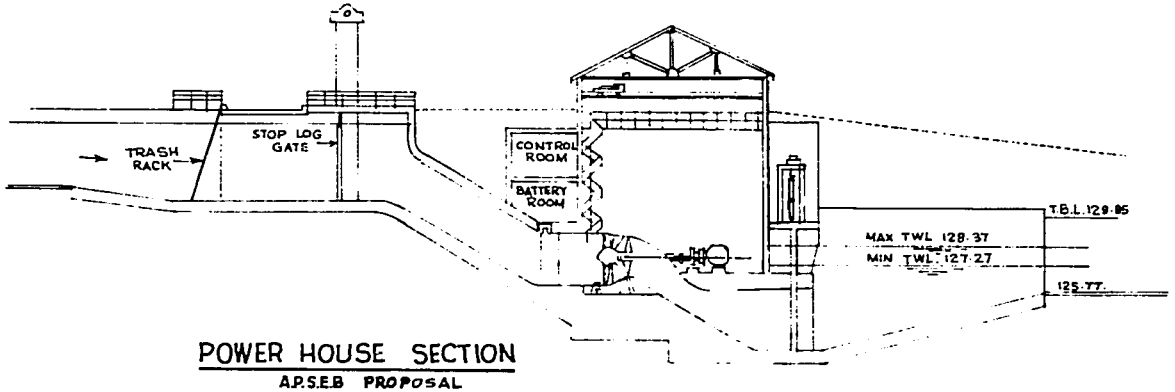

GUNTUR BRANCH CANAL (Scheme -1)
Energy Curve
Discharge Cumecs
E = 17.1 GWh/yr @ n = 80%
# 3
# 2
# 1
80
60
40
20
0
0
5
10
15
20
25
Energy kWh (Millions)
Head = 6.9m , eff = 100%



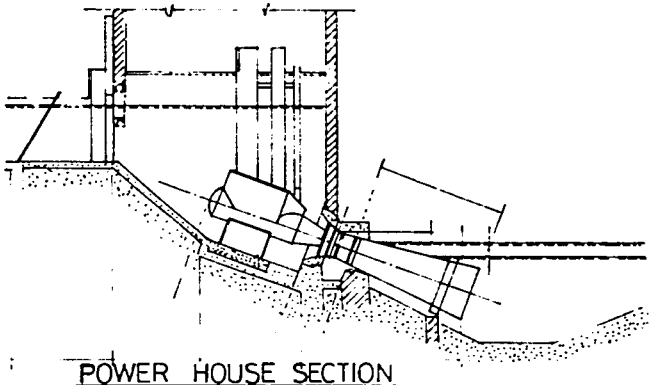
INDEX PLAN



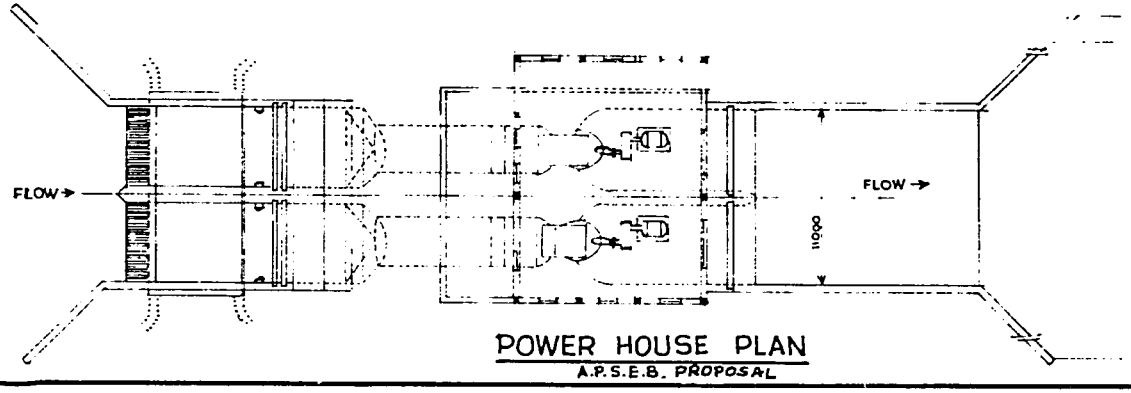
PLAN



POWER HOUSE SECTION
A.P.S.E.B PROPOSAL



POWER HOUSE SECTION
E.S.M.A.P ALTERNATIVE



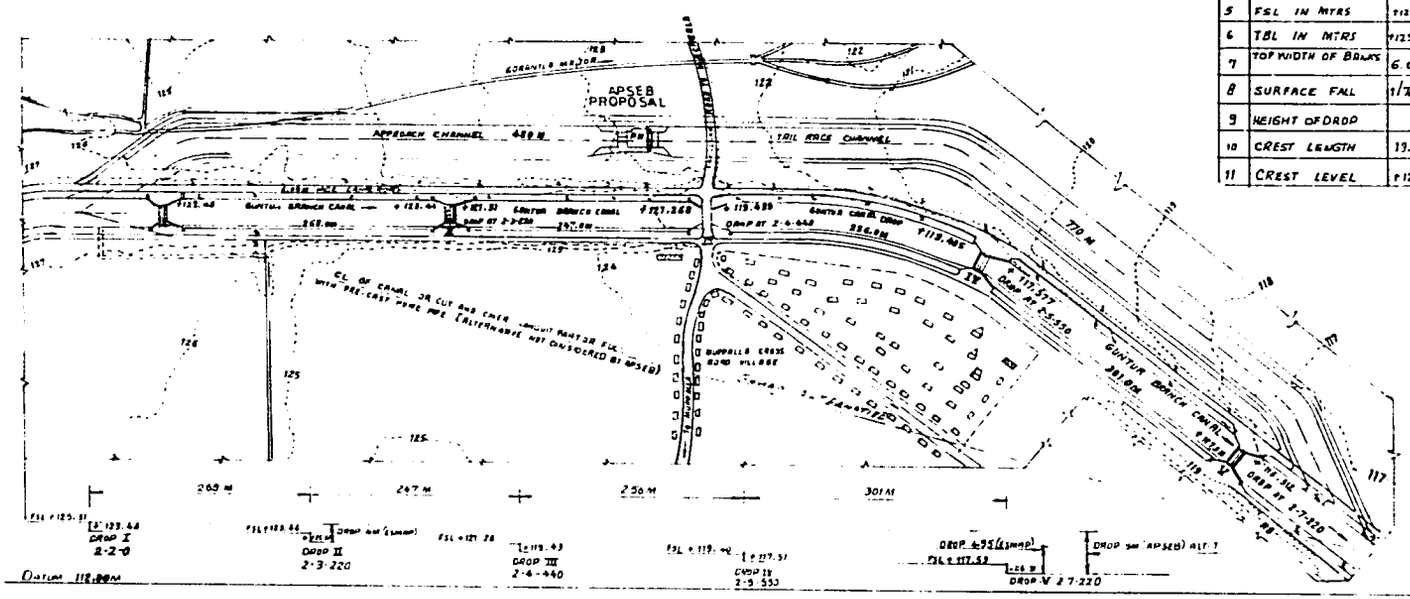
POWER HOUSE PLAN
A.P.S.E.B. PROPOSAL

NOTES:

ESMAP ALTERNATIVE IS WITH A HIGH LEVEL APPROACH CHANNEL AND A TROUGH TYPE (UPSTREAM ELBOW) POWER HOUSE. THE APSEB DESIGN NEEDS REVIEW DUE TO FUTURE RISE IN FRL BY ABOUT 2.5m AS PER DRAWING FOR REGULATOR IN PROJECT REPORT.

MINI HYDRO POWER PROJECT
ESMAP STUDY
GUNTUR CANAL - I
POWER HOUSE
APSEB PROPOSAL & ESMAP ALTERNATIVE
SHEET:

sads/w48595(4)



GUNTUR CANAL POWER HOUSE LAYOUT

HYDRAULIC PERTICULARS

n = 0.0225

SL NO	PERTICULARS	I DROP AT MILE-2-F2-00'		II DROP AT MILE 2-F3-220'		III DROP AT MILE 2-F4-440		IV DROP AT MILE 2-F5-550'		V DROP AT MILE 2-F7-220'	
		U/S	D/S	U/S	D/S	U/S	D/S	U/S	D/S	U/S	D/S
1	DESIGNED DISCHARGE IN CUSECS	3440	3440	3440	3440	3440	3440	3440	3440	3440	3440
2	BED FALL IN MTRS	+125.312	+122.483	+121.447	+121.33	+121.268	+119.439	+119.485	+117.577	+117.531	+116.312
3	BED WIDTH	28.346	28.346	28.346	28.346	28.346	28.346	28.346	28.346	28.346	28.346
4	FSD IN MTRS	3.17	3.17	3.17	3.17	3.17	3.17	3.17	3.17	3.17	3.17
5	FSL IN MTRS	+124.431	+126.653	+126.617	+124.463	+124.444	+122.601	+122.576	+120.744	+120.700	+113.482
6	TBL IN MTRS	+129.336	+127.568	+127.531	+125.398	+125.352	+123.523	+123.490	+121.661	+121.615	+120.396
7	TOP WIDTH OF BANKS	6.096/3.657		6.096/3.657		6.096/3.657		6.096/3.657		6.096/3.657	
8	SURFACE FALL	1/7000	1/7000	1/7000	1/7000	1/7000	1/7000	1/7000	1/7000	1/7000	1/7000
9	HEIGHT OF DROP	1.829		2.134		1.829		1.829		1.219	
10	CREST LENGTH	19.20	—	19.20	—	19.20	—	19.20	—	19.20	—
11	CREST LEVEL	+123.523		+123.928		DROP CUM ROAD BRIDGE		—		—	

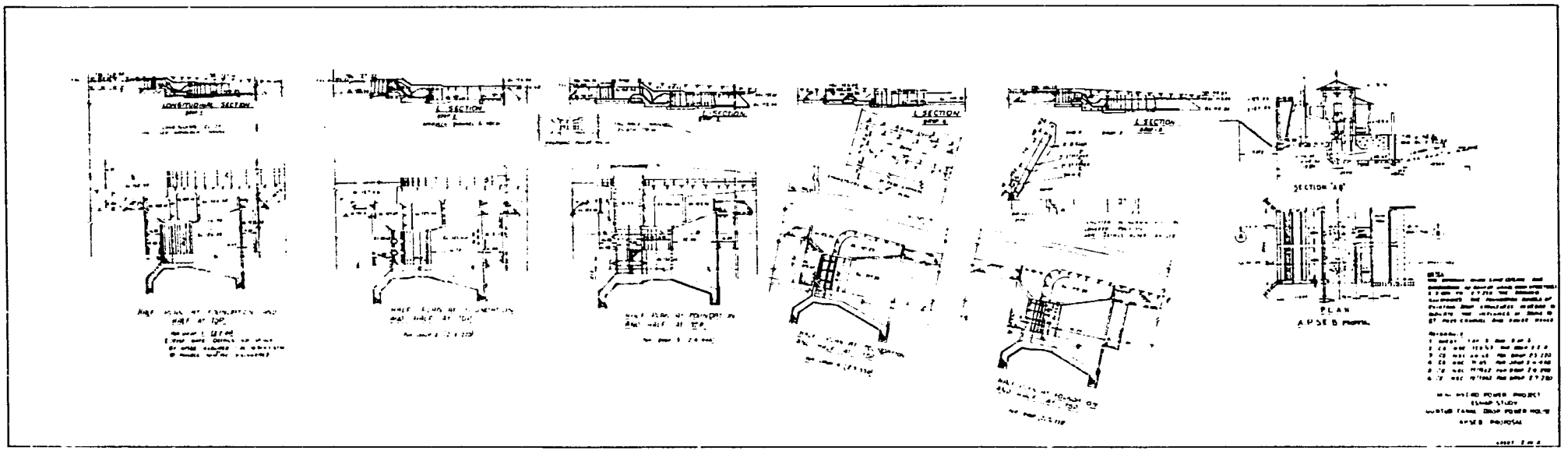
NOTES:-

ALL DIMENSIONS ARE IN MILLIMETERS AND ALL ELEVATIONS IN METERS. THIS DRAWING INDICATES EXISTING DROPS AND PROPOSED BYEPASS CHANNEL FOR MINI HYDRO POWER-STATION (2 x 2250 kw) ON GUNTUR BYE PASS CHANNEL AND BURRIED CONDUIT ON RIGHT BANK. THE ALTERNATIVE WOULD PROVIDE 25% SAVINGS IN LENGTH OF CANAL AND HENCE COSTS. THE TABULATED HYDRAULIC PERTICULARS SHOW DESIGNED DISCHARGE IN THE CANAL AS ABOUT 100 m^3/sec WHERE AS THE DURATION CURVE SHOW A MAXIMUM UTILIZATION OF 60 m^3/sec ONLY. HENCE WATER LEVELS MAY CHANGE AND CORRESPONDING HEADS TO BE REFIXED BY APSEB. THE CANAL LINING IS DAMAGED AT A FEW LOCATIONS. SUITABLE ROUGHNESS COEFFICIENT AND INTEGRITY TESTS FOR LINING IS REQUIRED.

MINI HYDRO POWER PROJECT
ESMAP STUDY
GUNTUR CANAL DROPS FROM 2-2-00 TO 2-7-200
APSEB PROPOSAL AND
ESMAP ALTERNATIVE LAYOUT

SHEET 1 OF 4

sada/w48595(95)



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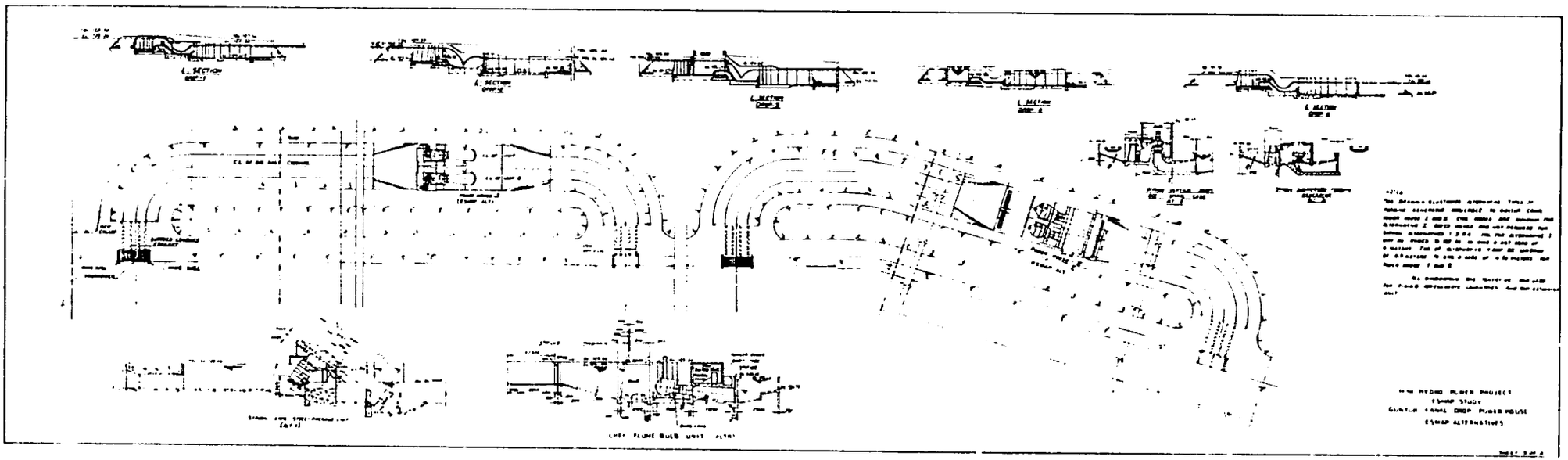

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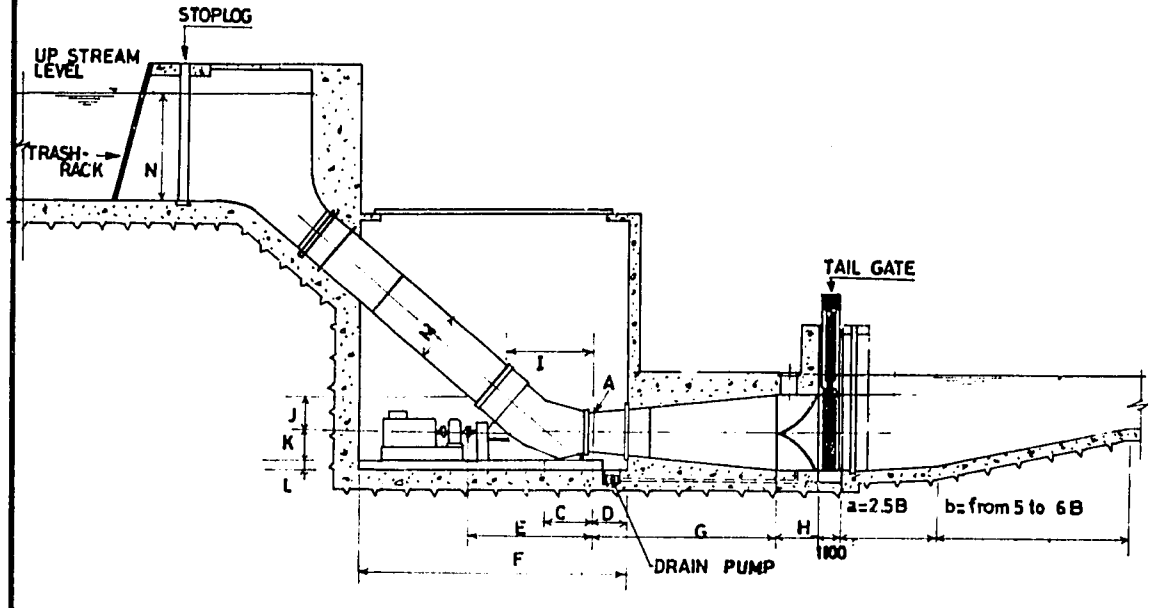
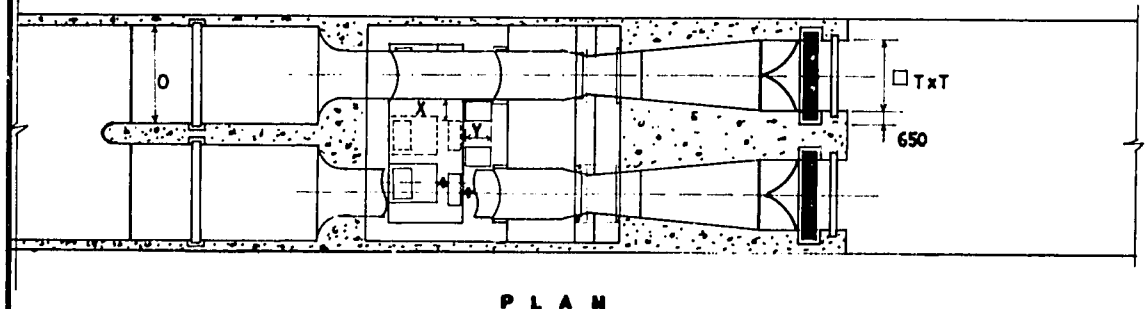


SECTION



PLAN

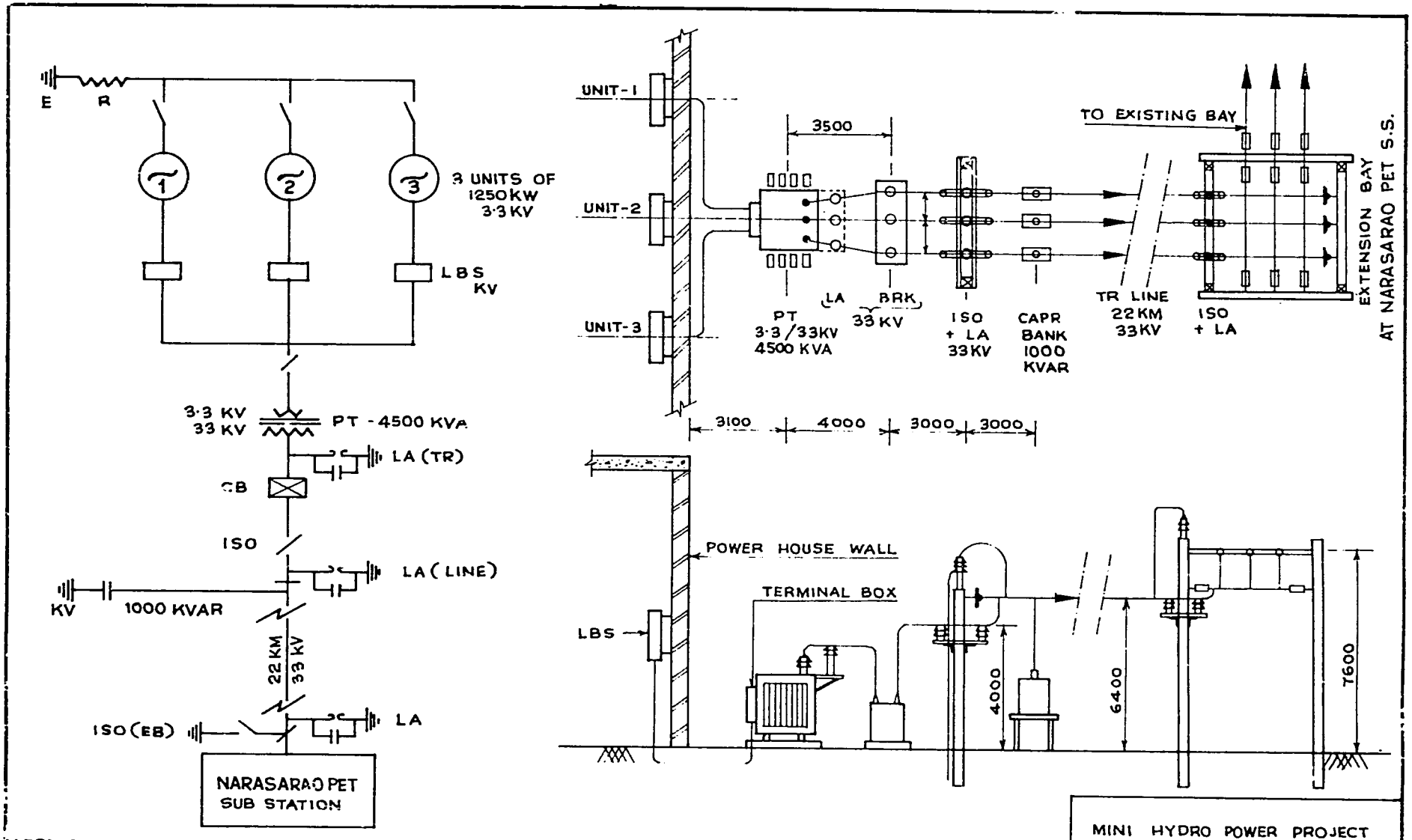
TYPE OF RUNNER HUB	640	810
RUNNER DIAMETER	1700	2120
B	1700	2120
C	2120	2640
D	1370	1720
E	5115	7100
F	11230	15600
G	7990	9960
H	1810	2260
I	3855	4805
J	1455	1820
K	1245	1550
L	400	400
M	2130	2660
M1	2720	3390
M2	2380	3000
EL mini	3230	4030
T	3200	4030
X	1000	1000
Y	1300	1300
Z	2520	3135

UPSTREAM ELBOW TYPE FOR
1) 8M DROP - 2120 RUNNER DIA
2) 4M DROP - 1700 RUNNER DIA

ESMAP ALTERNATIVE '4' OF APSEB ALTERNATIVE SHOWN IN SHEETS 1 OF 4 AND 2 OF 4

MINI HYDRO POWER PROJECT
ESMAP STUDY
GUNTUR CANAL
POWER HOUSE PLAN & SECTIONS
ESMAP ALTERNATIVE
SHEET 4 OF 4

sads/w48595(5)

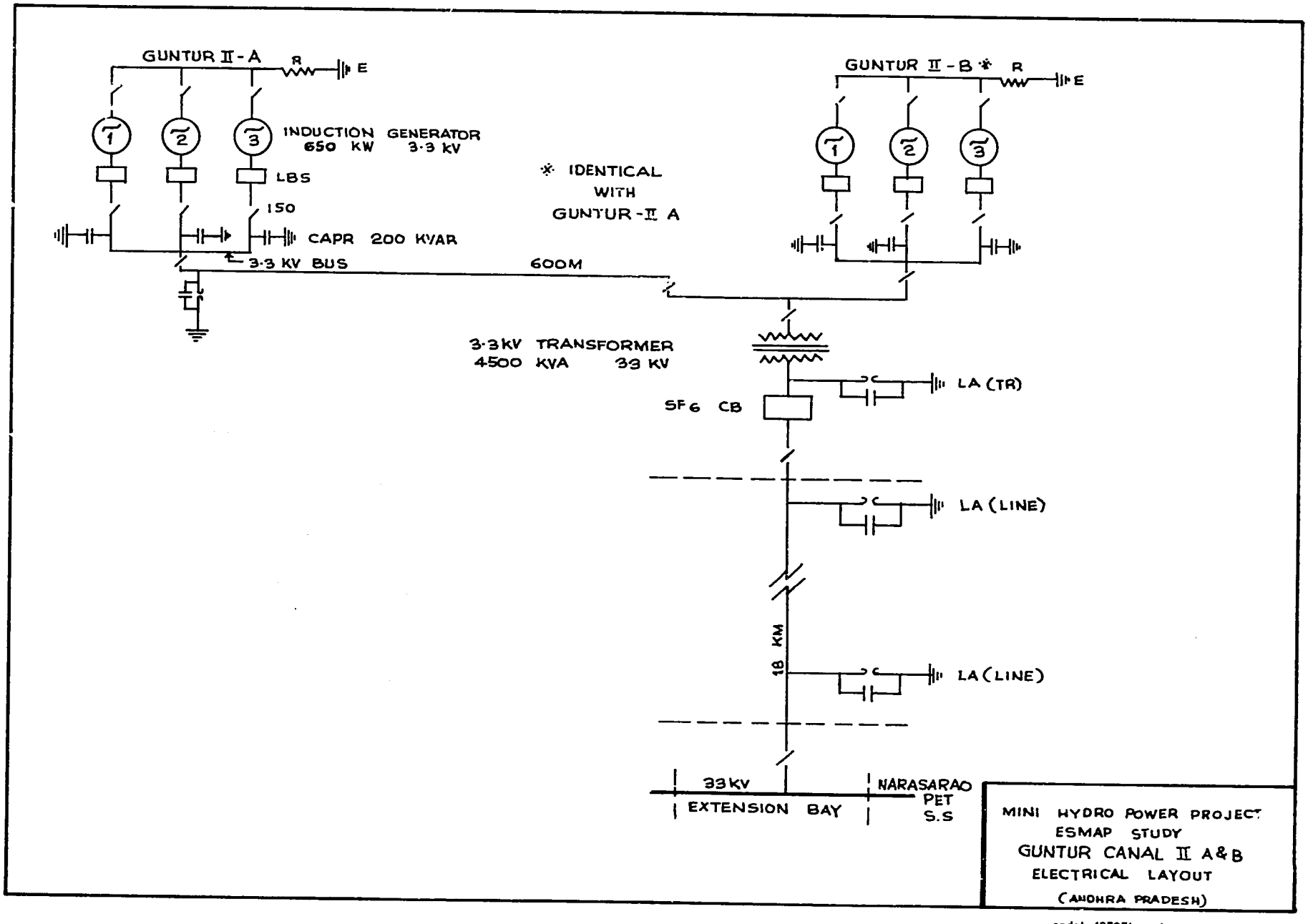


LEGEND: ISO : ISOLATOR.
LA : LIGHTNING ARRESTER.
BRK : BREAKER (MOCB).
LBS : LOAD BREAK SWITCH.
PT : POWER TRANSFORMER.

NOTE : ALL DIMENSIONS ARE IN 'MM'

MINI HYDRO POWER PROJECT
ESMAP STUDY
GUNTUR CANAL-I & II
ELECTRICAL LAYOUT
(ANDHRA PRADESH)

sads/w48595(6)



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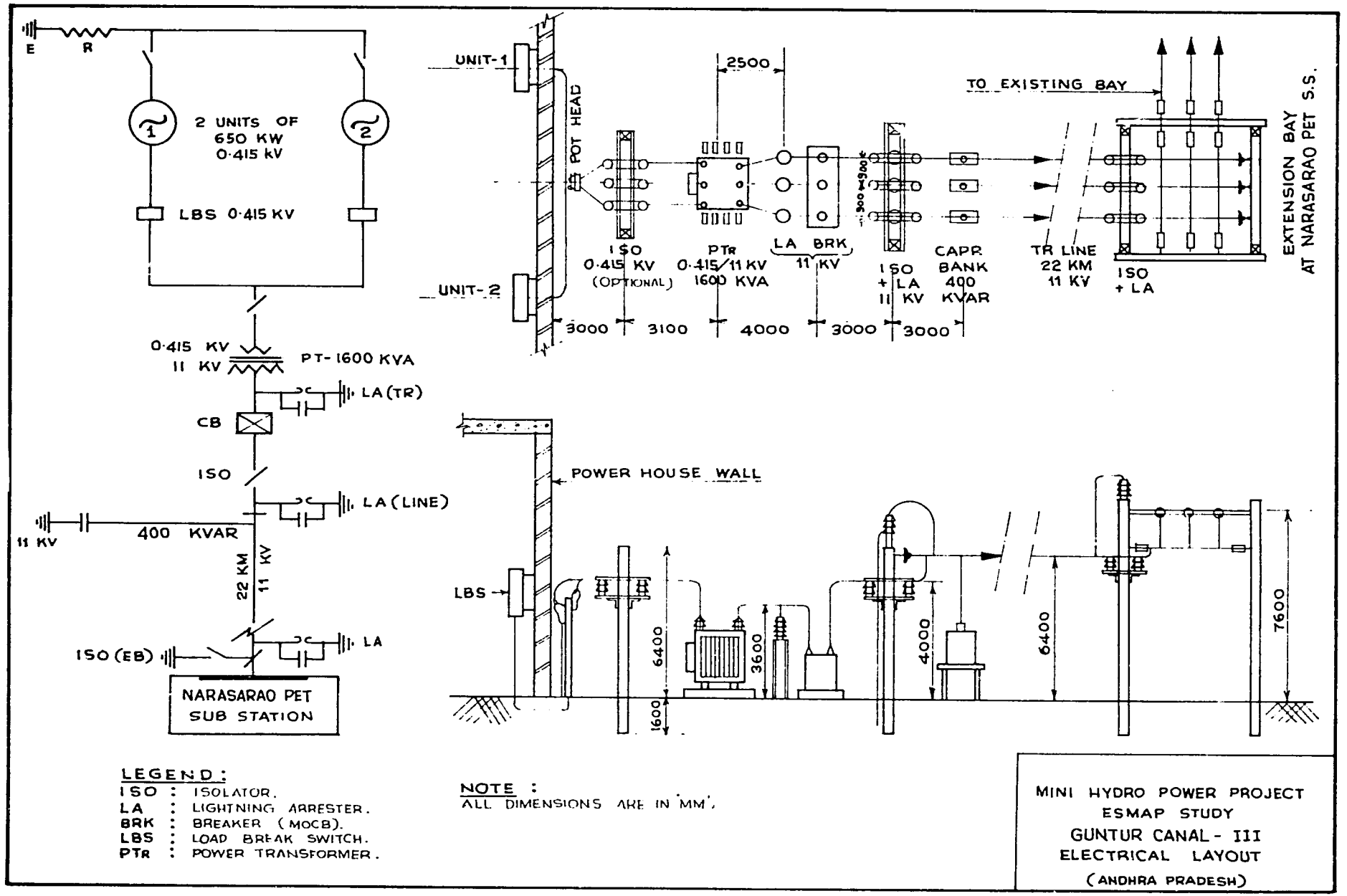


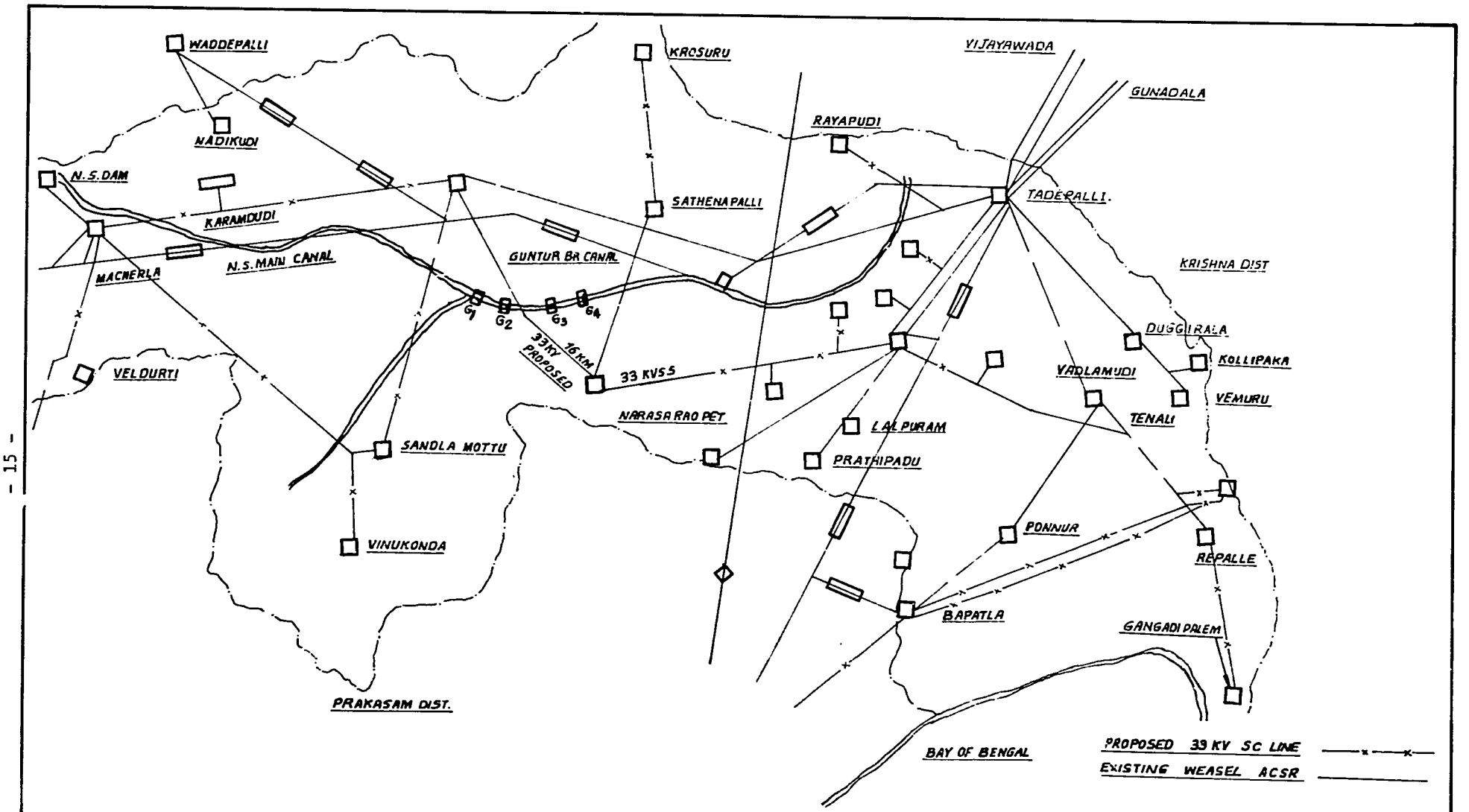
LEGEND:

ISO : ISOLATOR.
LA : LIGHTNING ARRESTER.
BRK : BREAKER (MOCB).
LBS : LOAD BREAK SWITCH.
PTr : POWER TRANSFORMER.

NOTE :
ALL DIMENSIONS ARE IN 'MM'.

MINI HYDRO POWER PROJECT
ESMAP STUDY
GUNTUR CANAL - III
ELECTRICAL LAYOUT
(ANDHRA PRADESH)

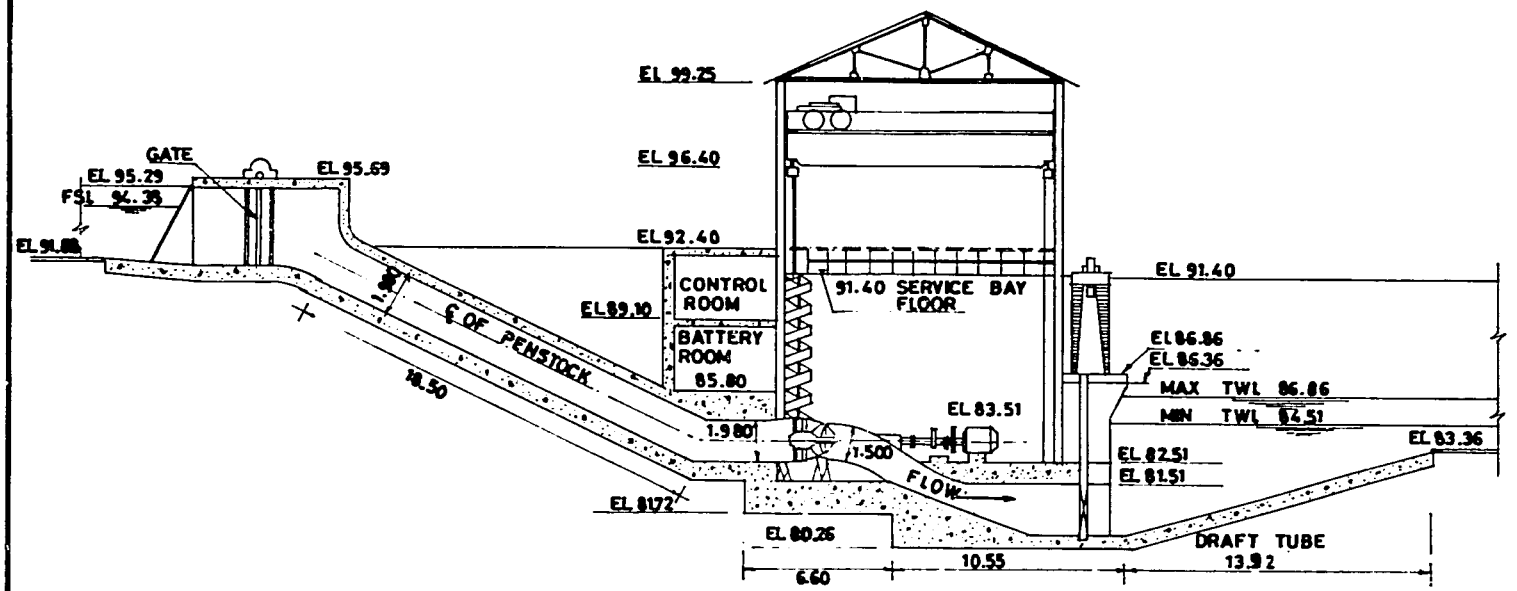
sads/w48595(8)



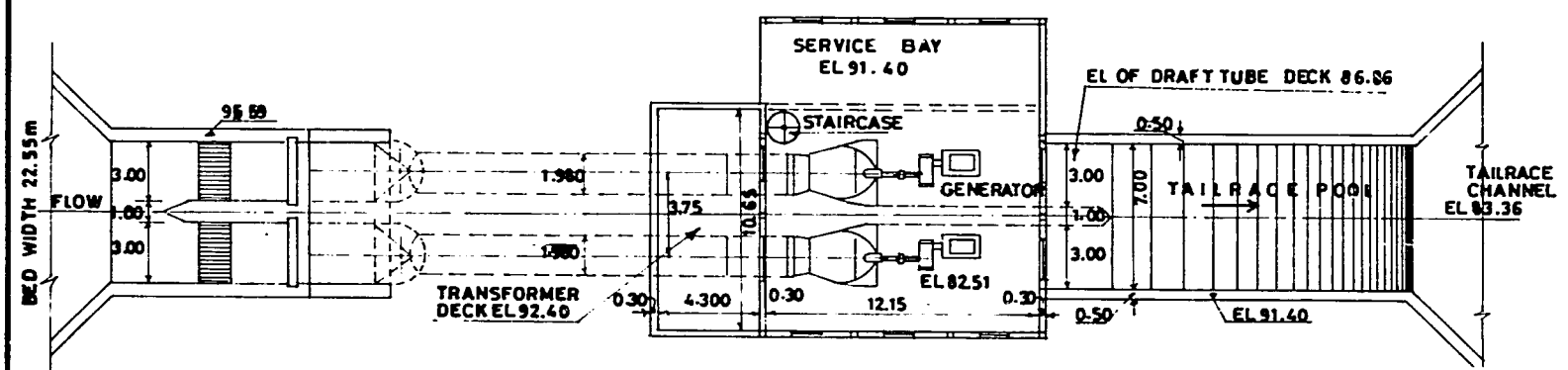
G_1	AT	M 0 - 0.550
G_2		2 - 4 - 370
G_3		5 - 3 - 550
G_4		9 - 3 - 220

MINI HYDRO PROJECT
ESMAP STUDY
GUNTUR CANAL POWER HOUSE
TRANSMISSION GRID

sads/w48595(9)



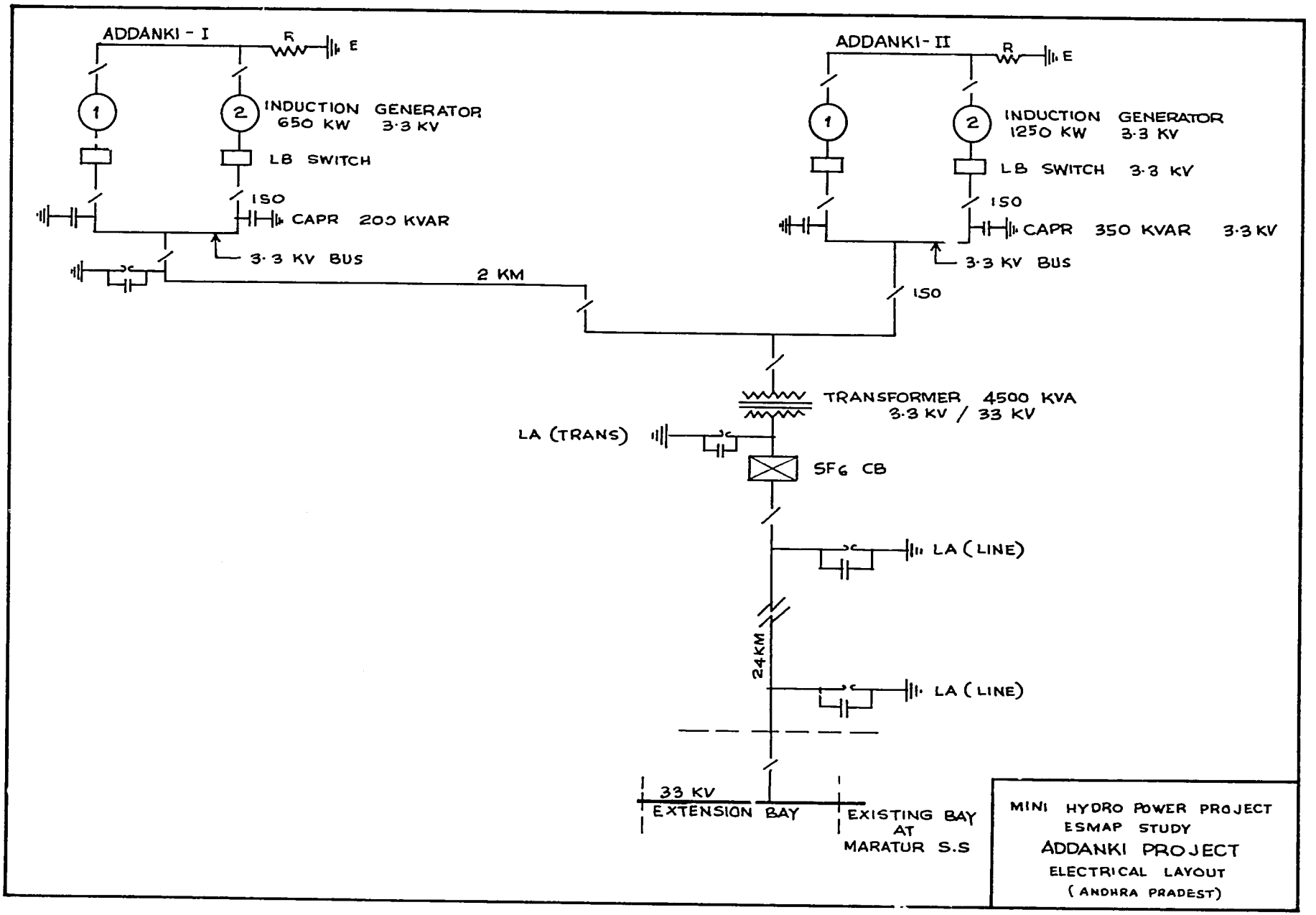
SECTION OF POWER HOUSE



PLAN OF POWER HOUSE

MINI HYDRO POWER PROJECT
ESMAP STUDY
ADANKI CANAL
POWER HOUSE PLAN & SECTIONS
APSEB PROPOSAL

sads/w48595(10)



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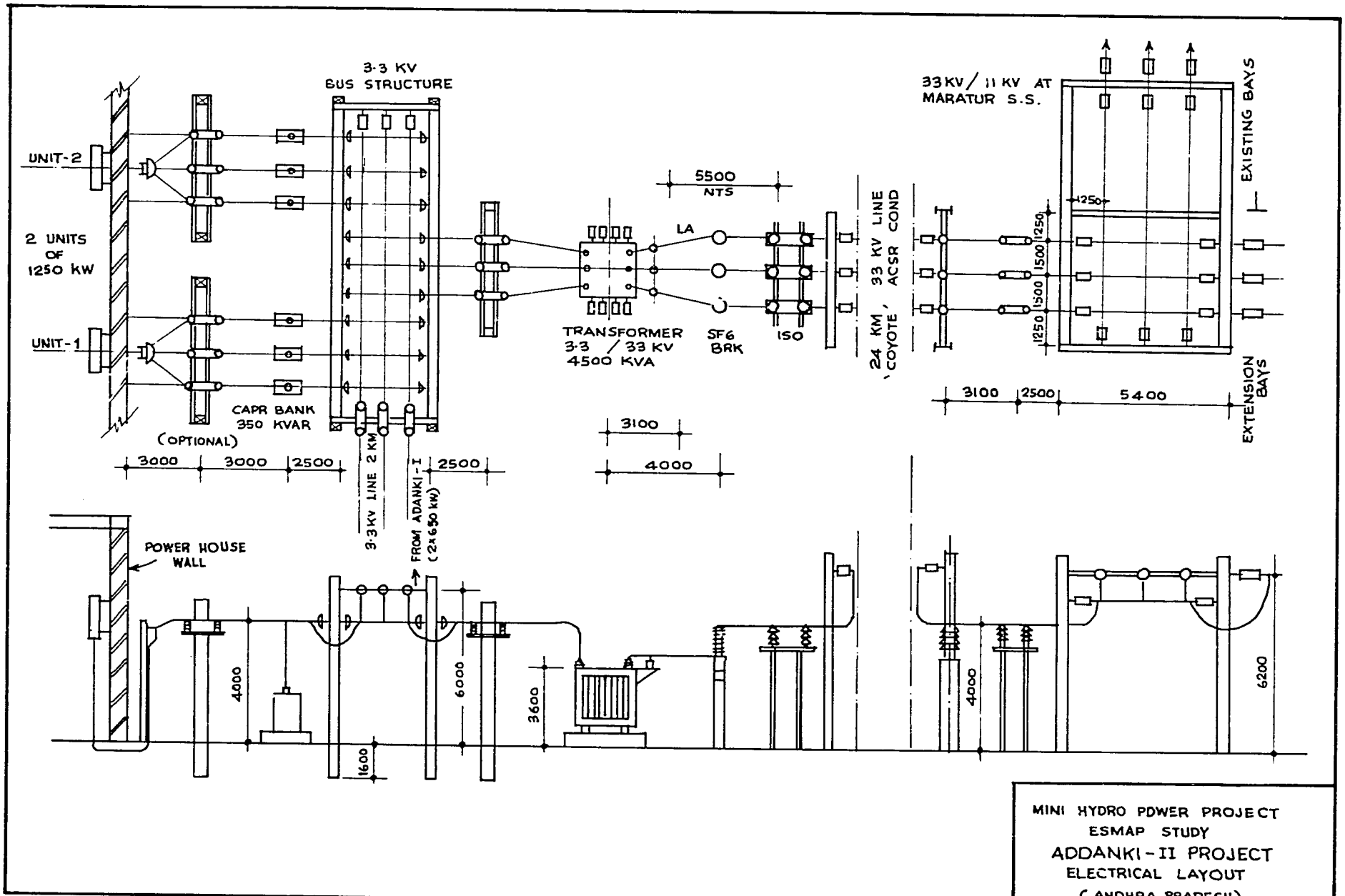
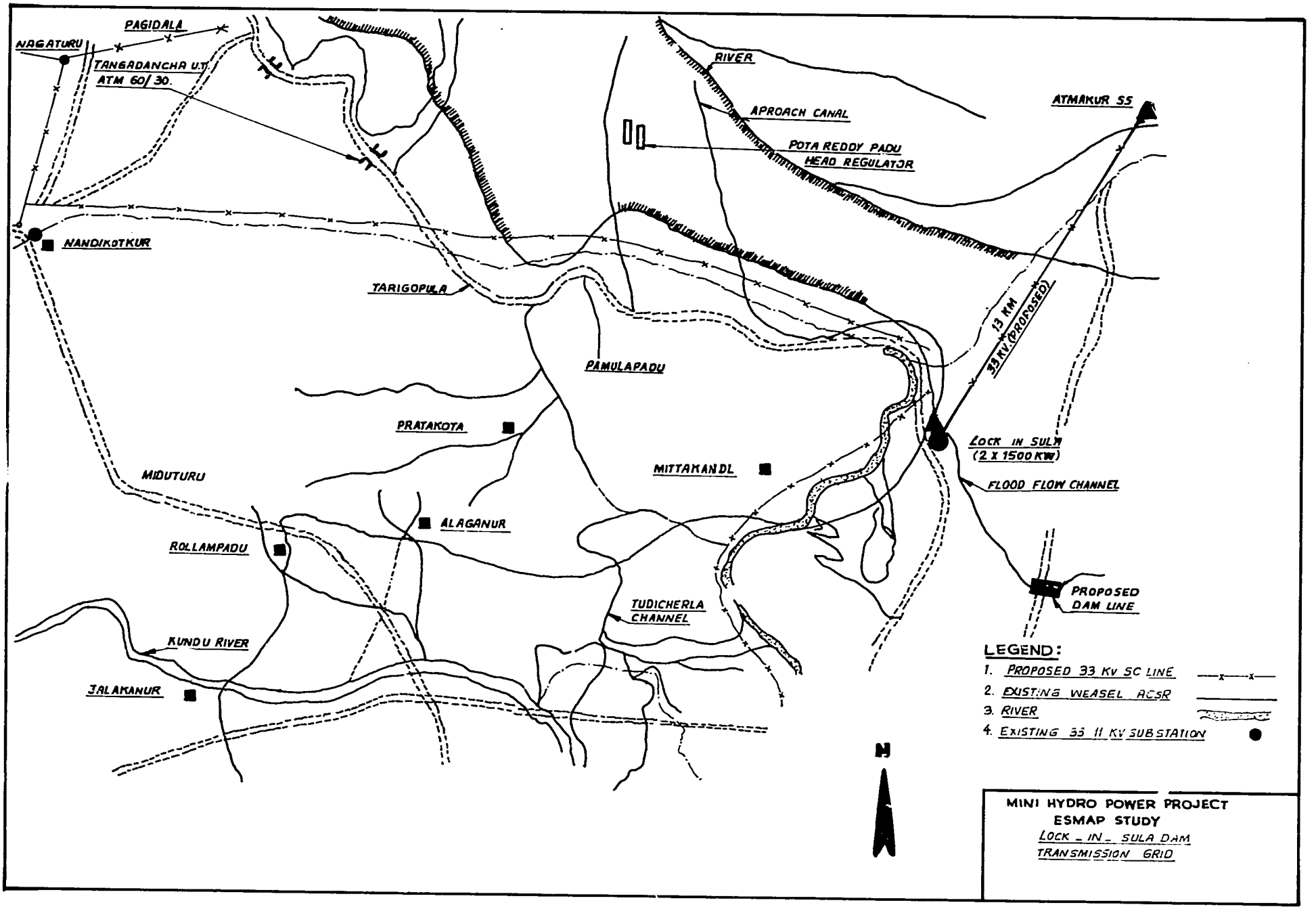


MINI HYDRO POWER PROJECT
ESMAP STUDY
ADDANKI-II PROJECT
ELECTRICAL LAYOUT
(ANDHRA PRADESH)

sads/w48595(12)



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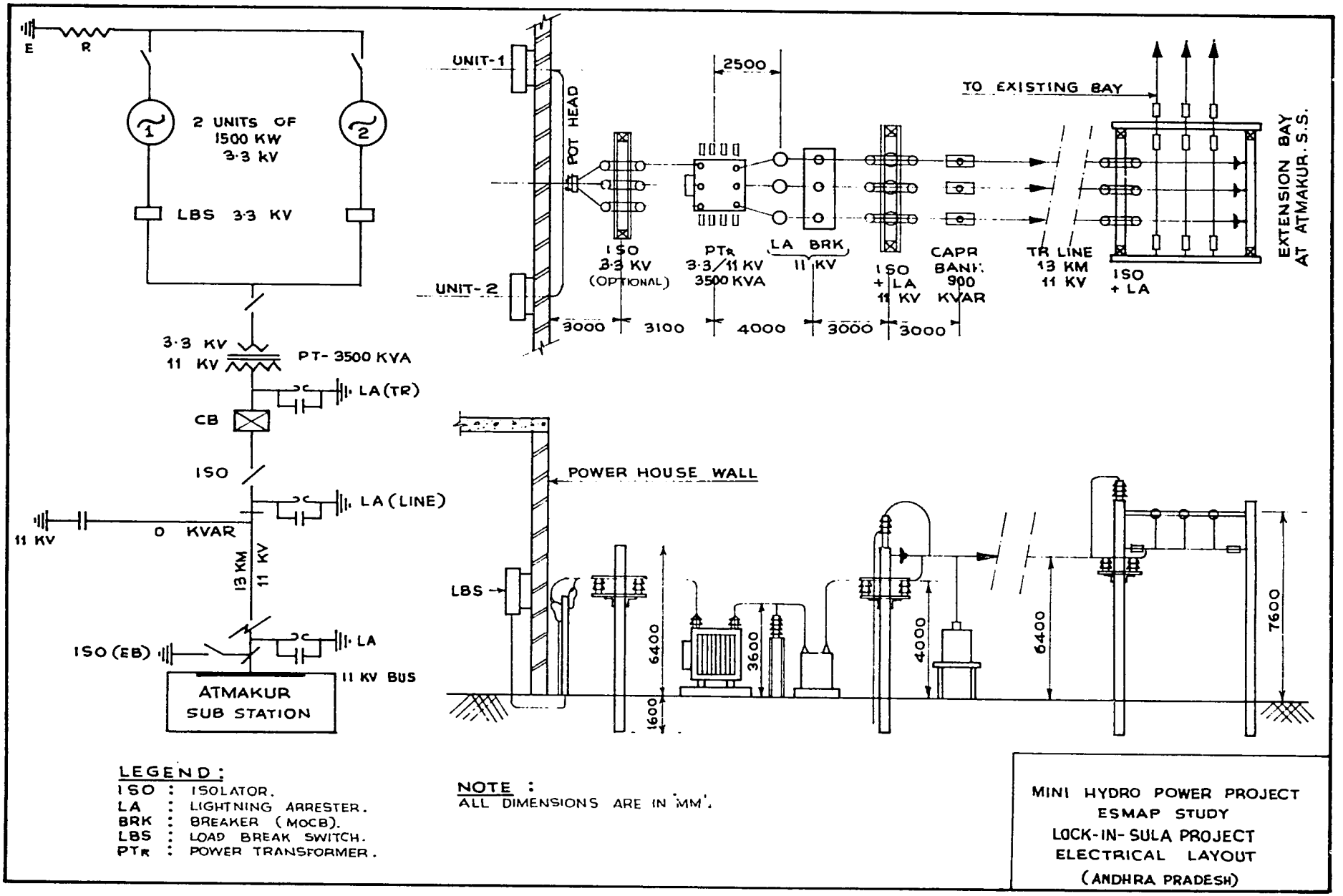


LEGEND:

ISO : ISOLATOR.
LA : LIGHTNING ARRESTER.
BRK : BREAKER (MOCB).
LBS : LOAD BREAK SWITCH.
PTR : POWER TRANSFORMER.

NOTE :
ALL DIMENSIONS ARE IN 'MM'.

MINI HYDRO POWER PROJECT
ESMAP STUDY
LOCK-IN-SULA PROJECT
ELECTRICAL LAYOUT
(ANDHRA PRADESH)

sads/w48595(13)

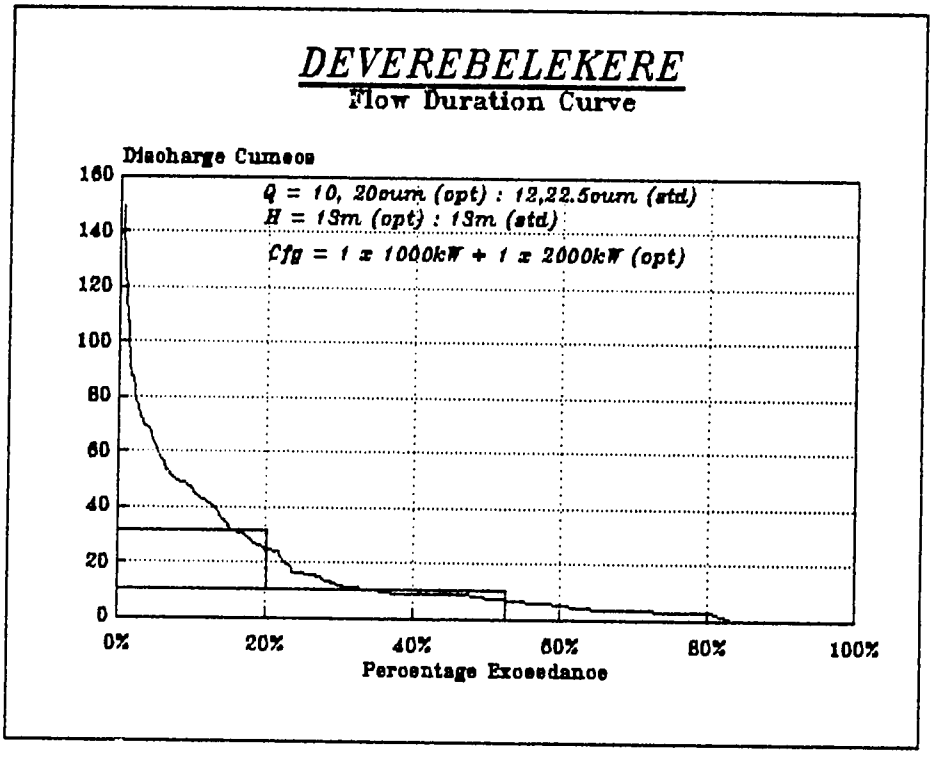
20A

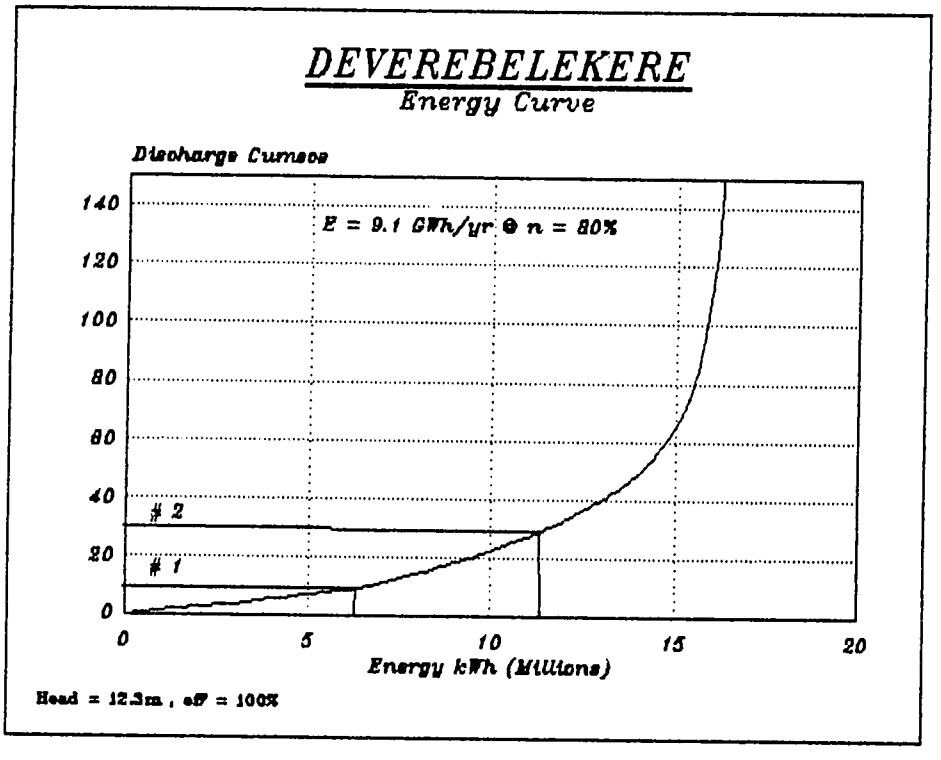
SECTION II - KARNATAKA

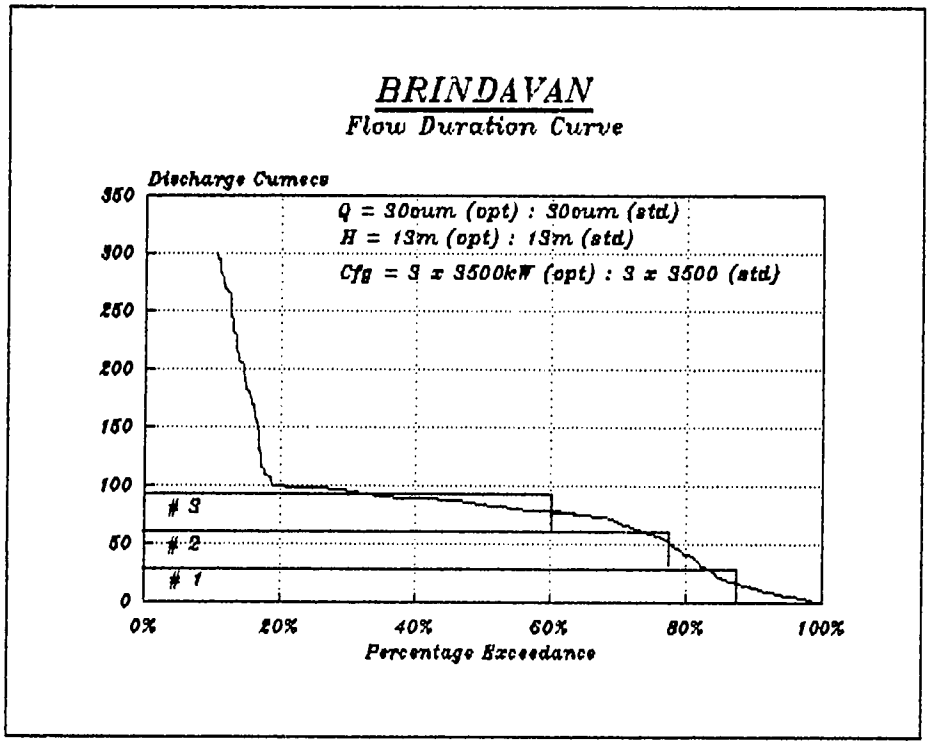
Maddur Canal Drop
Kilara Canal Drop
Attehala Weir
Brindavan Dam
Nugu Dam
Harangi Dam
Kabini Dam
Shahpur Branch Canal Cluster
Deverebelekere Tank
Malaprabha Reservoir
Rajankollur Canal Drop
Mudhol Reservoir
Anveri Canal

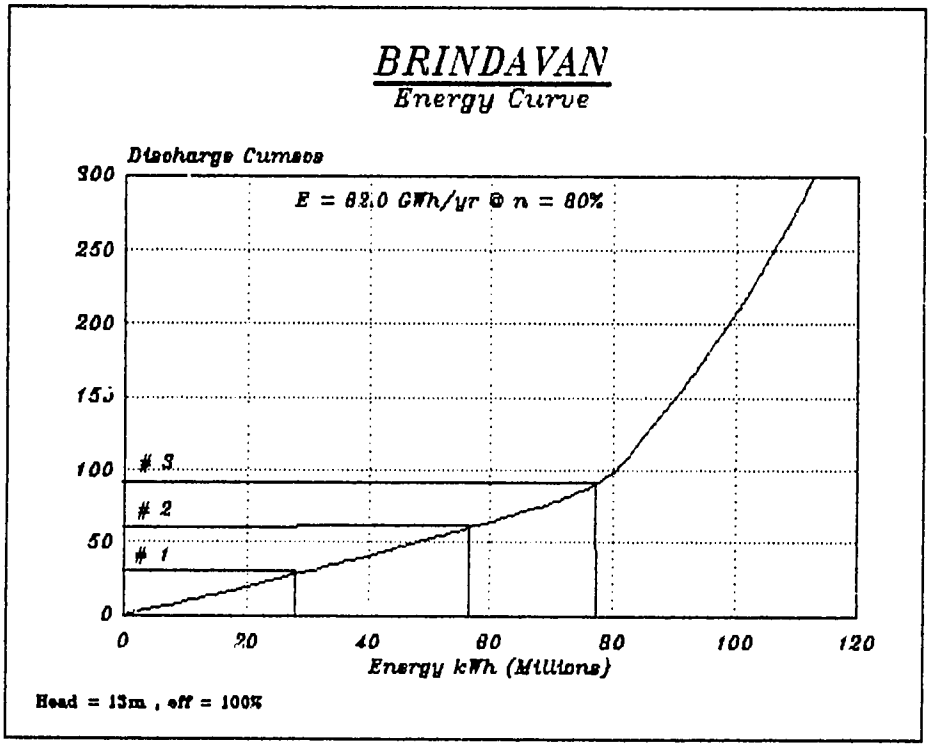
Contents:

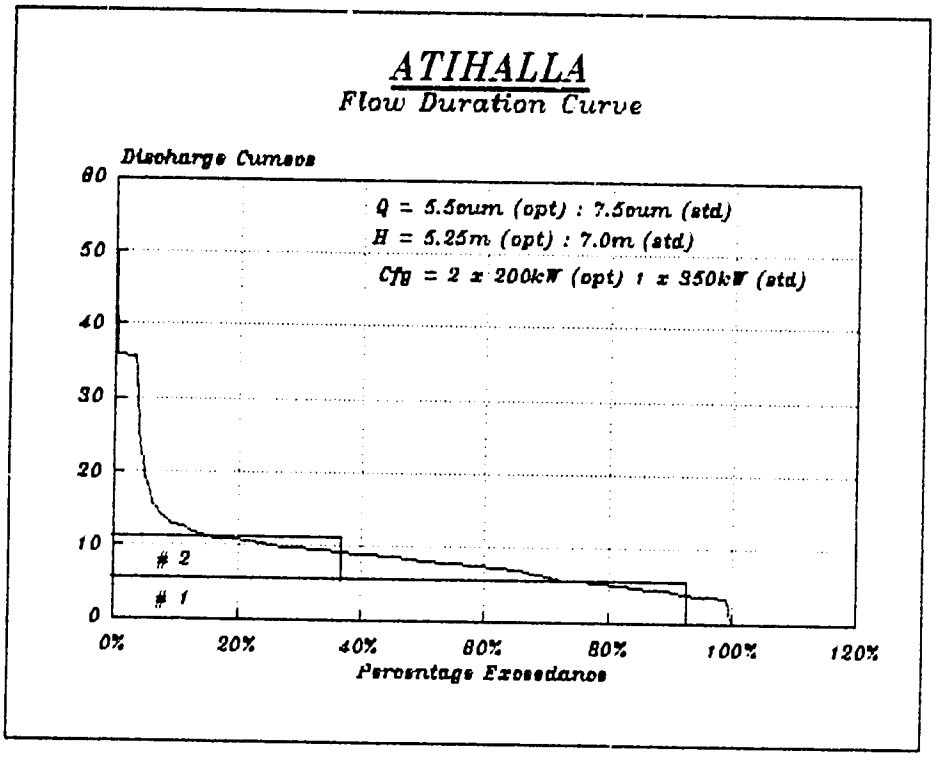
1. ***Design Graphs***
   (Flow duration curves, Energy curves)
2. ***Technical Drawings***
   (Layouts, Electrical Schemes, Grid-Tie Arrangements)

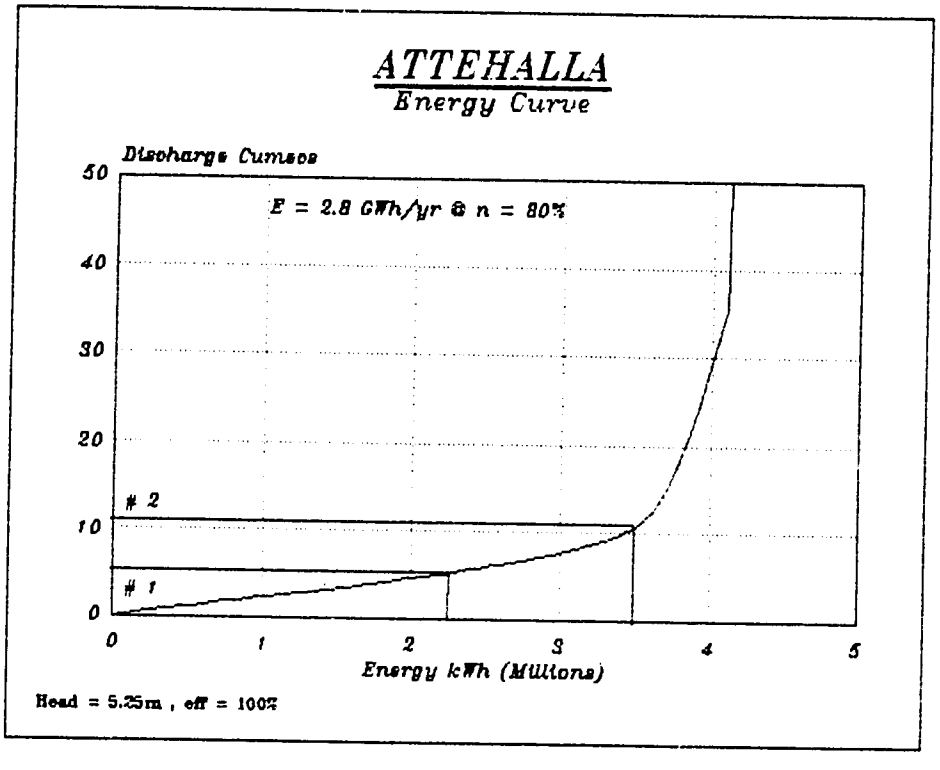

DEVEREBELEKERE
Flow Duration Curve
Discharge Cumecs
Q = 10, 20cum (opt) : 12,22.5cum (std)
H = 13m (opt) : 13m (std)
Cfg = 1 x 1000kW + 1 x 2000kW (opt)
160
140
120
100
80
60
40
20
0
0%
20%
40%
60%
80%
100%
Percentage Exceedance

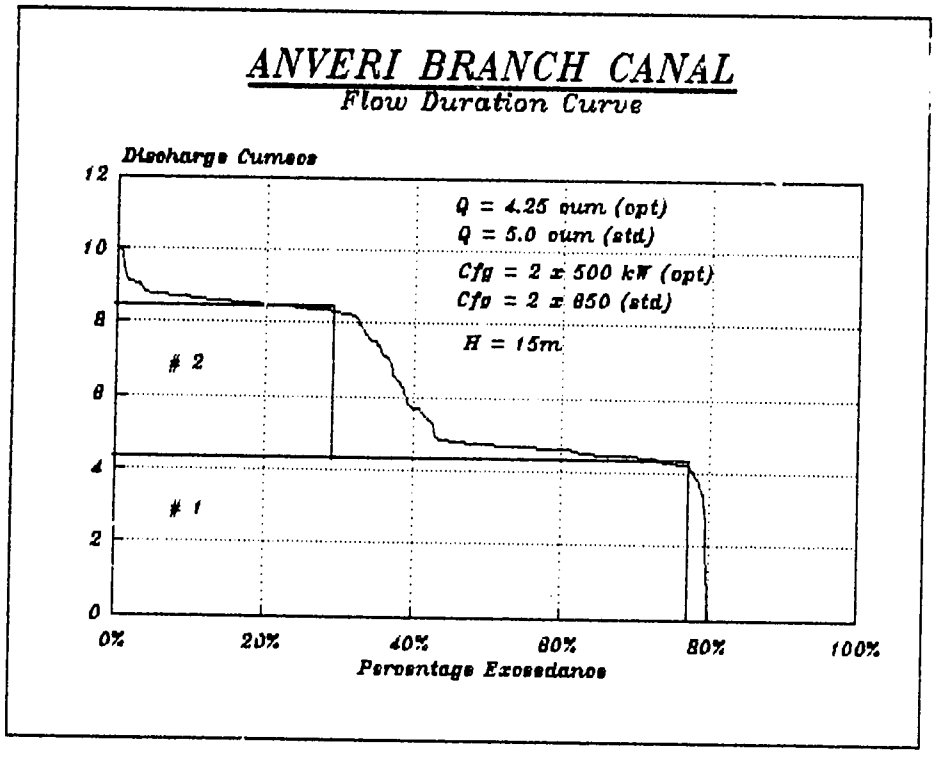

DEVEREBELEKERE
Energy Curve
Discharge Cumecs
E = 9.1 GWh/yr @ n = 80%
140
120
100
80
60
40
20
0
2
1
0
5
10
15
20
Energy kWh (Millions)
Head = 12.3m , eff = 100%

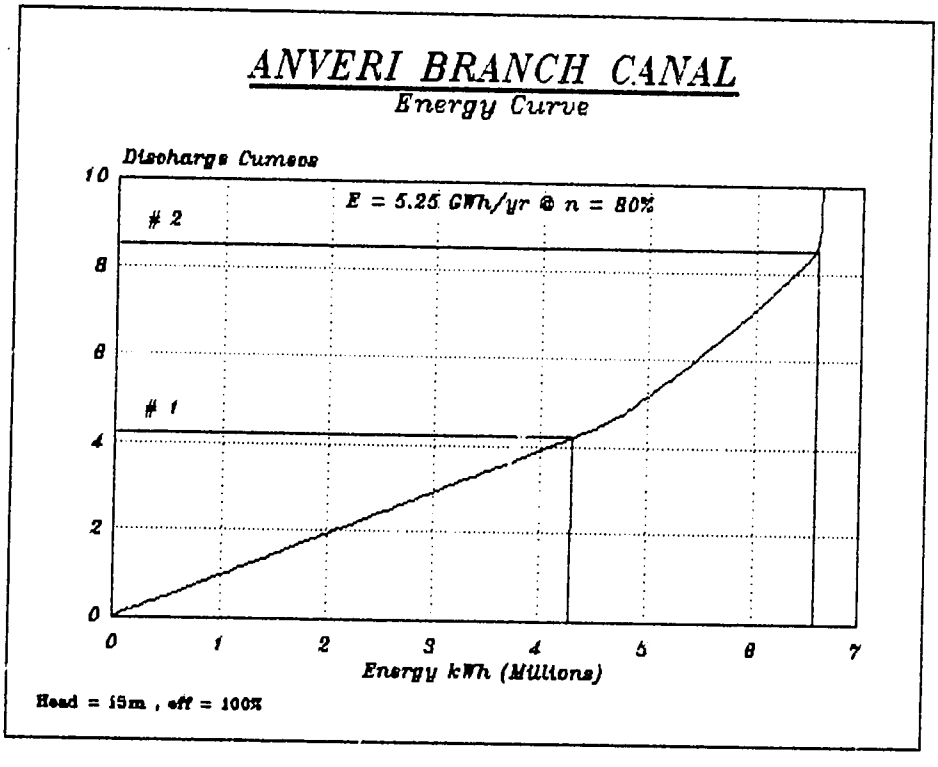

BRINDAVAN
Flow Duration Curve
Discharge Cumecs
Q = 30cum (opt) : 30cum (std)
H = 13m (opt) : 13m (std)
Cfg = 3 x 3500kW (opt) : 3 x 3500 (std)
350
300
250
200
150
100
50
0
3
2
1
0%
20%
40%
60%
80%
100%
Percentage Exceedance

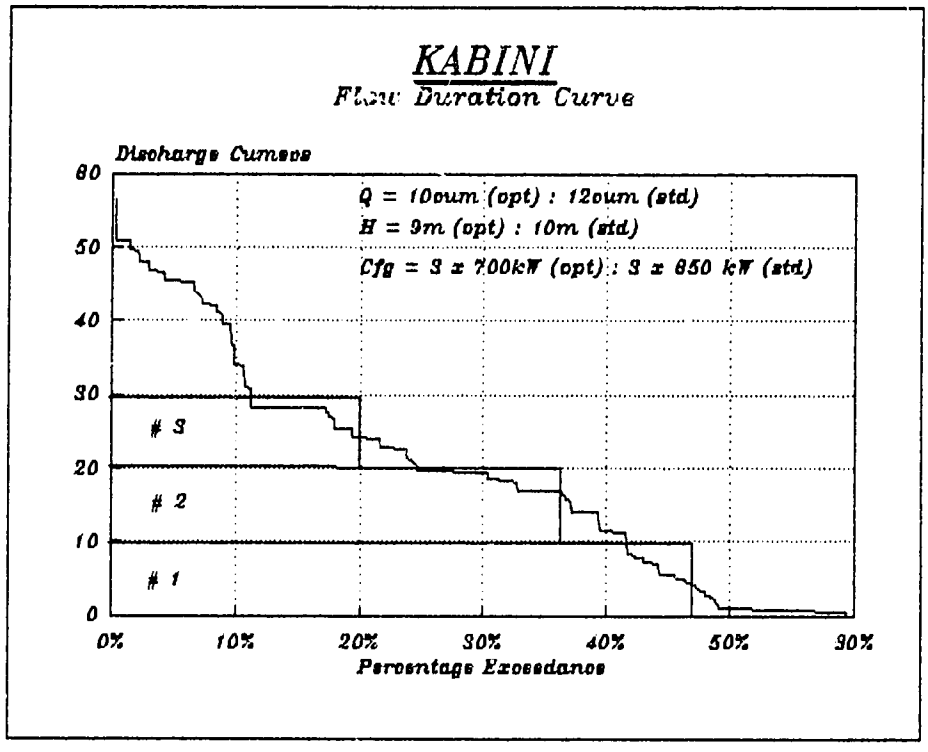

BRINDAVAN
Energy Curve
Discharge Cumecs
E = 83.0 GWh/yr @ n = 80%
300
250
200
150
100
50
0
3
2
1
0
20
40
60
80
100
120
Energy kWh (Millions)
Head = 13m , eff = 100%

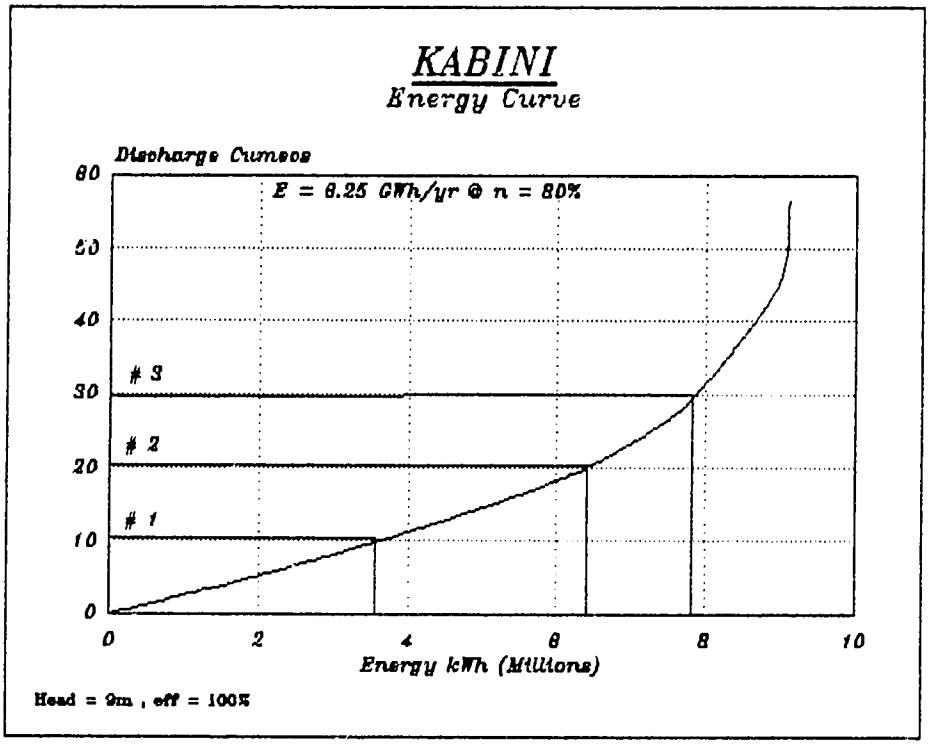

ATIHALLA
Flow Duration Curve
Discharge Cumecs
Q = 5.5cum (opt) : 7.5cum (std)
H = 5.25m (opt) : 7.0m (std)
Cfg = 2 x 200kW (opt) 1 x 350kW (std)
60
50
40
30
20
10
0
2
1
0%
20%
40%
60%
80%
100%
120%
Percentage Exceedance

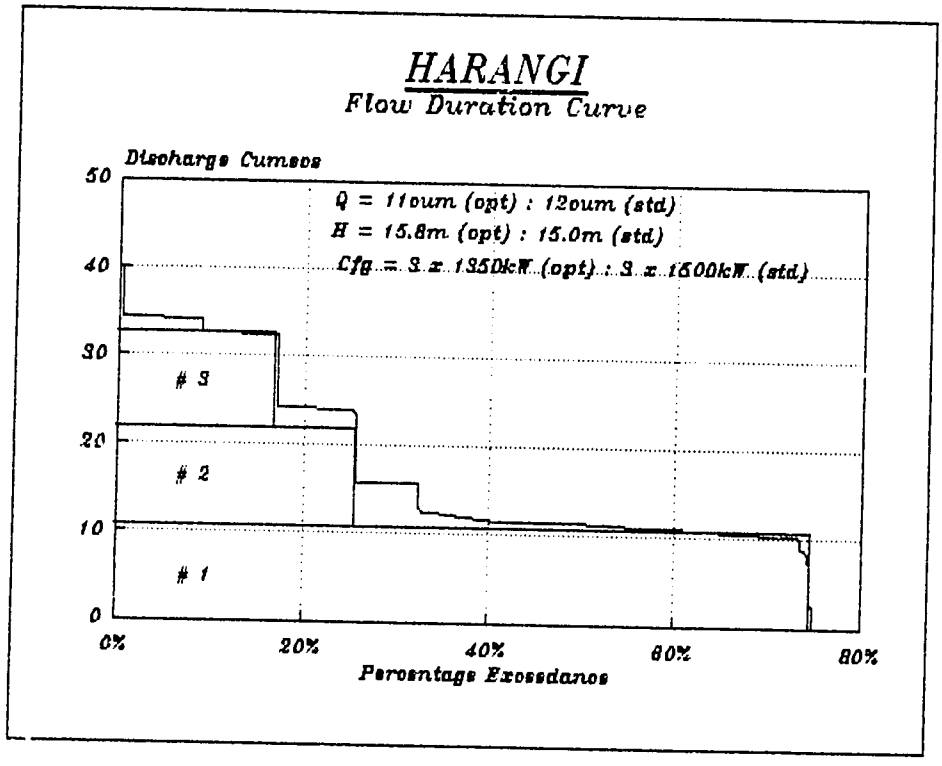

ATTEHALLA
Energy Curve
Discharge Cumecs
E = 2.8 GWh/yr @ n = 80%
50
40
30
20
10
0
2
1
0
1
2
3
4
5
Energy kWh (Millions)
Head = 5.25m , eff = 100%

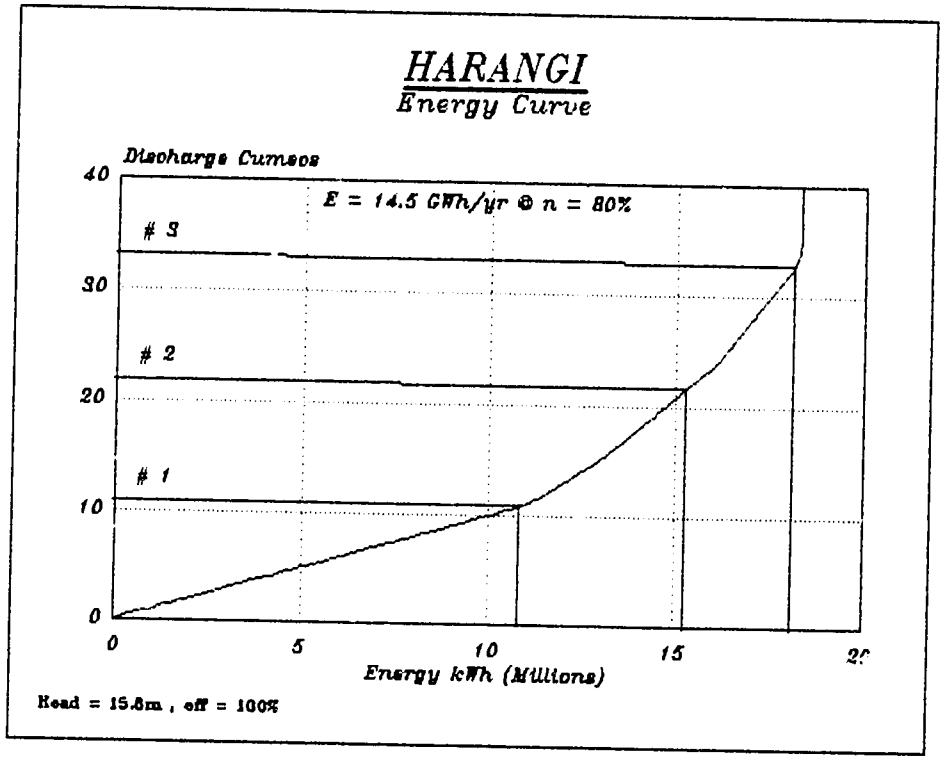

ANVERI BRANCH CANAL
Flow Duration Curve
Discharge Cumecs
Q = 4.25 cum (opt)
Q = 5.0 cum (std)
Cfg = 2 x 500 kW (opt)
Cfg = 2 x 850 (std)
H = 15m
# 2
# 1
0
2
4
6
8
10
12
0%
20%
40%
60%
80%
100%
Percentage Exceedance

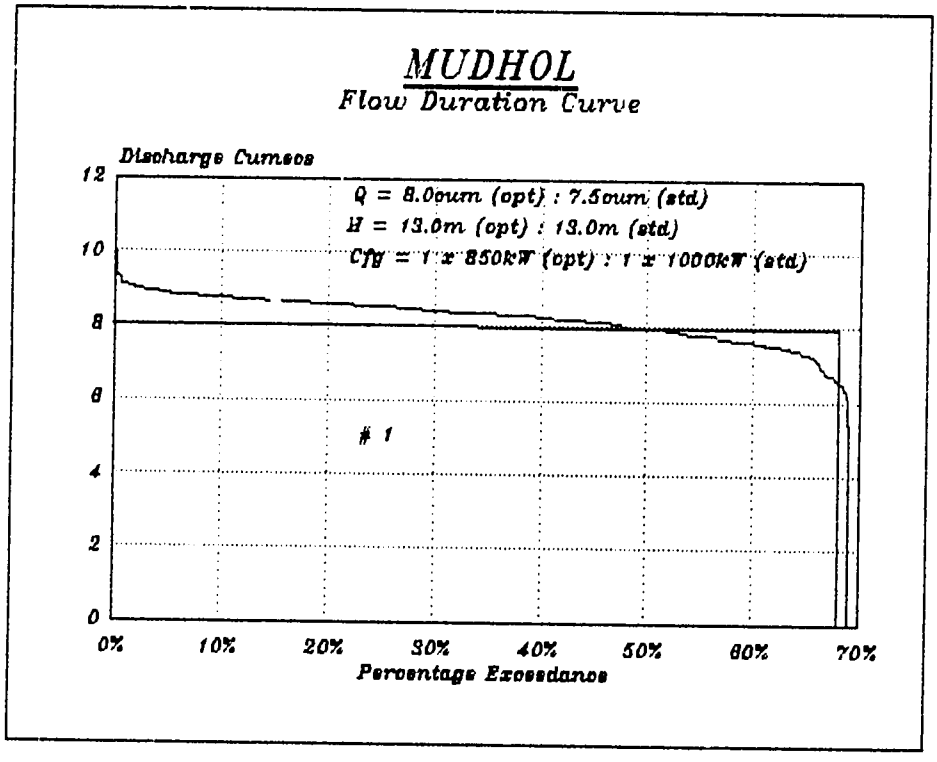

ANVERI BRANCH CANAL
Energy Curve
Discharge Cumecs
E = 5.25 GWh/yr @ n = 80%
# 2
# 1
0
2
4
6
8
10
0
1
2
3
4
5
6
7
Energy kWh (Millions)
Head = 15m , eff = 100%

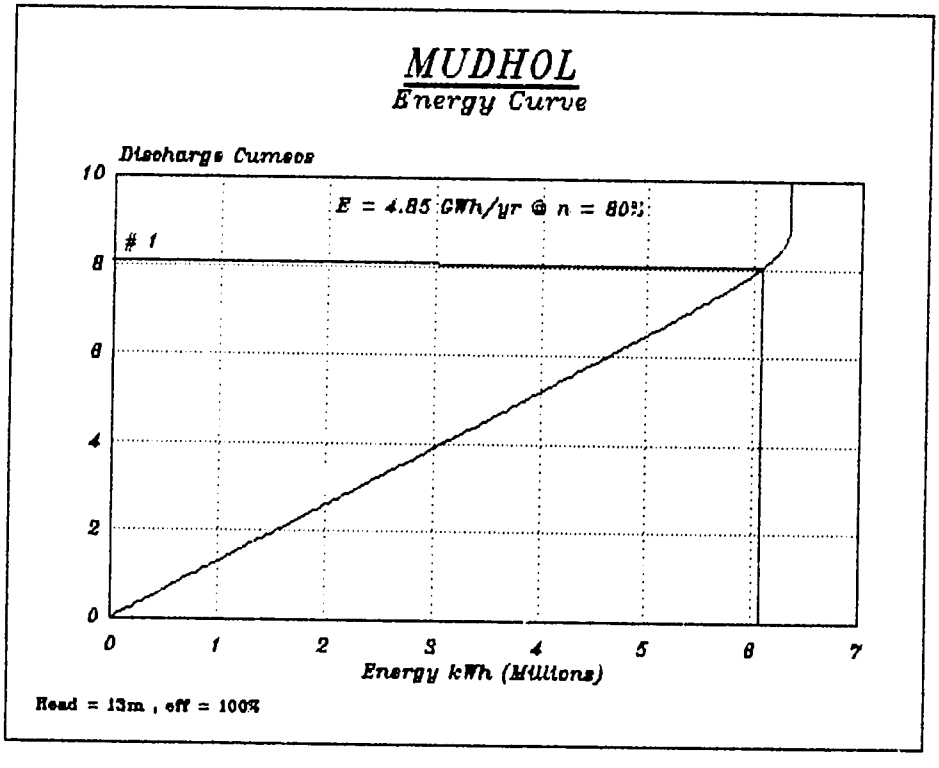

KABINI
Flow Duration Curve
Discharge Cumecs
Q = 10cum (opt) : 12cum (std)
H = 9m (opt) : 10m (std)
Cfg = 3 x 700kW (opt) : 3 x 850 kW (std)
# 3
# 2
# 1
0
10
20
30
40
50
60
0%
10%
20%
30%
40%
50%
60%
Percentage Exceedance

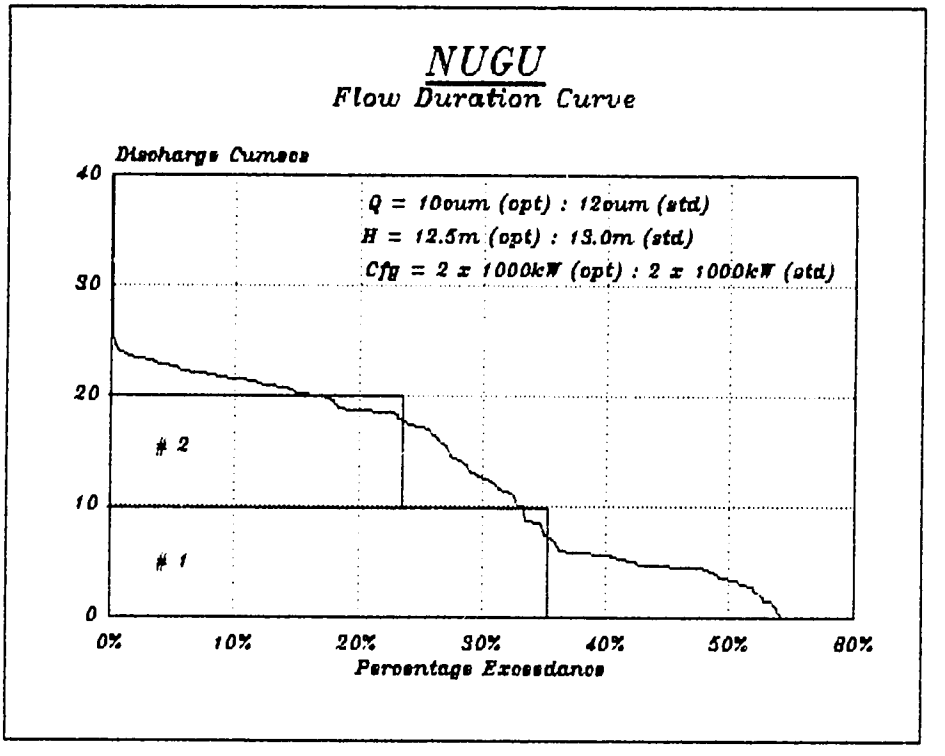

KABINI
Energy Curve
Discharge Cumecs
E = 8.25 GWh/yr @ n = 80%
# 3
# 2
# 1
0
10
20
30
40
50
60
0
2
4
6
8
10
Energy kWh (Millions)
Head = 9m , eff = 100%

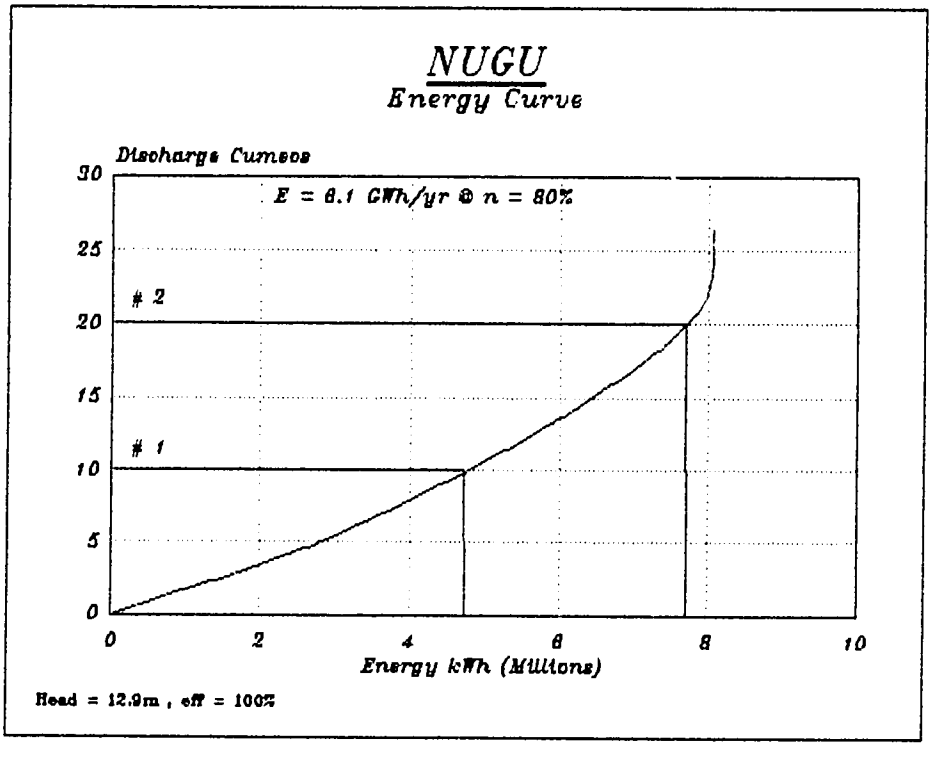

HARANGI
Flow Duration Curve
Discharge Cumecs
Q = 110um (opt) : 120um (std)
H = 15.8m (opt) : 15.0m (std)
Cfg = 3 x 1350kW (opt) : 3 x 1500kW (std)
# 3
# 2
# 1
50
40
30
20
10
0
0%
20%
40%
60%
80%
Percentage Exceedance

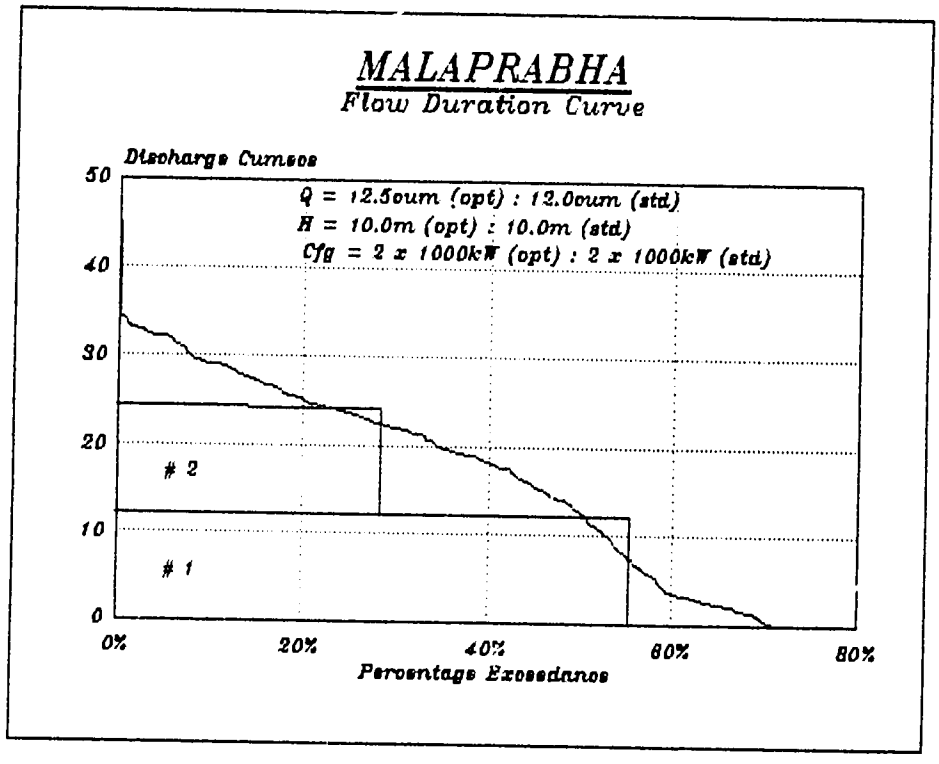

HARANGI
Energy Curve
Discharge Cumecs
E = 14.5 GWh/yr @ n = 80%
# 3
# 2
# 1
40
30
20
10
0
0
5
10
15
Energy kWh (Millions)
Head = 15.8m , eff = 100%

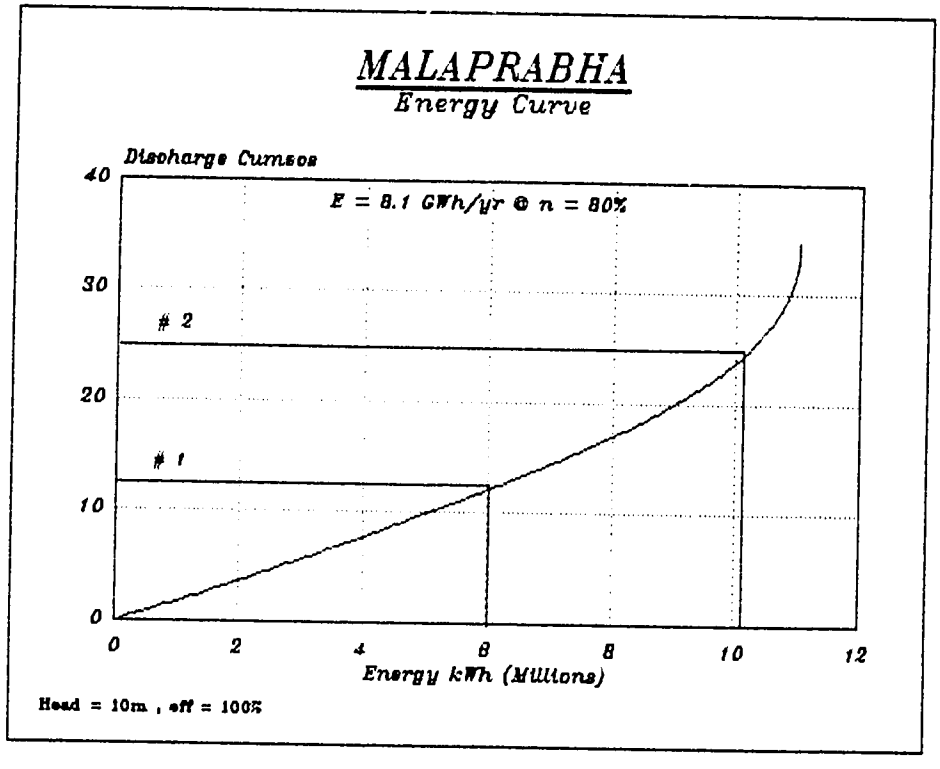

MUDHOL
Flow Duration Curve
Discharge Cumecs
Q = 8.0cum (opt) : 7.5cum (std)
H = 13.0m (opt) : 13.0m (std)
Cfg = 1 x 850kW (opt) : 1 x 1000kW (std)
# 1
0
2
4
6
8
10
12
0%
10%
20%
30%
40%
50%
60%
70%
Percentage Exceedance

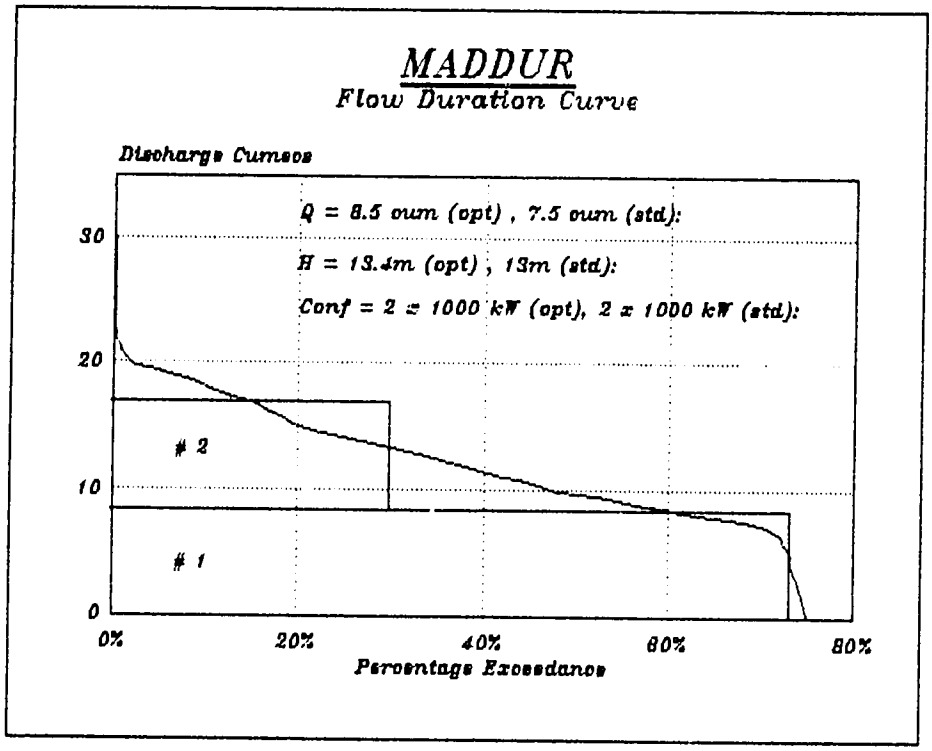

MUDHOL
Energy Curve
Discharge Cumecs
E = 4.85 GWh/yr @ n = 80%
# 1
0
2
4
6
8
10
0
1
2
3
4
5
6
7
Energy kWh (Millions)
Head = 13m , eff = 100%

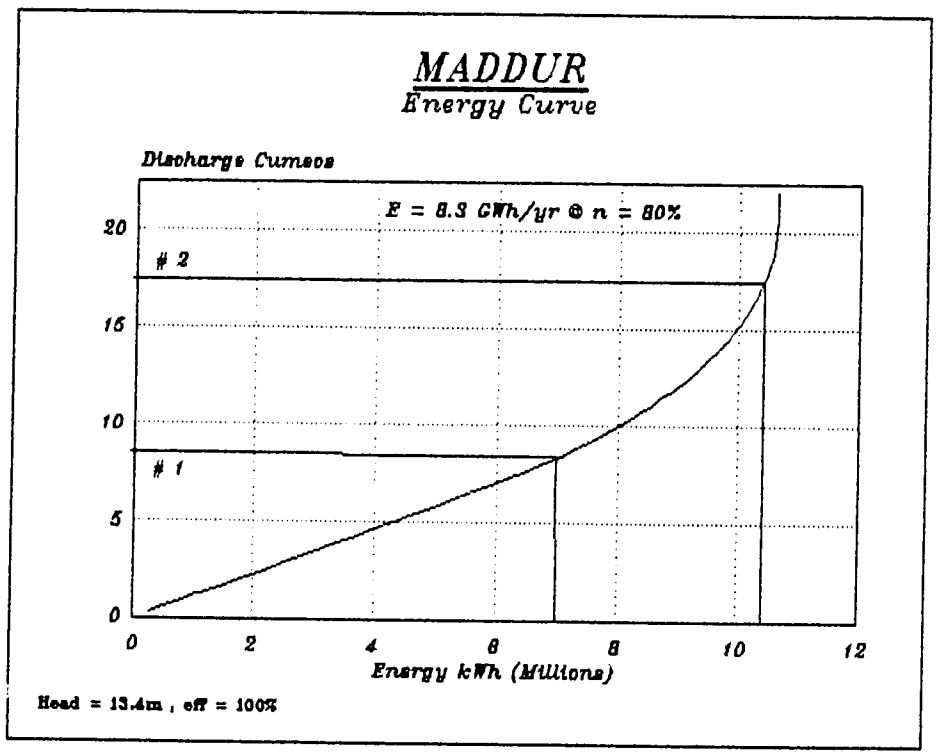

NUGU
Flow Duration Curve
Discharge Cumecs
Q = 10cum (opt) : 12cum (std)
H = 12.5m (opt) : 13.0m (std)
Cfg = 2 x 1000kW (opt) : 2 x 1000kW (std)
# 2
# 1
40
30
20
10
0
0%
10%
20%
30%
40%
50%
60%
Percentage Exceedance

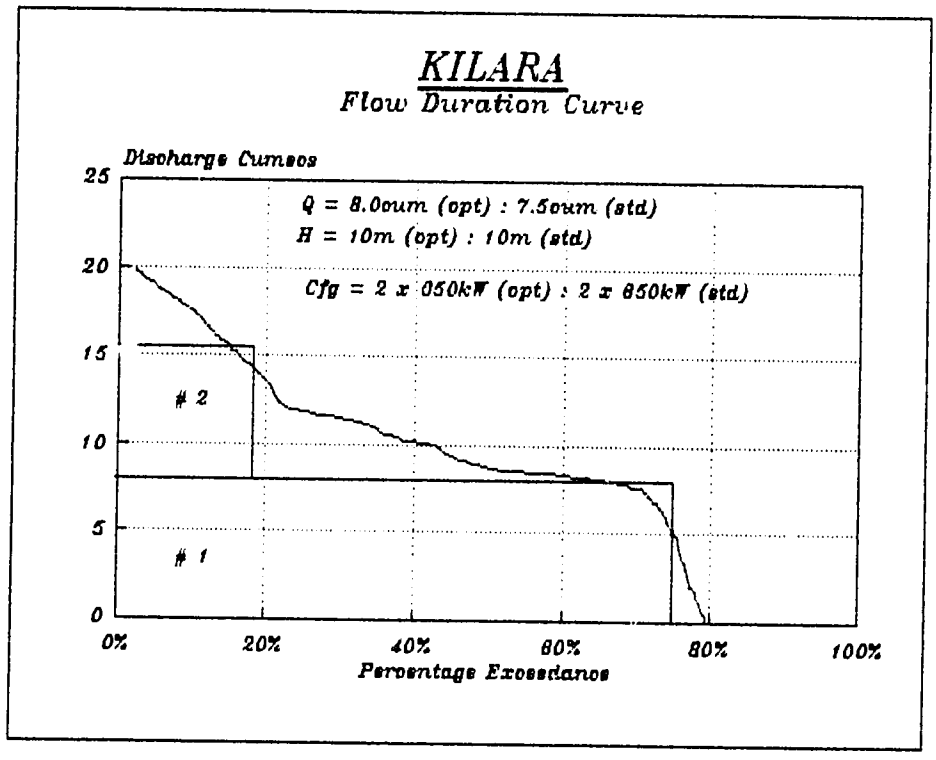

NUGU
Energy Curve
Discharge Cumecs
E = 8.1 GWh/yr @ n = 80%
# 2
# 1
30
25
20
15
10
5
0
0
2
4
6
8
10
Energy kWh (Millions)
Head = 12.9m , eff = 100%

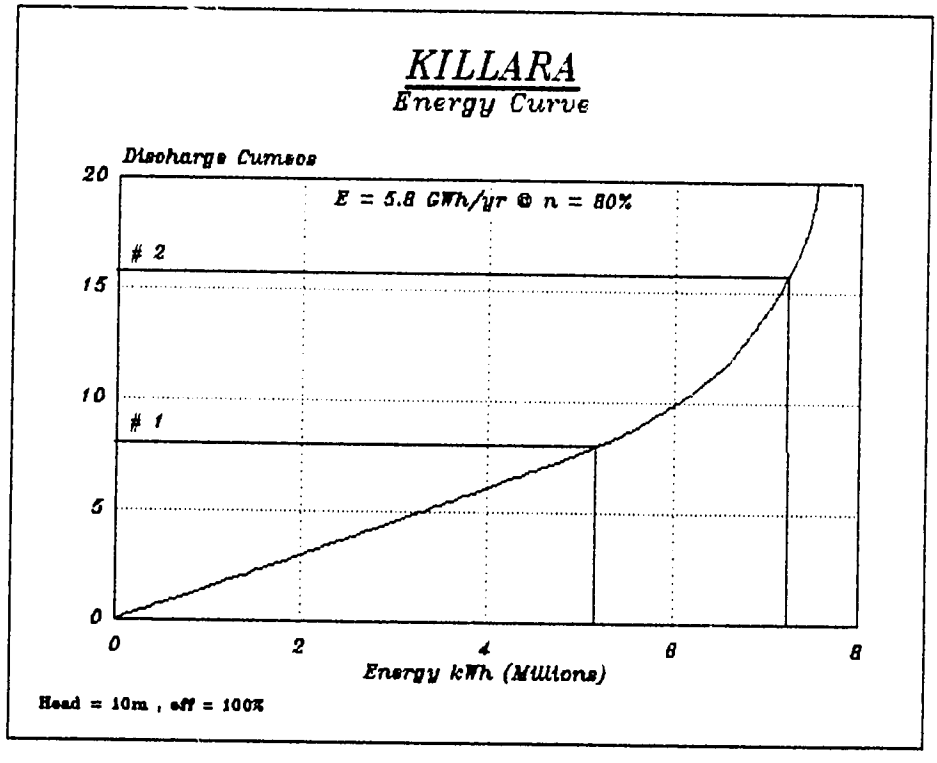

MALAPRABHA
Flow Duration Curve
Discharge Cumecs
Q = 12.5cum (opt) : 12.0cum (std)
H = 10.0m (opt) : 10.0m (std)
Cfg = 2 x 1000kW (opt) : 2 x 1000kW (std)
50
40
30
20
10
0
2
1
0%
20%
40%
60%
80%
Percentage Exceedance

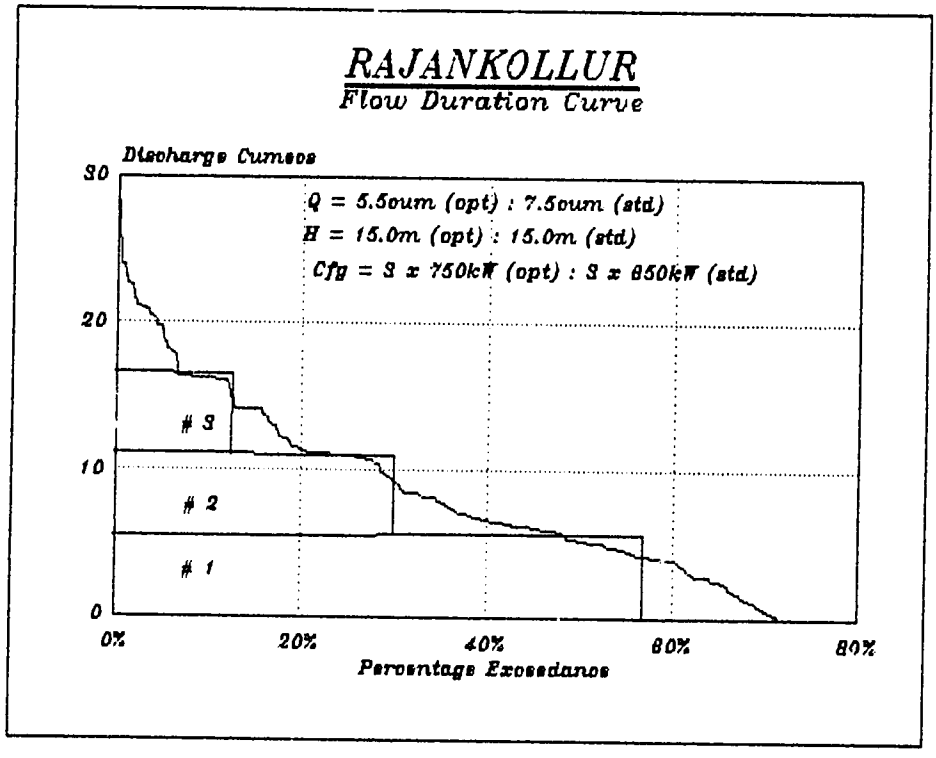

MALAPRABHA
Energy Curve
Discharge Cumecs
E = 8.1 GWh/yr @ n = 80%
40
30
20
10
0
2
1
0
2
4
6
8
10
12
Energy kWh (Millions)
Head = 10m , eff = 100%

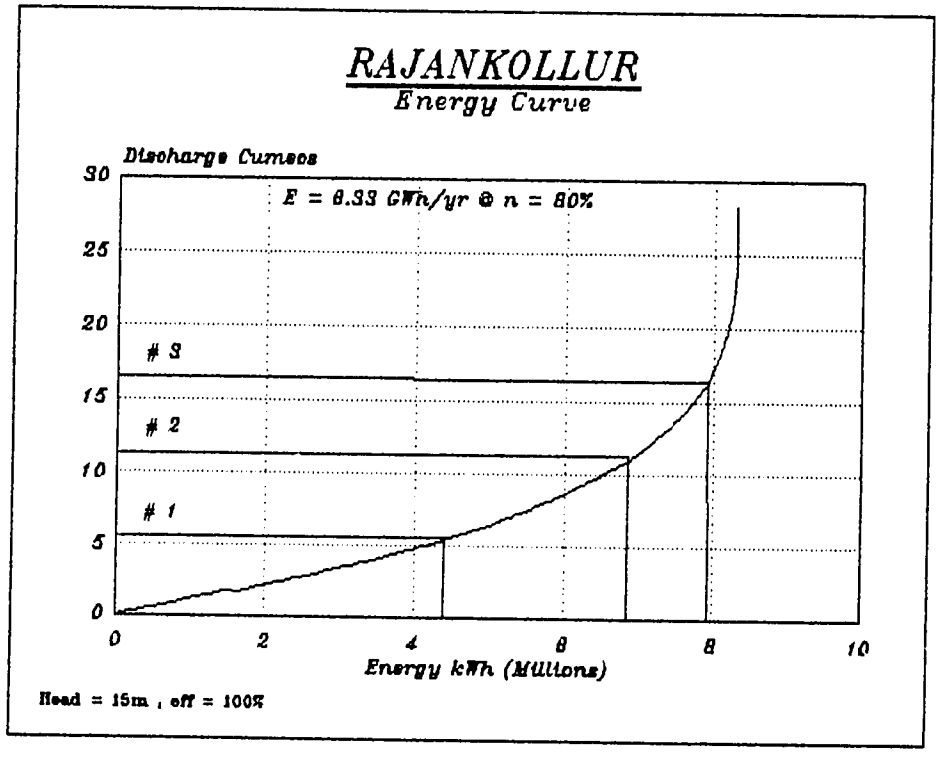

MADDUR
Flow Duration Curve
Discharge Cumecs
Q = 8.5 cum (opt) , 7.5 cum (std):
H = 13.4m (opt) , 13m (std):
Conf = 2 x 1000 kW (opt), 2 x 1000 kW (std):
30
20
10
0
2
1
0%
20%
40%
60%
80%
Percentage Exceedance

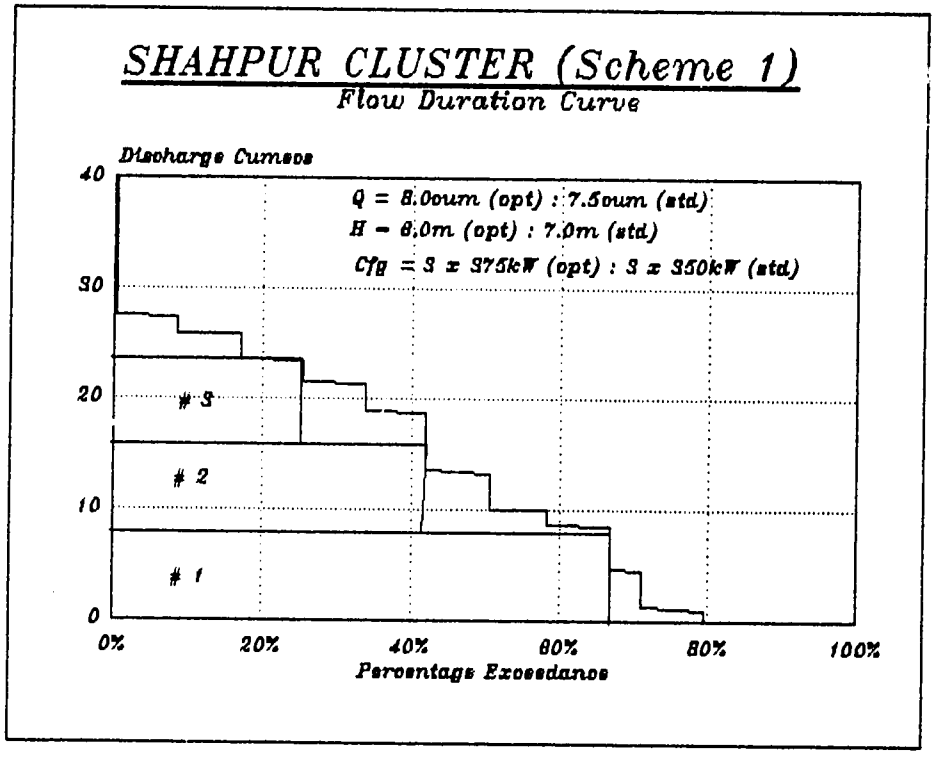

MADDUR
Energy Curve
Discharge Cumecs
E = 8.3 GWh/yr @ n = 80%
20
15
10
5
0
2
1
0
2
4
6
8
10
12
Energy kWh (Millions)
Head = 13.4m , eff = 100%

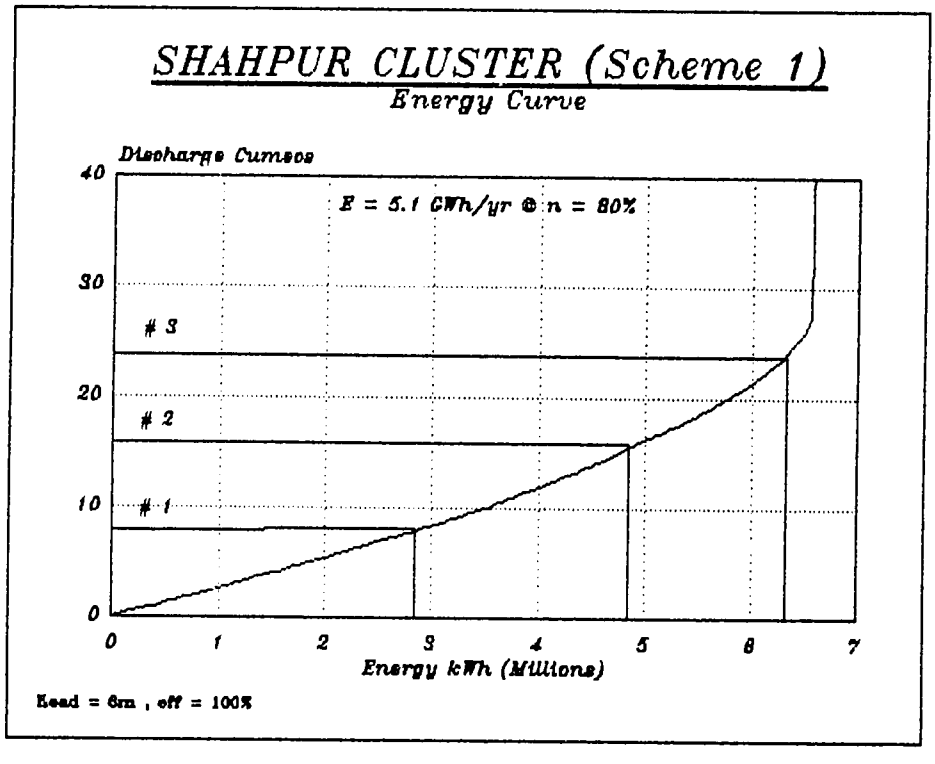

KILARA
Flow Duration Curve
Discharge Cumecs
Q = 8.0cum (opt) : 7.5cum (std)
H = 10m (opt) : 10m (std)
Cfg = 2 x 850kW (opt) : 2 x 850kW (std)
# 2
# 1
25
20
15
10
5
0
0%
20%
40%
60%
80%
100%
Percentage Exceedance

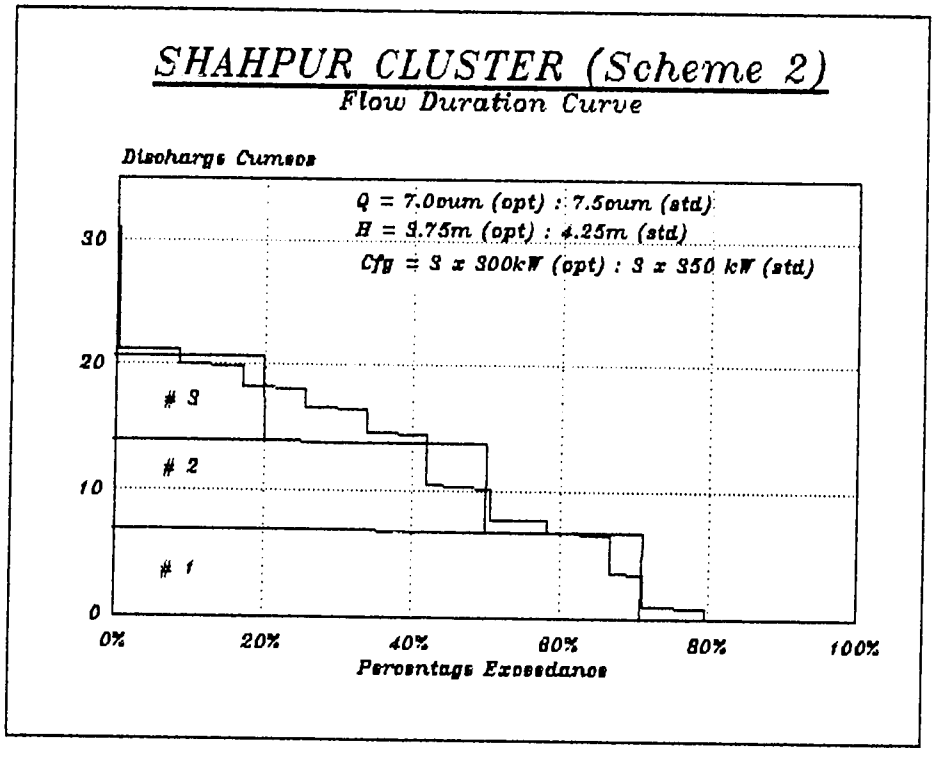

KILLARA
Energy Curve
Discharge Cumecs
E = 5.8 GWh/yr @ n = 80%
# 2
# 1
20
15
10
5
0
0
2
4
6
8
Energy kWh (Millions)
Head = 10m , eff = 100%

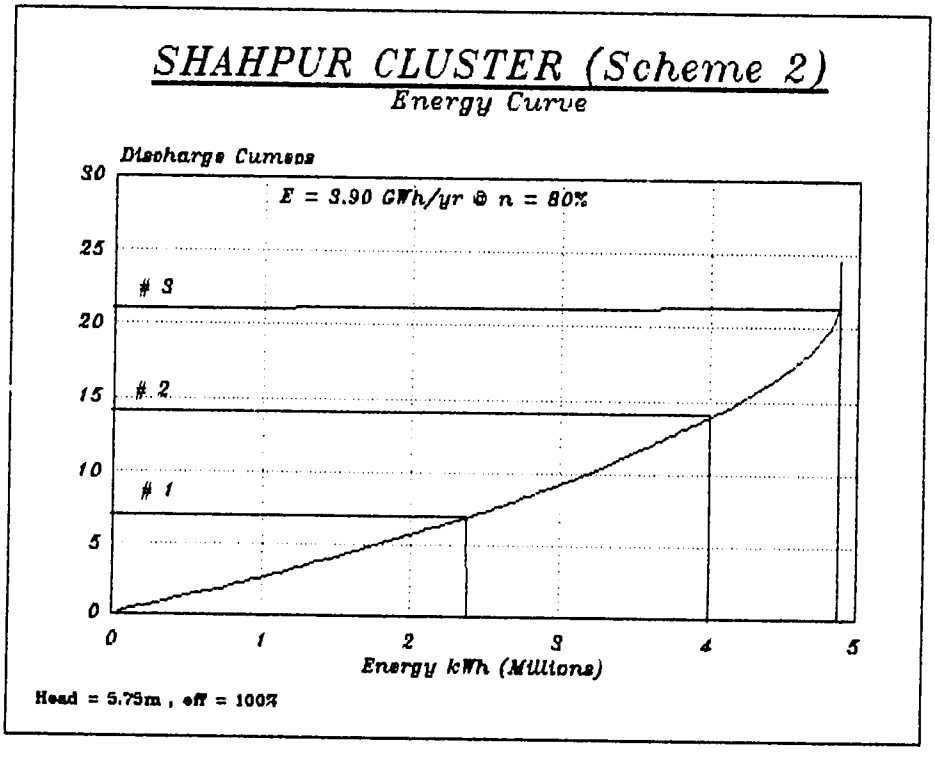

RAJANKOLLUR
Flow Duration Curve
Discharge Cumecs
30
20
10
0
Q = 5.5cum (opt) : 7.5cum (std)
H = 15.0m (opt) : 15.0m (std)
Cfg = 3 x 750kW (opt) : 3 x 850kW (std)
# 3
# 2
# 1
0%
20%
40%
60%
80%
Percentage Exceedance

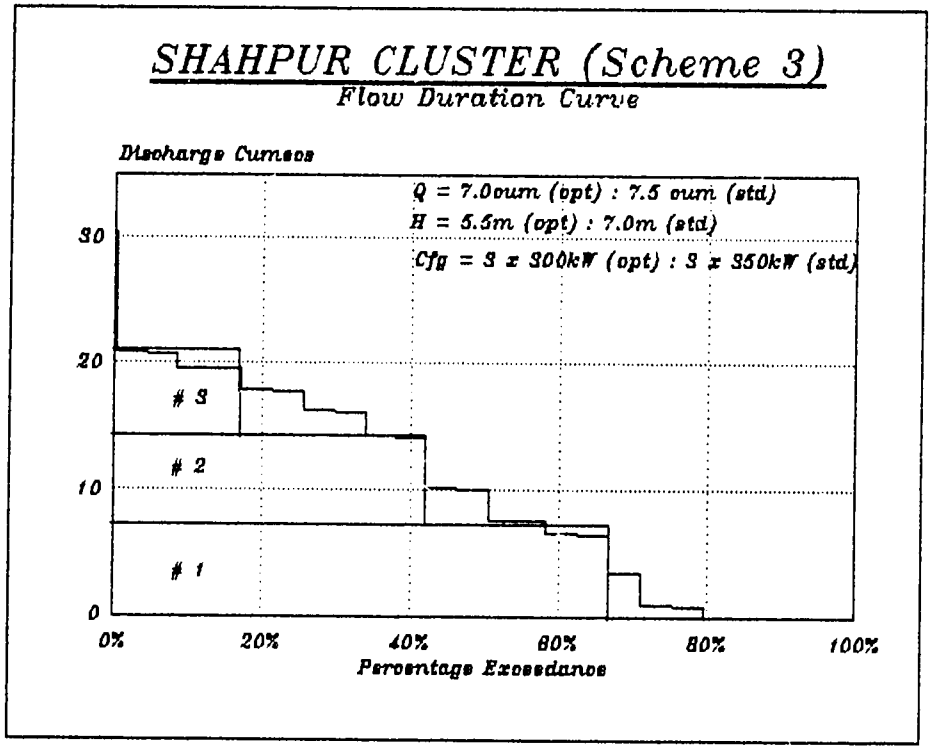

RAJANKOLLUR
Energy Curve
Discharge Cumecs
30
25
20
15
10
5
0
E = 8.33 GWh/yr @ n = 80%
# 3
# 2
# 1
0
2
4
6
8
10
Energy kWh (Millions)
Head = 15m , eff = 100%

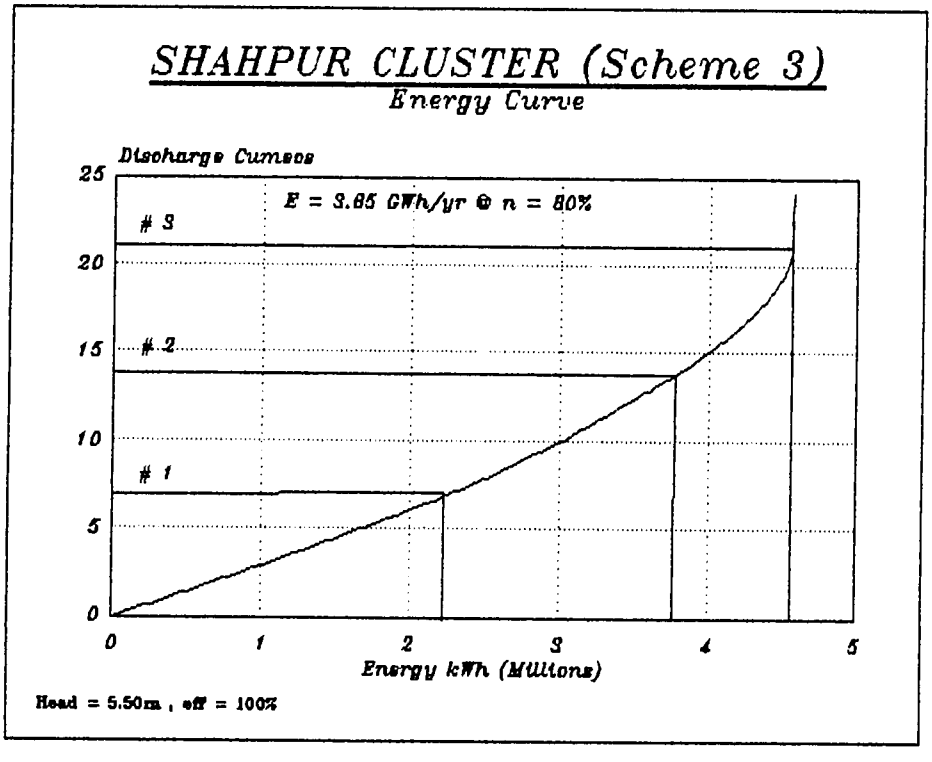

SHAHPUR CLUSTER (Scheme 1)
Flow Duration Curve
Discharge Cumecs
Q = 8.0cum (opt) : 7.5cum (std)
H = 8.0m (opt) : 7.0m (std)
Cfg = 3 x 375kW (opt) : 3 x 350kW (std)
# 3
# 2
# 1
40
30
20
10
0
0%
20%
40%
60%
80%
100%
Percentage Exceedance

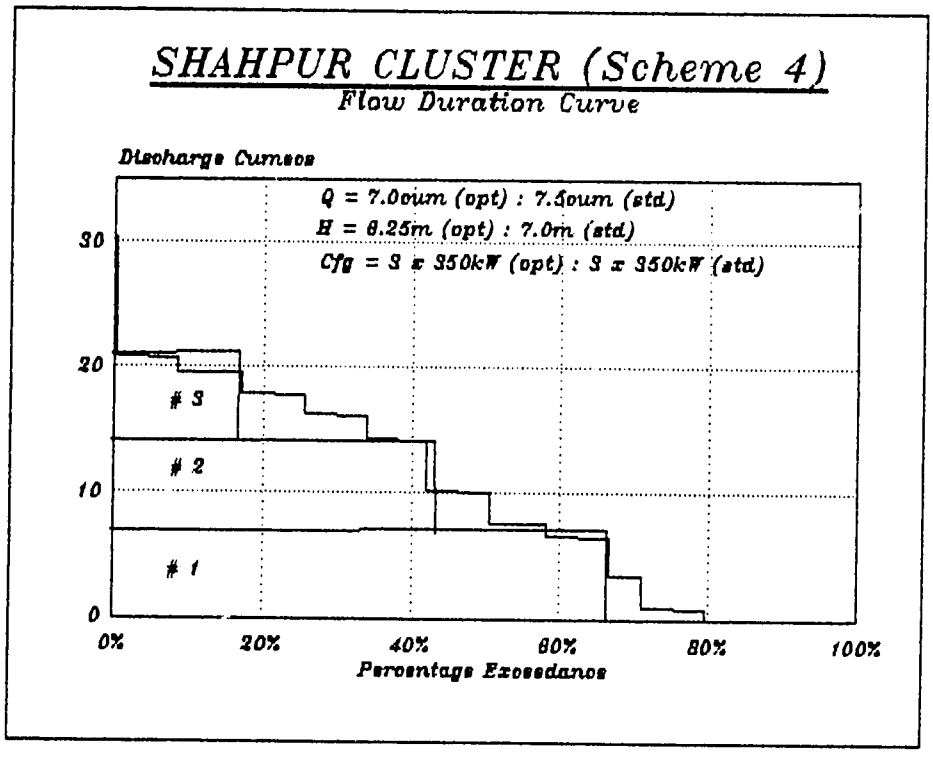

SHAHPUR CLUSTER (Scheme 1)
Energy Curve
Discharge Cumecs
E = 5.1 GWh/yr @ n = 80%
# 3
# 2
# 1
40
30
20
10
0
0
1
2
3
4
5
6
7
Energy kWh (Millions)
Head = 6m , eff = 100%

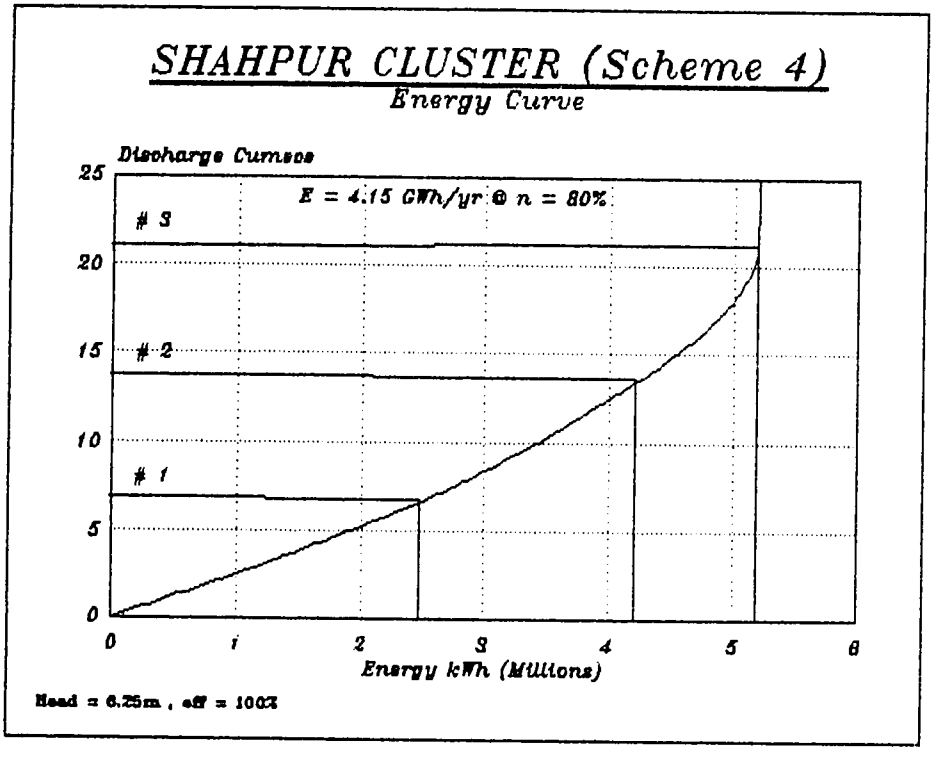

SHAHPUR CLUSTER (Scheme 2)
Flow Duration Curve
Discharge Cumecs
Q = 7.0cum (opt) : 7.5cum (std)
H = 3.75m (opt) : 4.25m (std)
Cfg = 3 x 300kW (opt) : 3 x 350 kW (std)
30
20
10
0
3
2
1
0%
20%
40%
60%
80%
100%
Percentage Exceedance

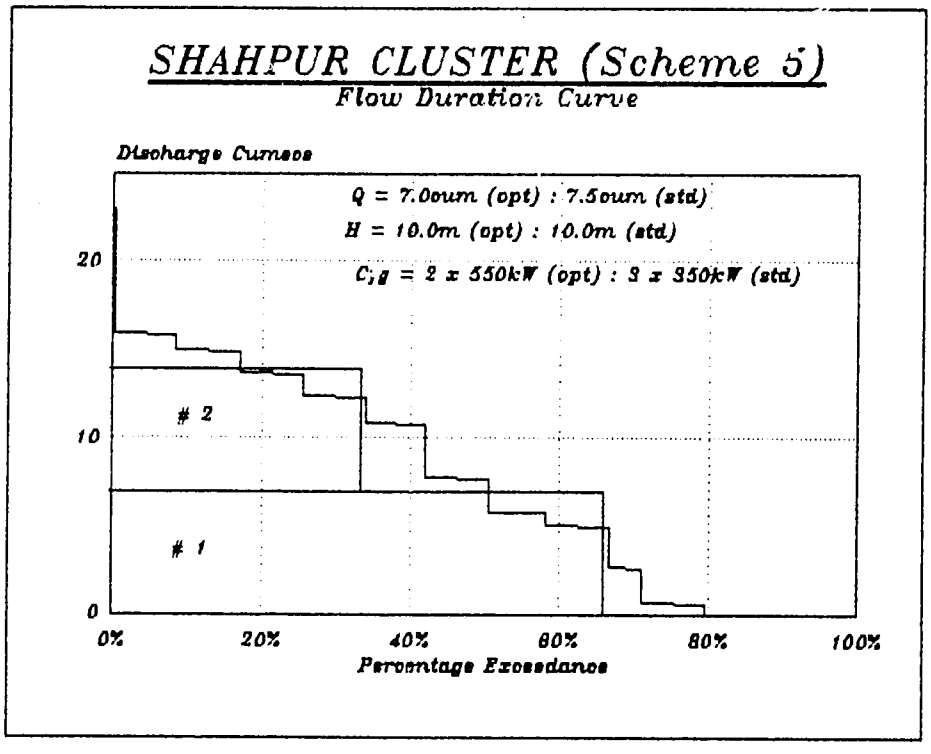

SHAHPUR CLUSTER (Scheme 2)
Energy Curve
Discharge Cumecs
E = 3.90 GWh/yr @ n = 80%
30
25
20
15
10
5
0
3
2
1
0
1
2
3
4
5
Energy kWh (Millions)
Head = 5.75m , eff = 100%

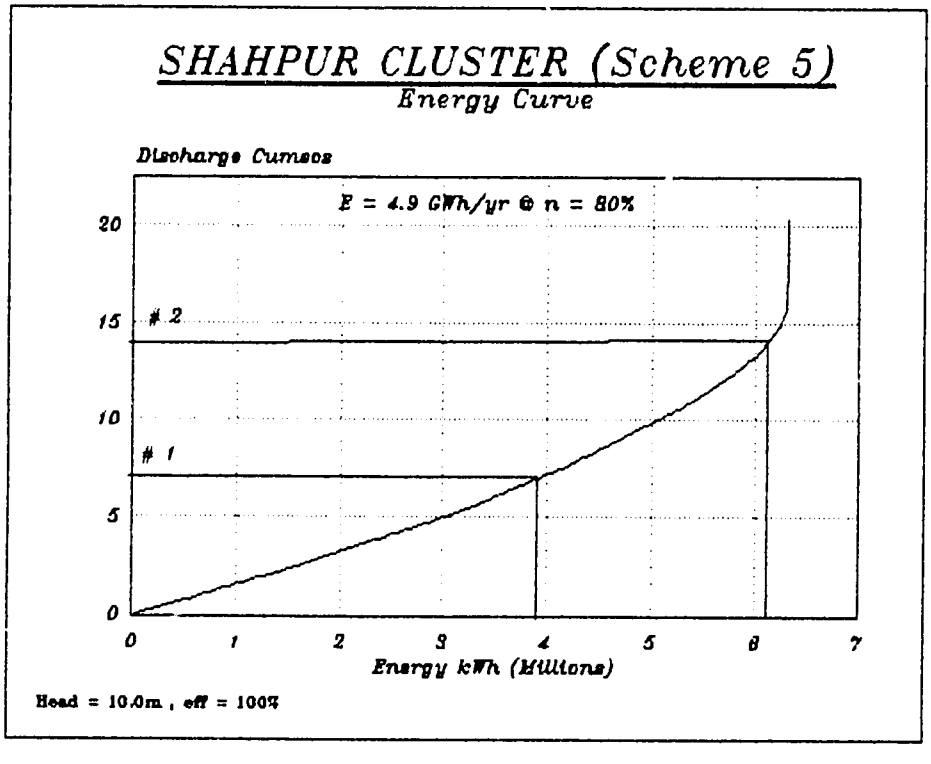

SHAHPUR CLUSTER (Scheme 3)
Flow Duration Curve
Discharge Cumecs
Q = 7.0cum (opt) : 7.5 cum (std)
H = 5.5m (opt) : 7.0m (std)
Cfg = 3 x 300kW (opt) : 3 x 350kW (std)
30
20
10
0
3
2
1
0%
20%
40%
60%
80%
100%
Percentage Exceedance

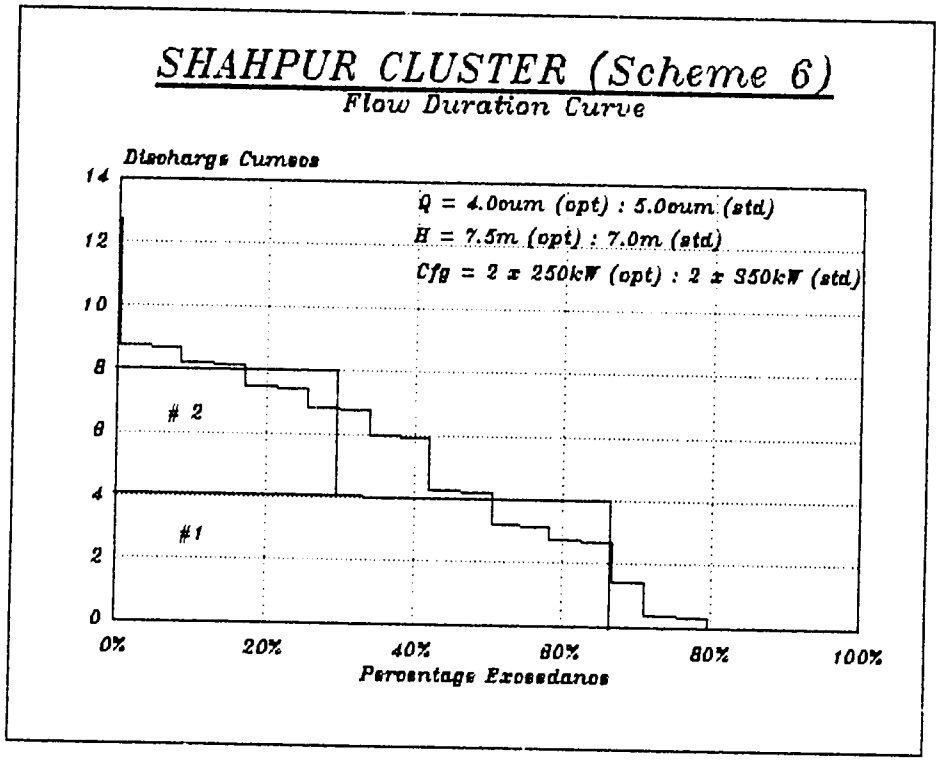

SHAHPUR CLUSTER (Scheme 3)
Energy Curve
Discharge Cumecs
E = 3.85 GWh/yr @ n = 80%
25
20
15
10
5
0
3
2
1
0
1
2
3
4
5
Energy kWh (Millions)
Head = 5.50m , eff = 100%

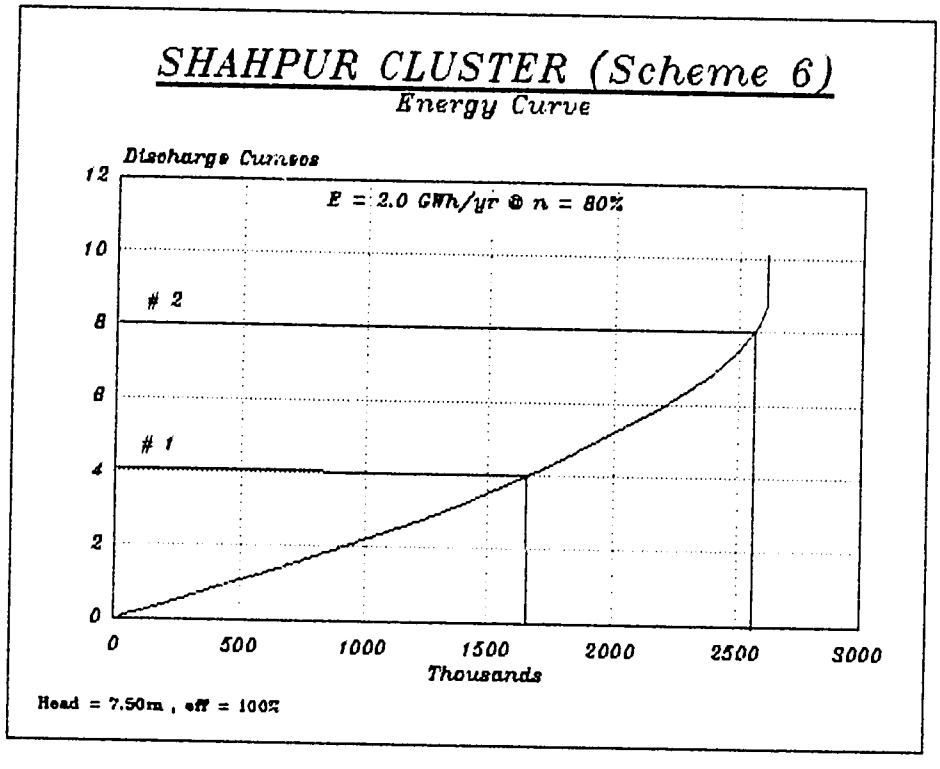

SHAHPUR CLUSTER (Scheme 4)
Flow Duration Curve
Discharge Cumecs
Q = 7.0cum (opt) : 7.5cum (std)
H = 6.25m (opt) : 7.0m (std)
Cfg = 3 x 350kW (opt) : 3 x 350kW (std)
30
20
10
0
3
2
1
0%
20%
40%
60%
80%
100%
Percentage Exceedance

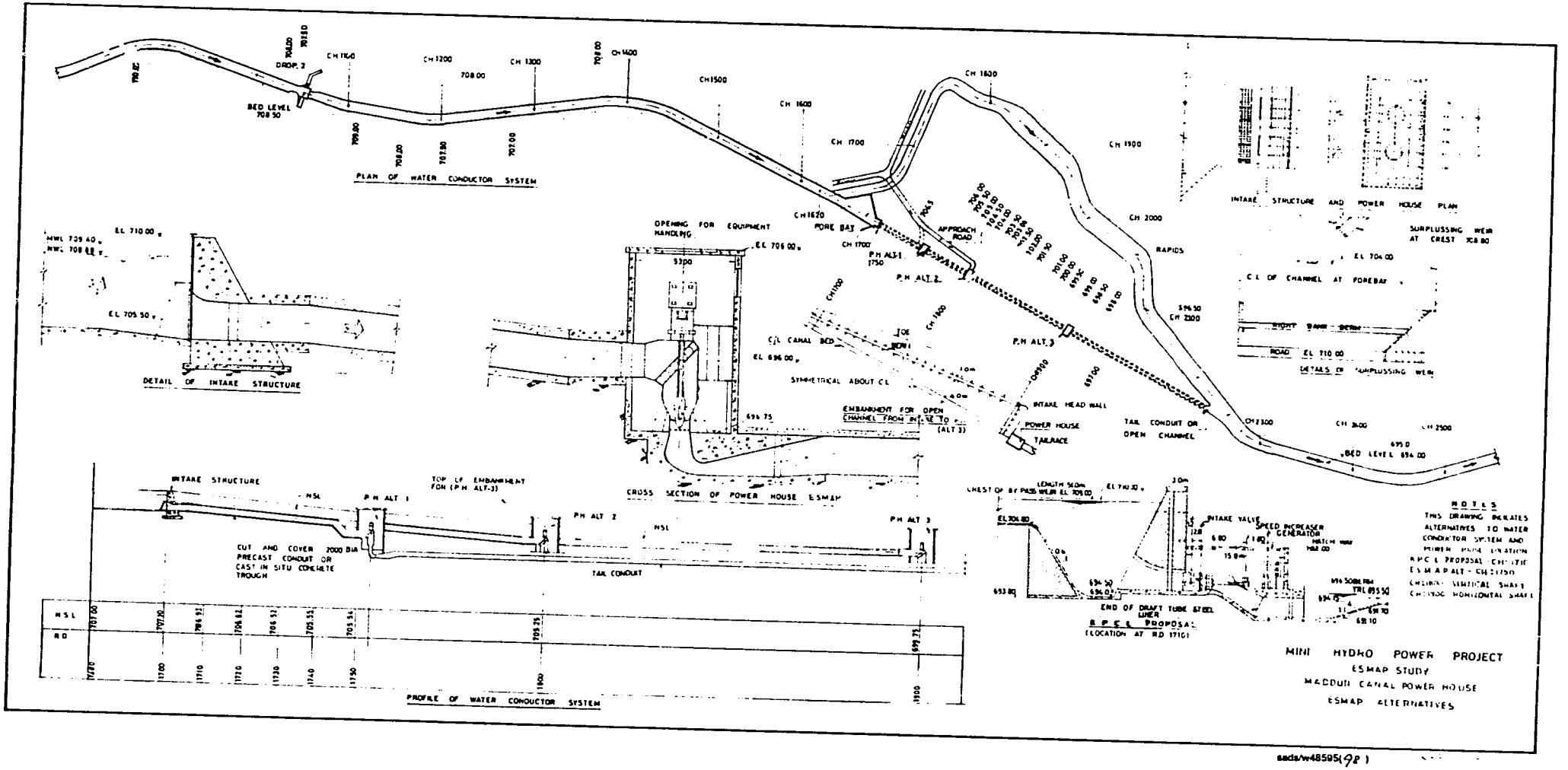

SHAHPUR CLUSTER (Scheme 4)
Energy Curve
Discharge Cumecs
E = 4.15 GWh/yr @ n = 80%
25
20
15
10
5
0
3
2
1
0
1
2
3
4
5
6
Energy kWh (Millions)
Head = 6.25m , eff = 100%


SHAHPUR CLUSTER (Scheme 5)
Flow Duration Curve
Discharge Cumecs
Q = 7.0cum (opt) : 7.5cum (std)
H = 10.0m (opt) : 10.0m (std)
C;g = 2 x 550kW (opt) : 3 x 350kW (std)
2
1
20
10
0
0%
20%
40%
60%
80%
100%
Percentage Exceedance

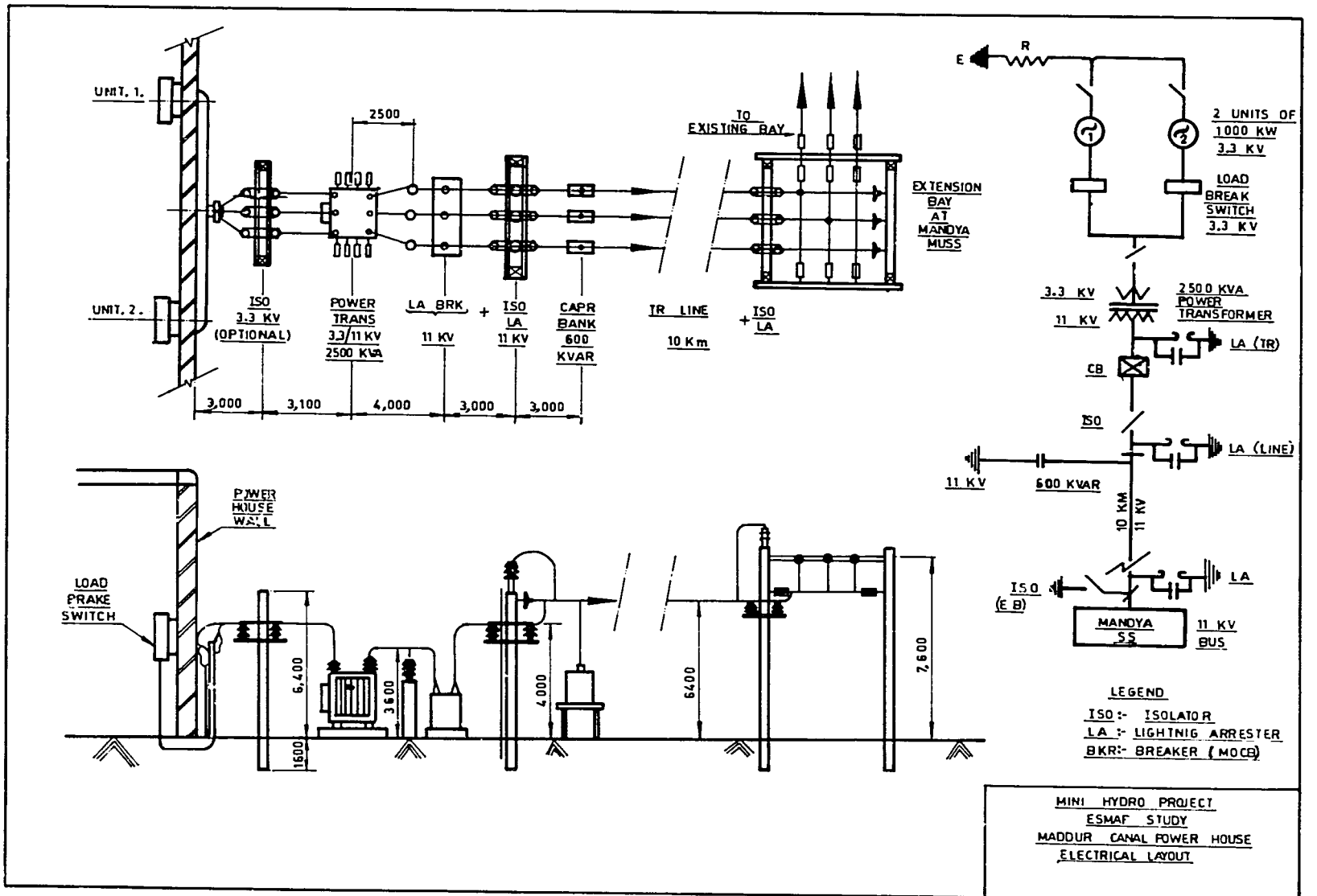

SHAHPUR CLUSTER (Scheme 5)
Energy Curve
Discharge Cumecs
E = 4.9 GWh/yr @ n = 80%
# 2
# 1
20
15
10
5
0
0
1
2
3
4
5
6
7
Energy kWh (Millions)
Head = 10.0m , eff = 100%


SHAHPUR CLUSTER (Scheme 6)
Flow Duration Curve
Discharge Cumecs
Q = 4.0cum (opt) : 5.0cum (std)
H = 7.5m (opt) : 7.0m (std)
Cfg = 2 x 250kW (opt) : 2 x 350kW (std)
# 2
#1
0
2
4
6
8
10
12
14
0%
20%
40%
60%
80%
100%
Percentage Exceedance

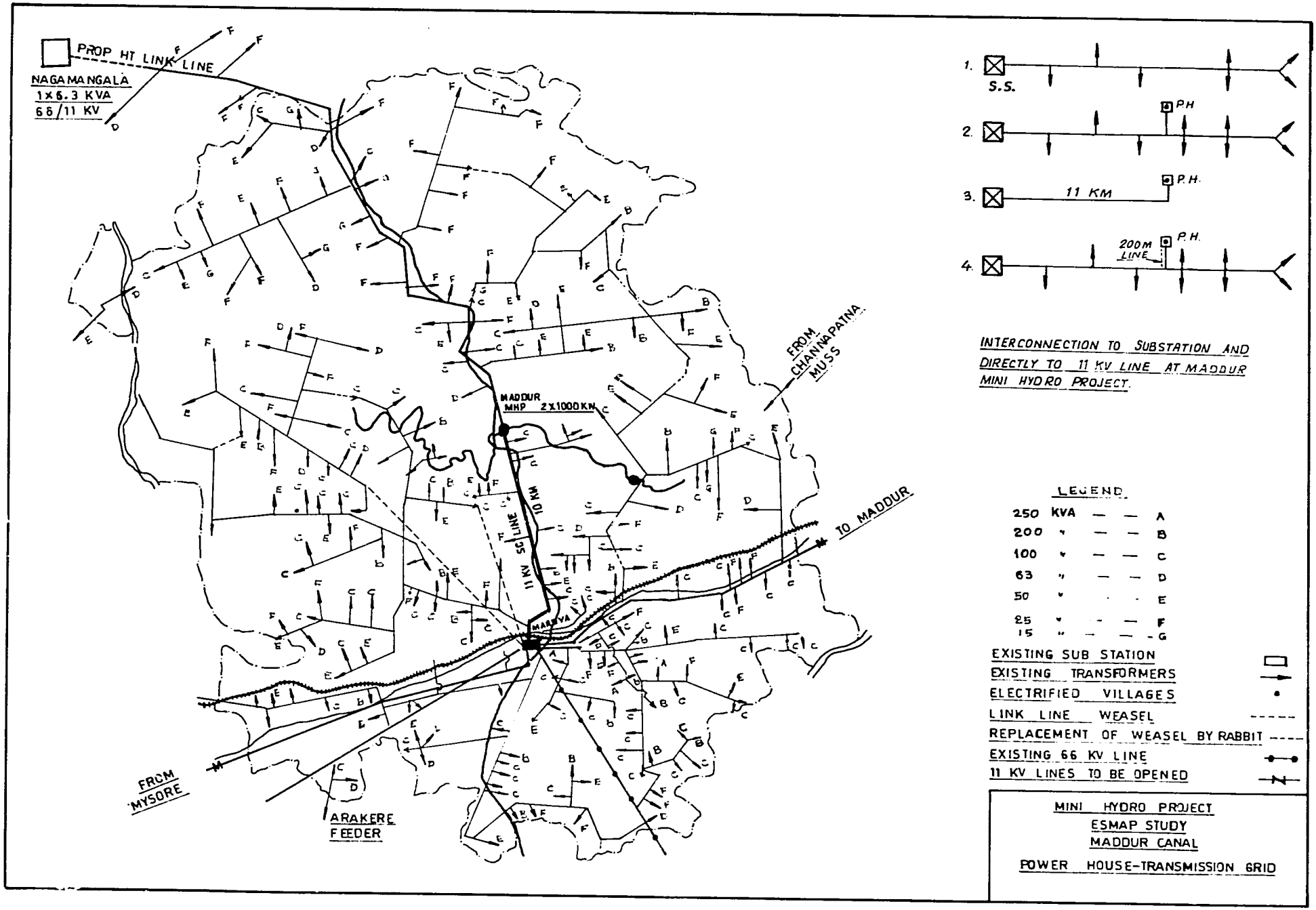

SHAHPUR CLUSTER (Scheme 6)
Energy Curve
Discharge Cumecs
E = 2.0 GWh/yr @ n = 80%
# 2
# 1
0
2
4
6
8
10
12
0
500
1000
1500
2000
2500
3000
Thousands
Head = 7.50m , eff = 100%



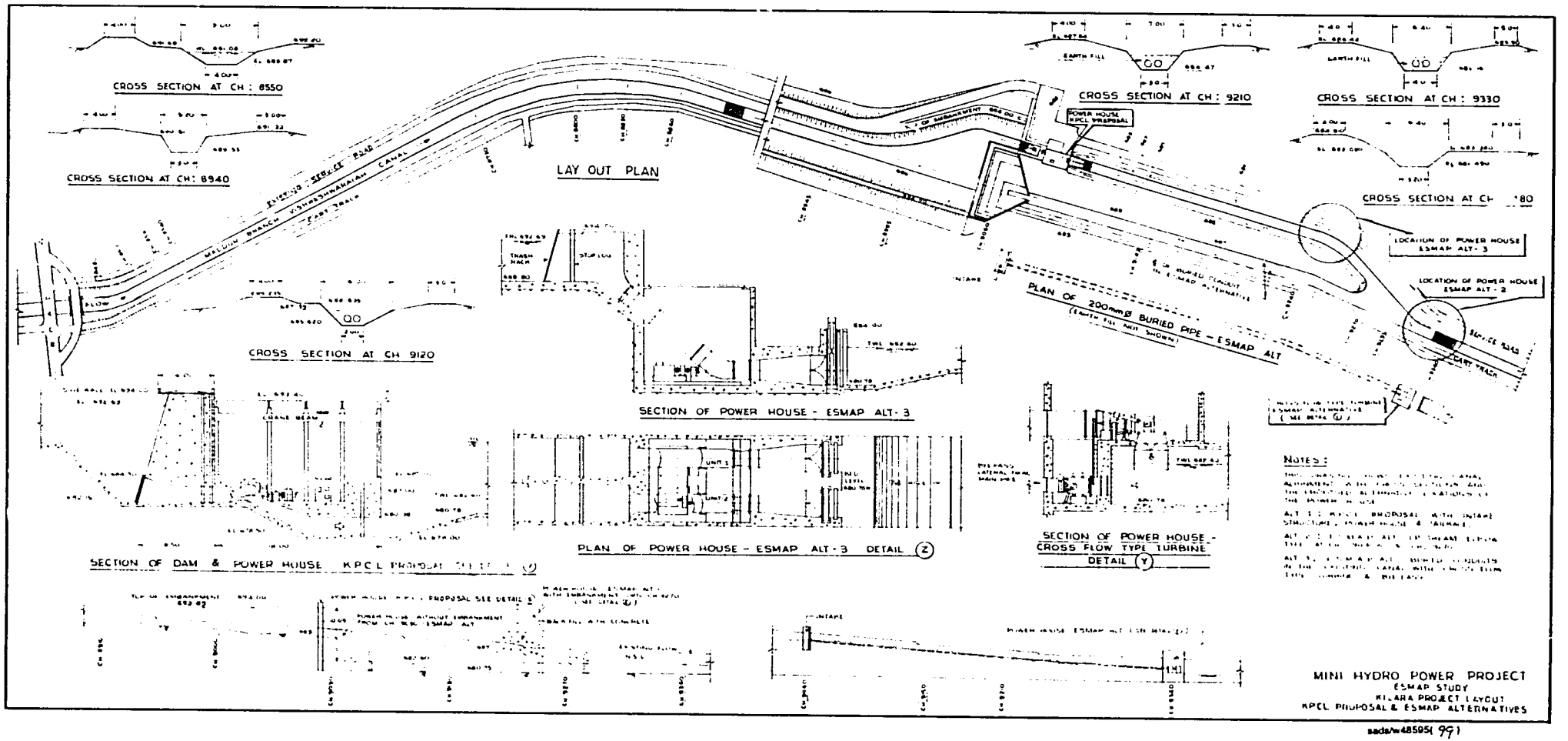
sads/w48595(98)



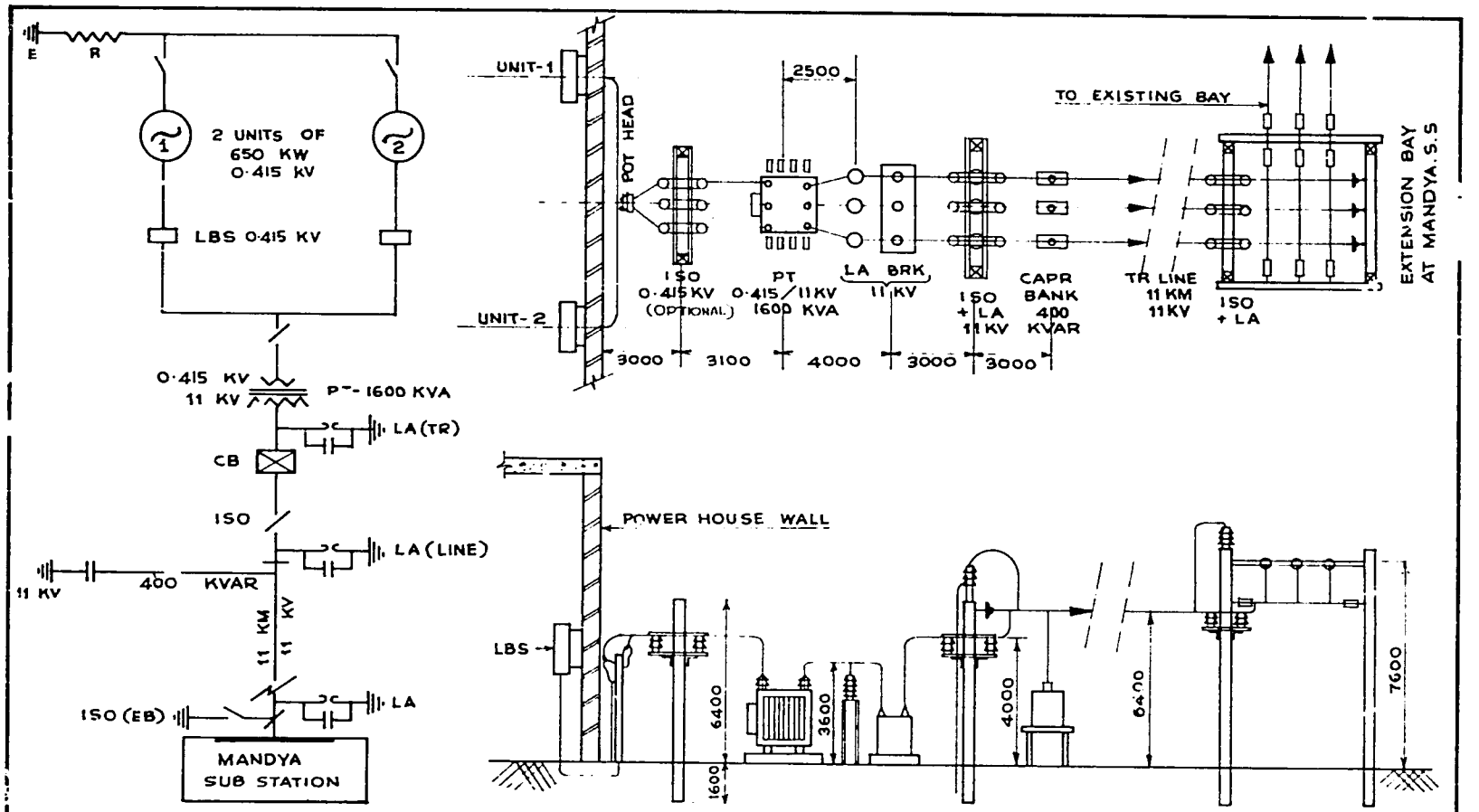
sade/w48595(17)



sads/w48595(/8)



sada/w48595(99)



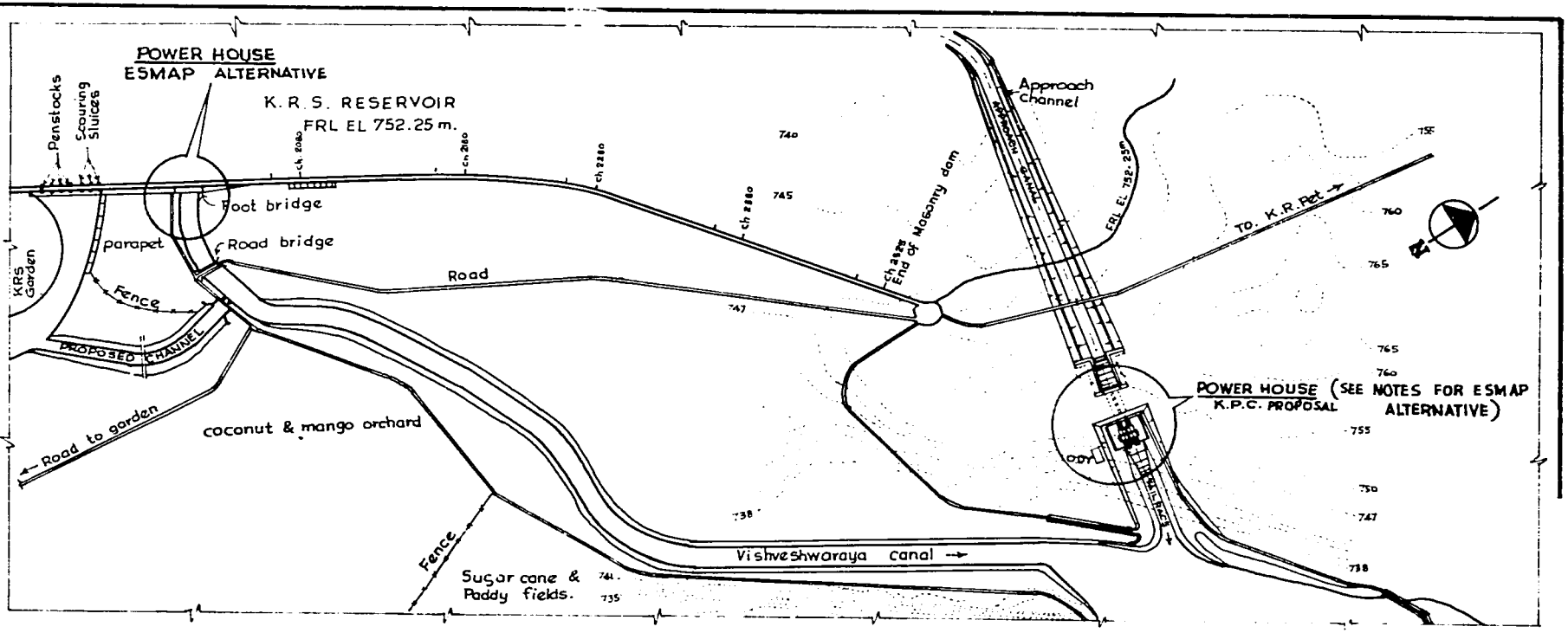
LEGEND :

ISO : ISOLATOR.
LA : LIGHTNING ARRESTER.
BRK : BREAKER (MOCB).
LBS : LOAD BREAK SWITCH.
PT : POWER TRANSFORMER.

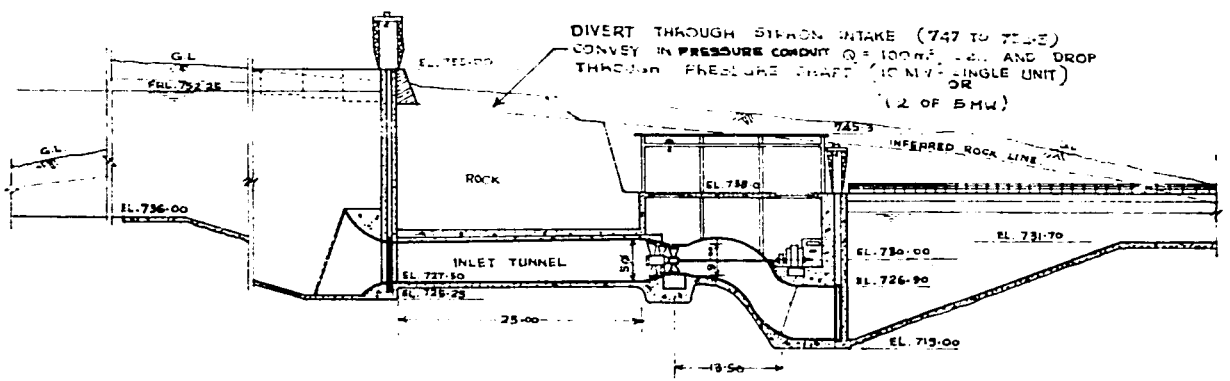
NOTE :
ALL DIMENSIONS ARE IN 'MM'.

MINI HYDRO POWER PROJECT
ESMAP STUDY
KILARA PROJECT
ELECTRICAL LAYOUT
(KARNATAKA)

sada/w48505(/9)



LAYOUT PLAN K.P.C.L. PROPOSAL



SECTION OF POWER HOUSE - KPCL PROPOSAL

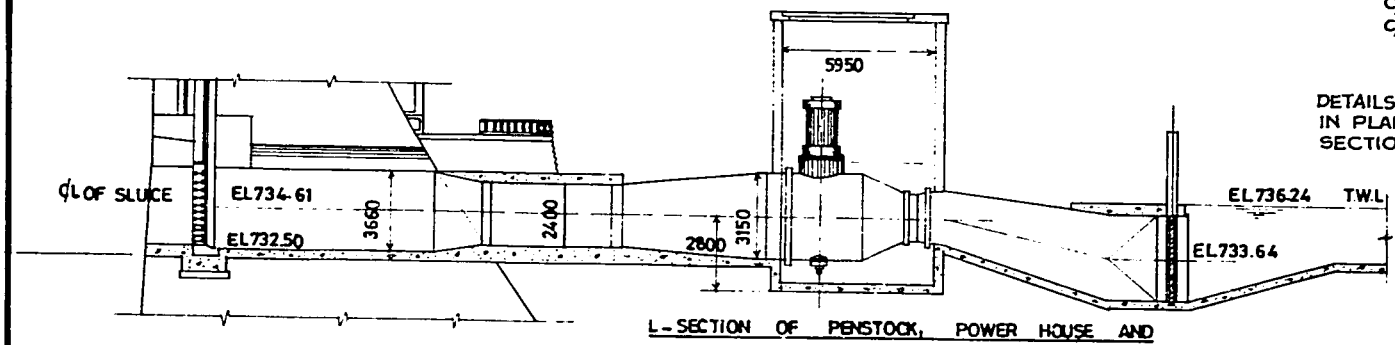
NOTES:

REFER SHEET 2 OF 2 FOR ESMAP ALT WITH POWER HOUSE AT SLUICE. THE SLUICES CAN HANDLE $3 \times 20 = 60 m^3/Sec$ OR A MAXIMUM OF $3 \times 30 m^3/Sec$. SURPLUS FLOWS, IF ANY, CAN BE HANDLED IN KPCL ALTERNATIVE WITH SYPHON TYPE INTAKE (SHOWN IN SATHANUR-T.N.E.B DRAWING) AND A LARGE CAPACITY SINGLE UNIT* PRESSURE SHAFT & UPSTREAM ELBOW TYPE POWER HOUSE.

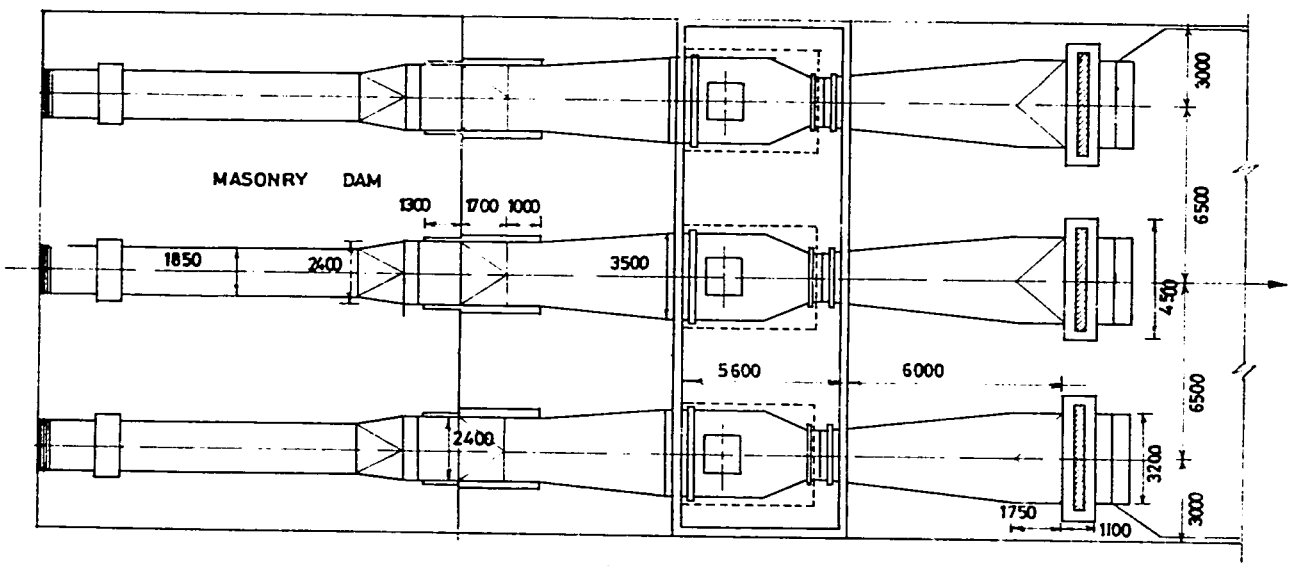
*OR TWO UNIT

MINI HYDRO POWER PROJECT
ESMAP STUDY
BRINDAVAN DAM & POWER HOUSE
KPCL PROPOSAL & ESMAP ALTERNATIVE
SHEET: 1 OF 2

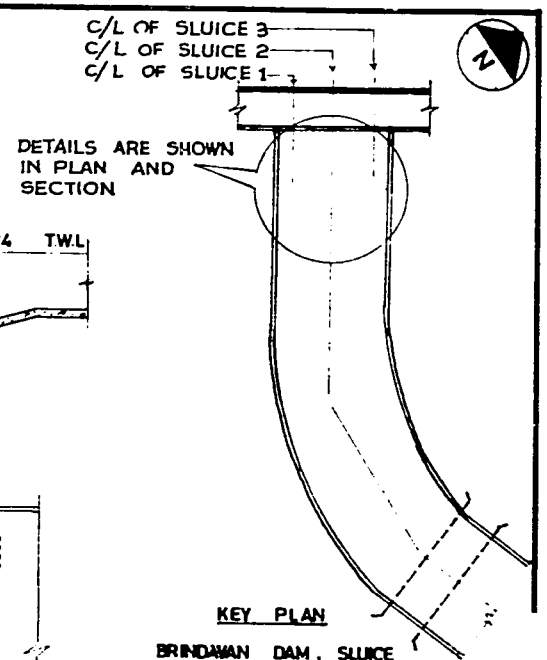
sads/w48595(21)



L-SECTION OF PENSTOCK, POWER HOUSE AND DRAFT TUBE



PLAN OF POWER HOUSE



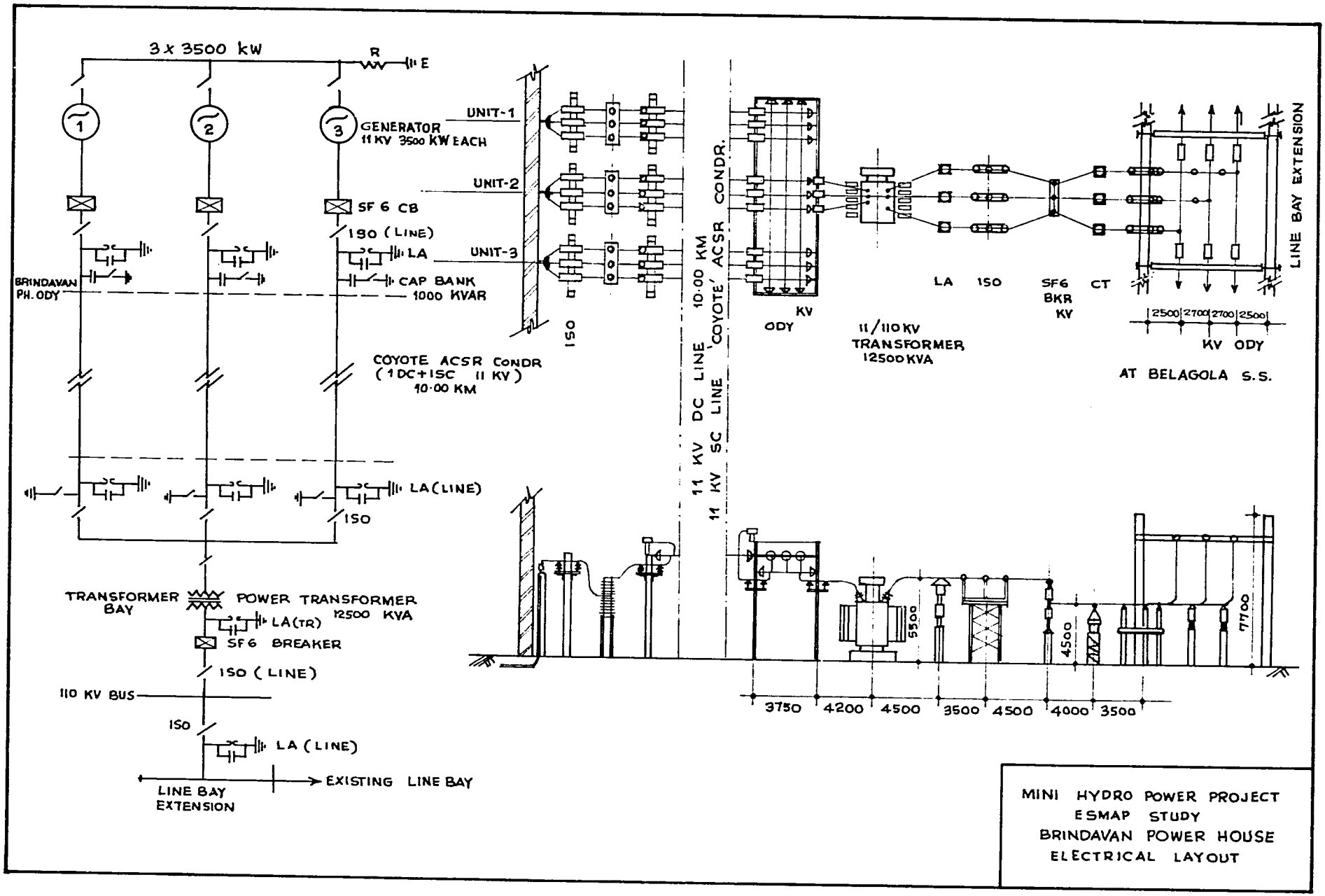
KEY PLAN

BRINDAVAN DAM, SLUICE AND POWER HOUSE

MINI HYDRO POWER PROJECT
ESMAP STUDY
BRINDAVAN DAM AND POWER HOUSE
ESMAP ALTERNATIVES

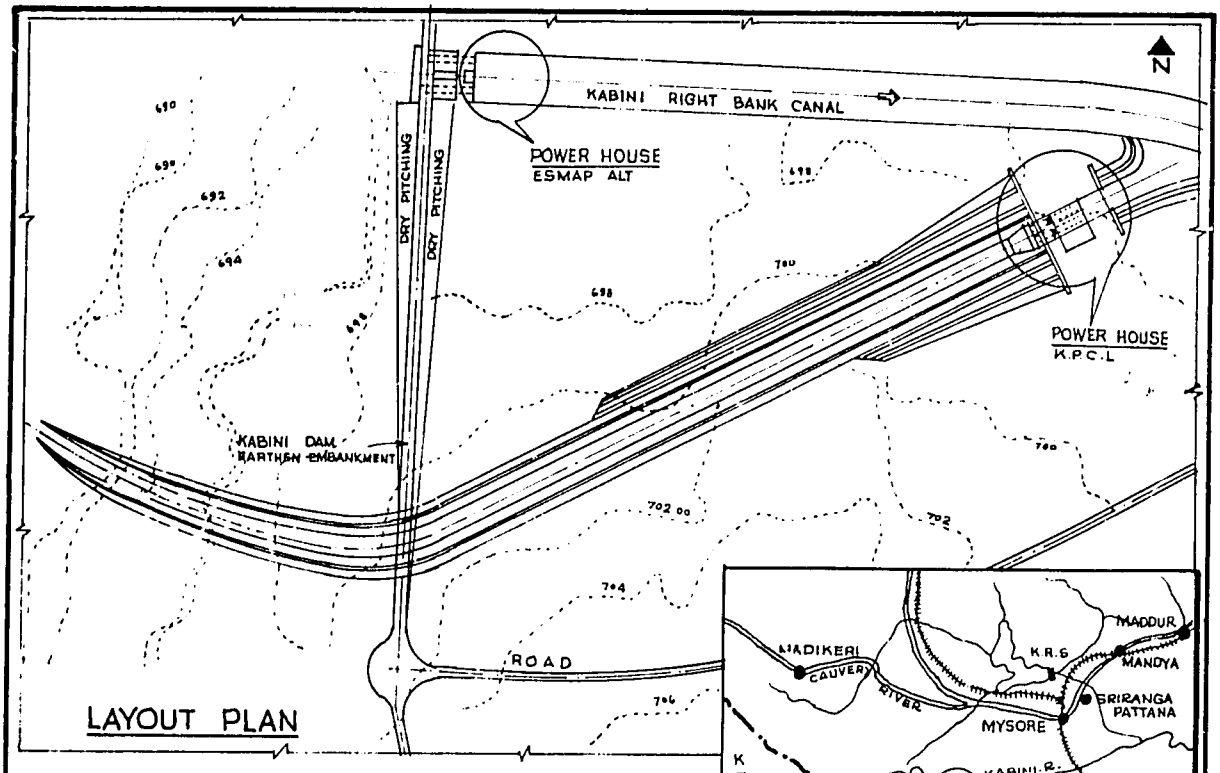
SHEET 2 OF 2

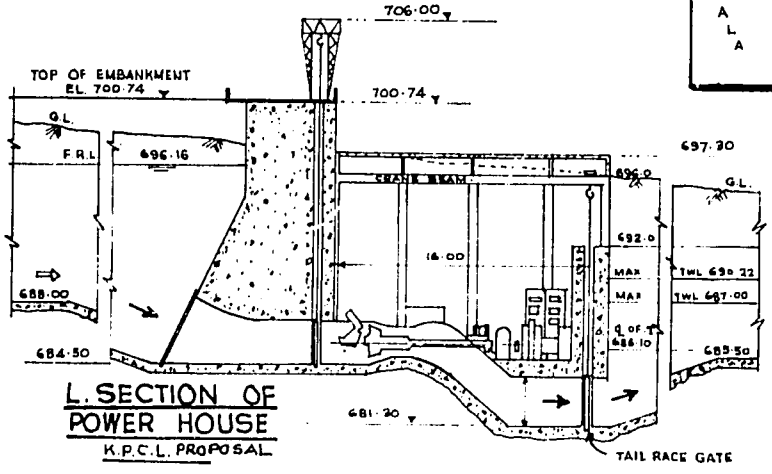
sads/w48595(22)



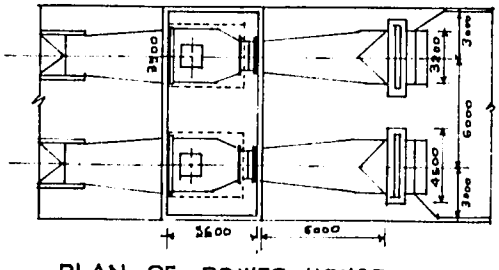
MINI HYDRO POWER PROJECT
ESMAP STUDY
BRINDAVAN POWER HOUSE
ELECTRICAL LAYOUT

sads/w48595(23)

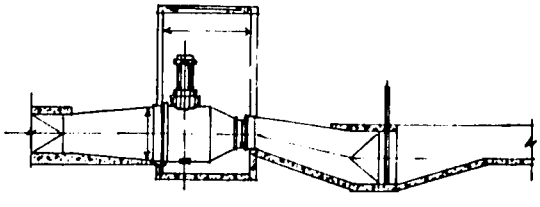




L. SECTION OF POWER HOUSE
K.P.C.L. PROPOSAL



PLAN OF POWER HOUSE ESMAP ALT

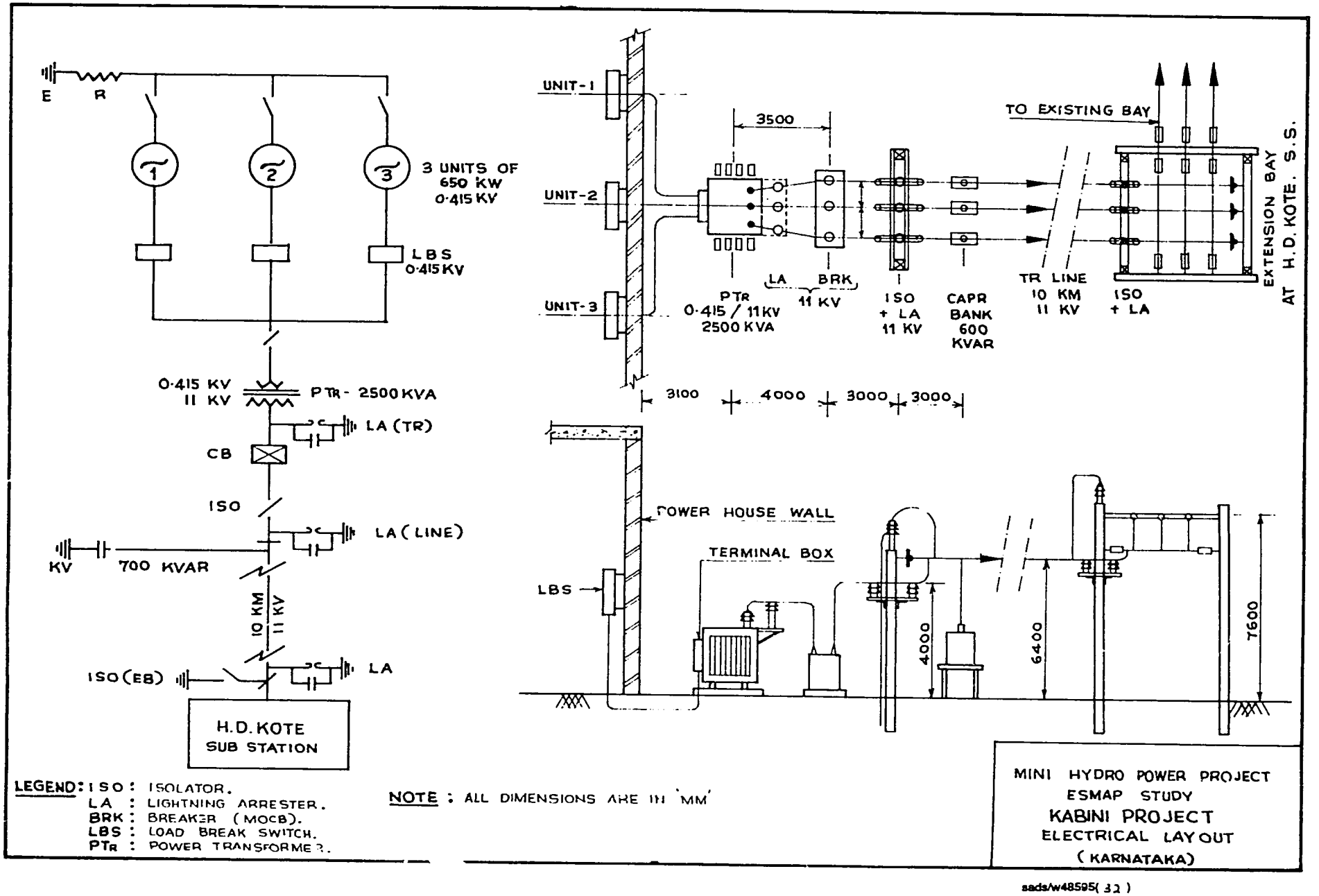


SECTION OF POWER HOUSE.

NOTES :

SYPHON TYPE INTAKE WITH PIT TYPE SUBMERSIBLE TURBINE OR CROSS FLOW AT SLUICES OF RIGHT BANK CANAL ARE OTHER ALTERNATIVES. CERTAIN SETTLEMENTS WERE SEEN IN THE EMBANKMENT. HENCE ALT OF USING EXISTING SLUICE OUTLET IN THE E.S.M.A.P. ALTERNATIVE.

MINI HYDRO POWER PROJECT
ESMAP STUDY
KABINI DAM AND
POWER HOUSE DETAILS
KPCL PROPOSAL & ESMAP ALTERNATIVES.
SHEET - 1

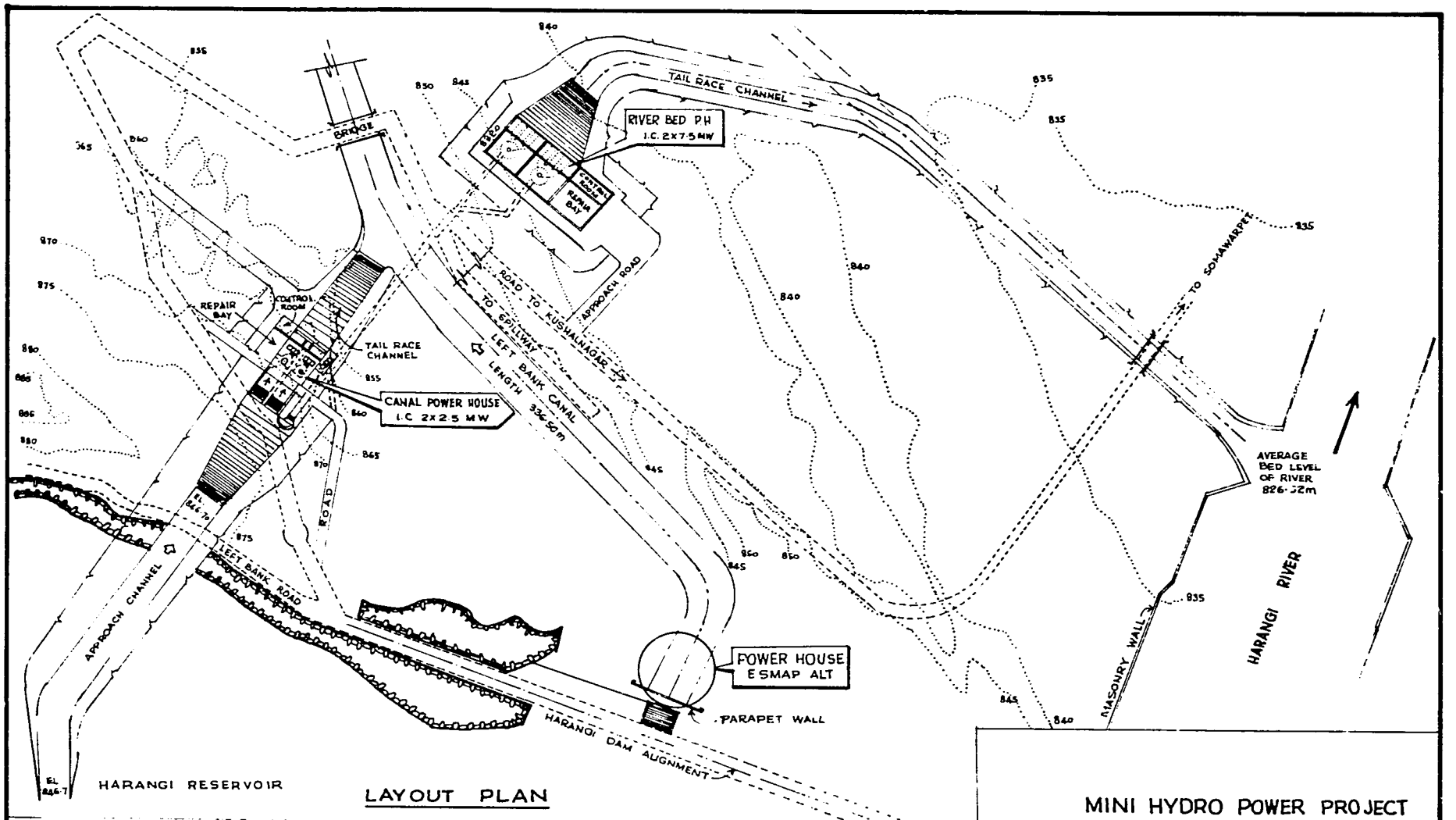


LEGEND: ISO : ISOLATOR.
LA : LIGHTNING ARRESTER.
BRK : BREAKER (MOCB).
LBS : LOAD BREAK SWITCH.
PTR : POWER TRANSFORMER.

NOTE : ALL DIMENSIONS ARE IN 'MM'

MINI HYDRO POWER PROJECT
ESMAP STUDY
KABINI PROJECT
ELECTRICAL LAYOUT
(KARNATAKA)

sads/w48595(32)

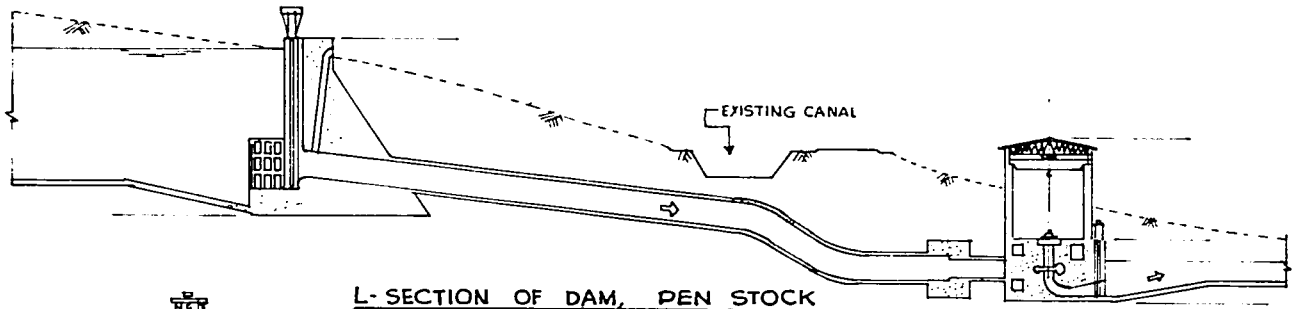


LAYOUT PLAN

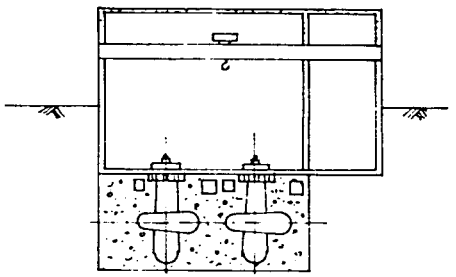
NOTES: IN VIEW OF HARD ROCK AT SURFACE NEAR DIVERSION, ROCK EXCAVATION MAY POSE PROBLEMS, RIVER BED UNIT WILL HAVE WATER FOR BARELY A MONTH IN A YEAR. HENCE RIVER BED UNIT MAY NOT BE ECONOMICAL. IF CONSIDERED NECESSARY. THIS MAY BE SHIFTED TO RIGHT BANK (SYPHON INTAKE).

MINI HYDRO POWER PROJECT
ESMAP STUDY
HARANGI DAM & POWER HOUSE
LAYOUT PLAN
KPCL PROPOSAL & ESMAP ALTERNATIVE
SHEET 1 OF 2

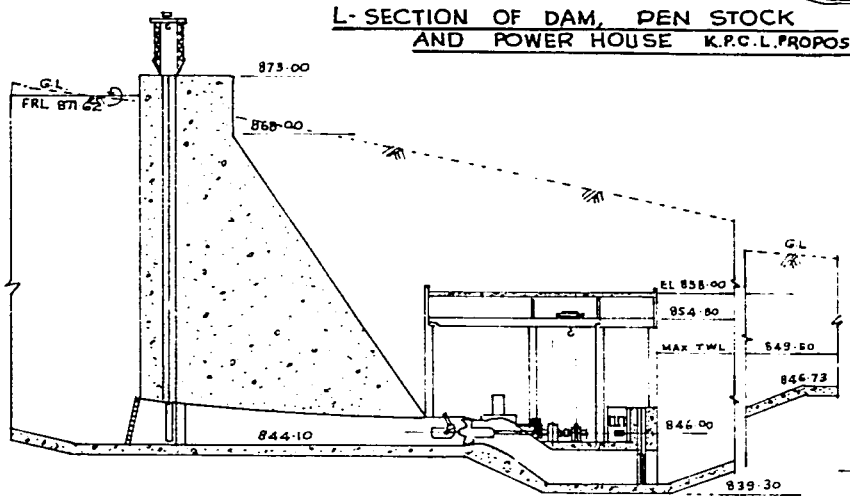
sads/w48595(27)



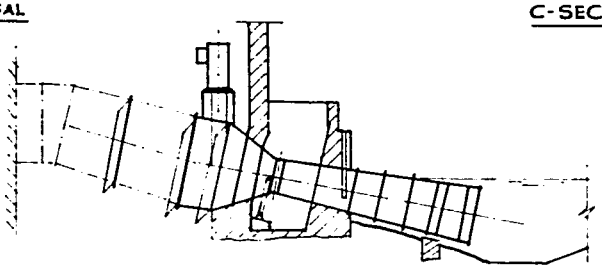
L- SECTION OF DAM, PEN STOCK AND POWER HOUSE K.P.C.L. PROPOSAL



C-SECTION OF POWER HOUSE.



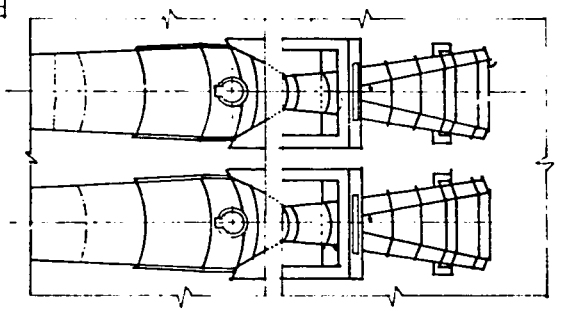
SECTION OF DAM & POWER HOUSE
K.P.C.L. PROPOSAL



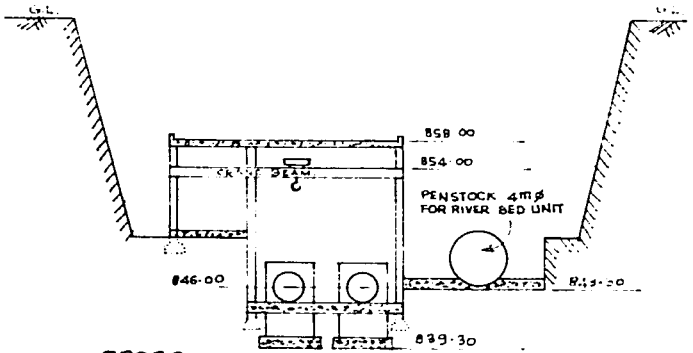
SECTION OF POWER HOUSE ESMAP ALT.

NOTES:

RIVER BED UNIT MAY NOT BE ECONOMICAL AS DURATION CURVE INDICATES FLOW AVAILABALITY FOR ONLY ONE MONTH IN A YEAR.
IF CONSIDERED NECESSARY THE POWER HOUSE WILL HAVE TO BE PROVIDED ON RIGHT BANK WITH SYPHON TYPE INTAKE AS PER DETAILS SIMILAR TO SHOWN FOR SATHANUR MINI HYDRO POWER PROJECT.



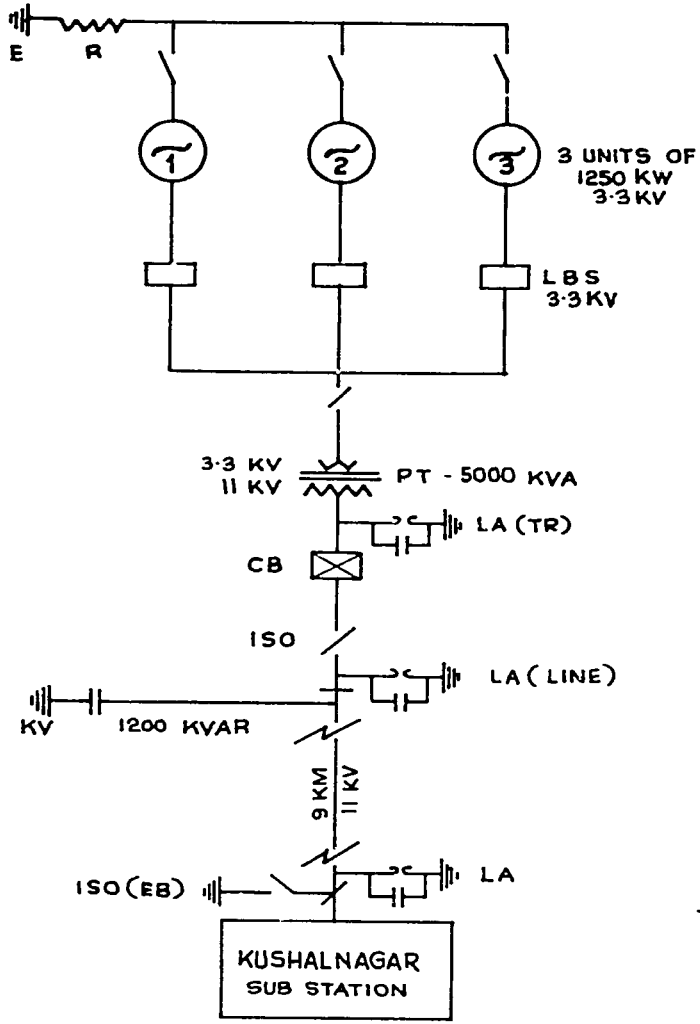
PLAN OF POWER HOUSE ESMAP ALT

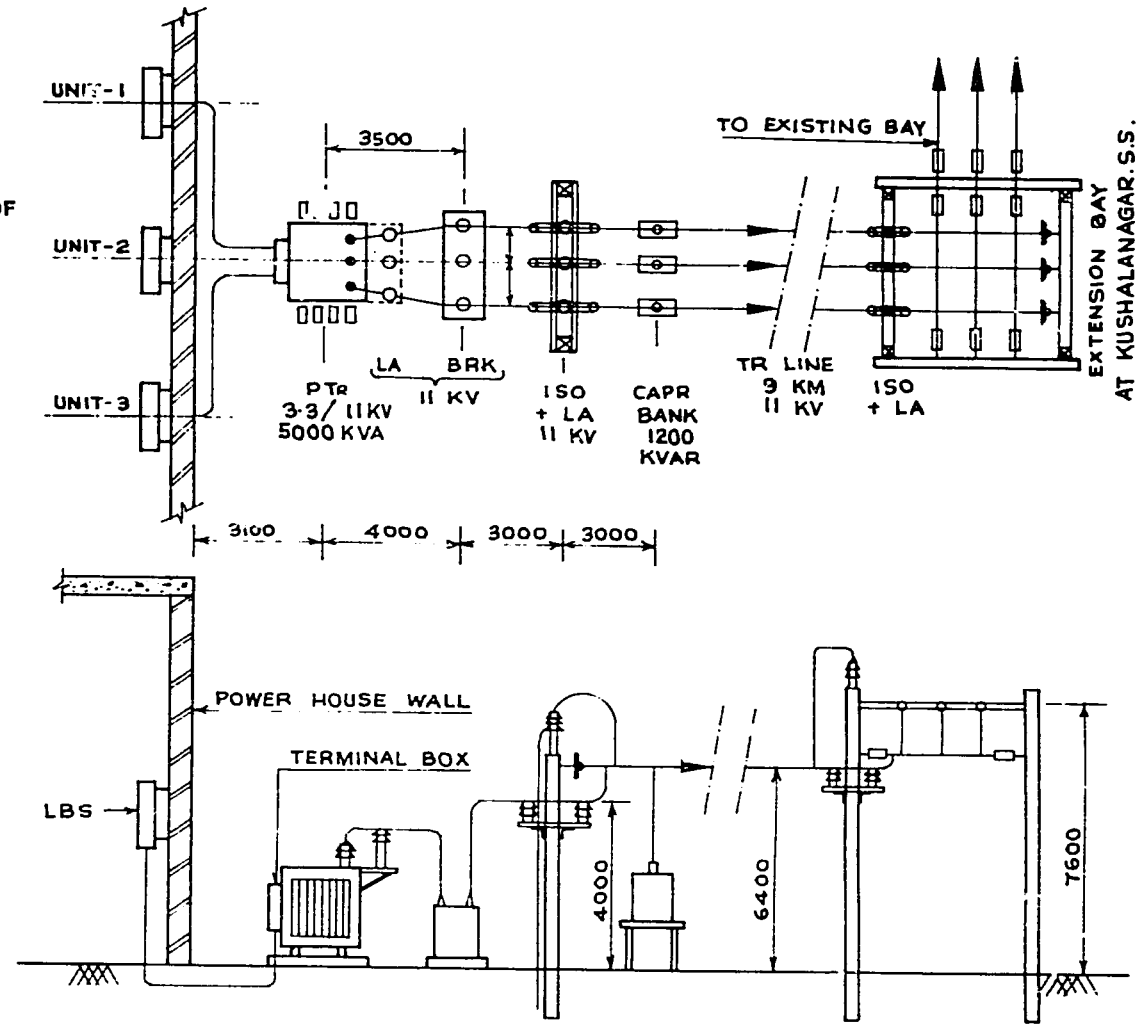


CROSS SECTION OF P. H - KPCL PROPOSAL

MINI HYDRO POWER PROJECT
ESMAP STUDY
HARANGI DAM & POWER HOUSE
KPCL PROPOSAL & ESMAP ALTERNATIVE
SHEET 2 OF 2

sads/w48595(28)



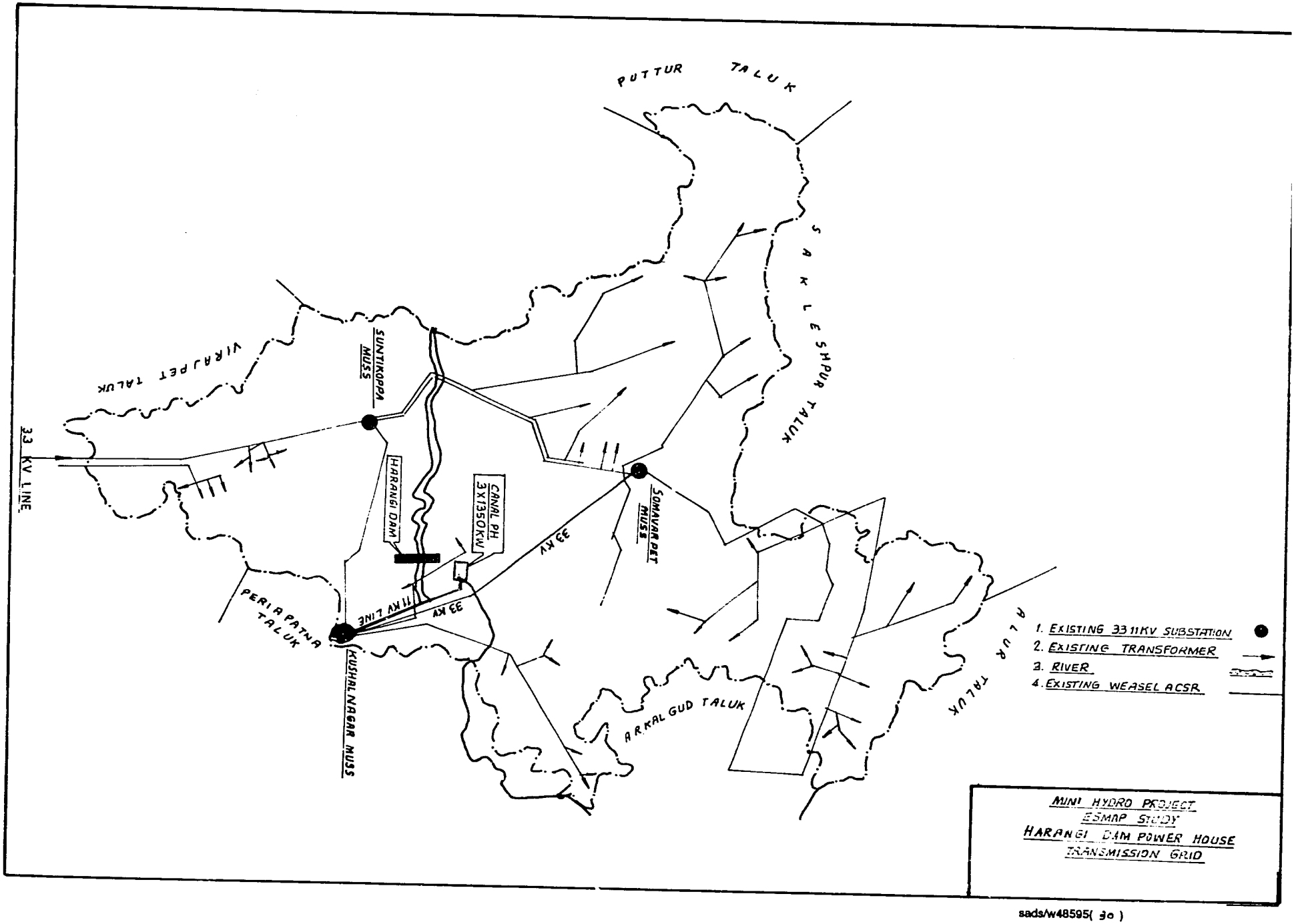


LEGEND: ISO : ISOLATOR.
LA : LIGHTNING ARRESTER.
BRK : BREAKER (MOCB).
BS : LOAD BREAK SWITCH.
PTR : POWER TRANSFORMER.

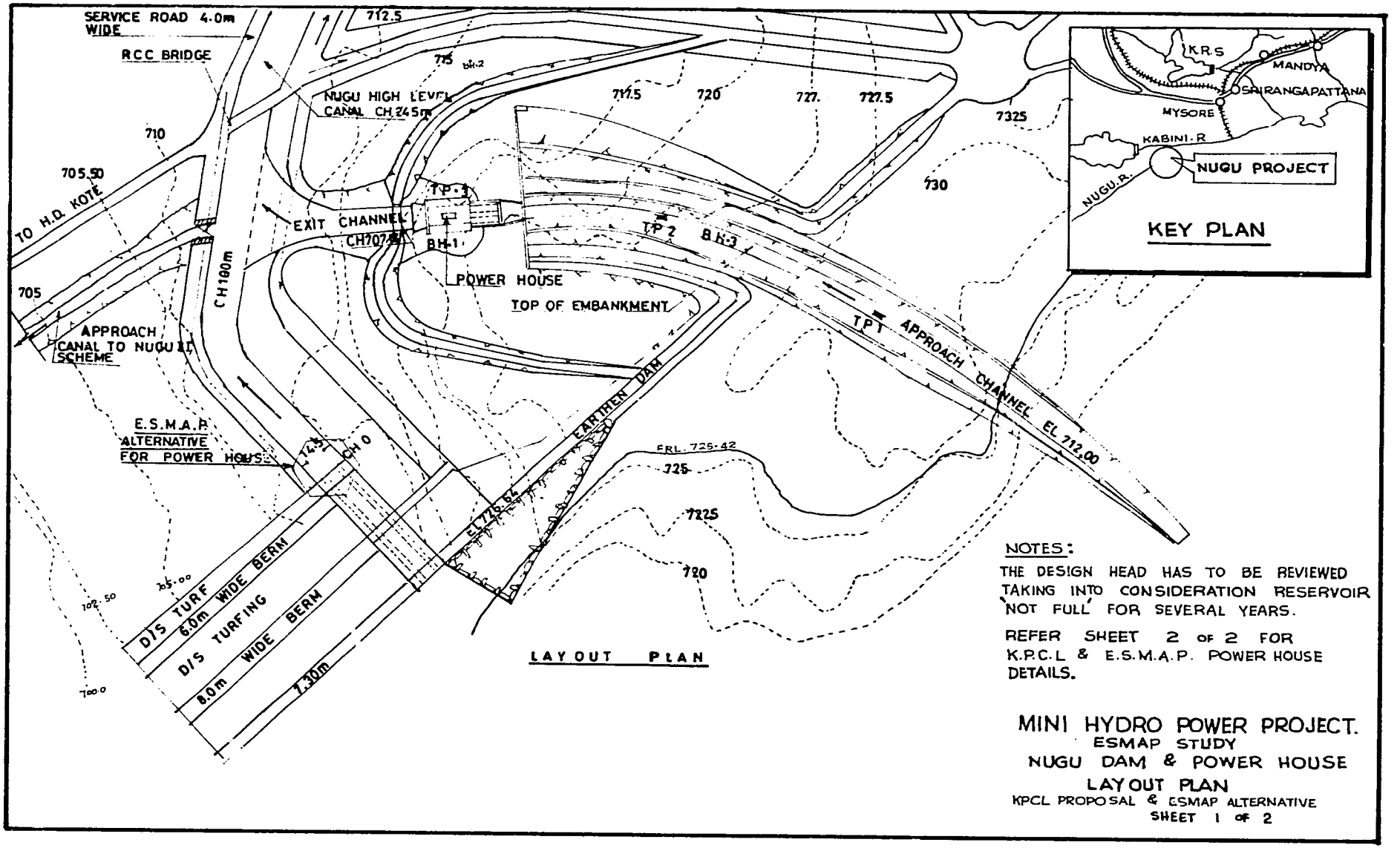
NOTE : ALL DIMENSIONS ARE IN 'MM'

MINI HYDRO POWER PROJECT
ESMAP STUDY
HARANGI PROJECT
ELECTRICAL LAYOUT
(KARNATAKA)

sads/w48595(29)



sads/w48595(30)



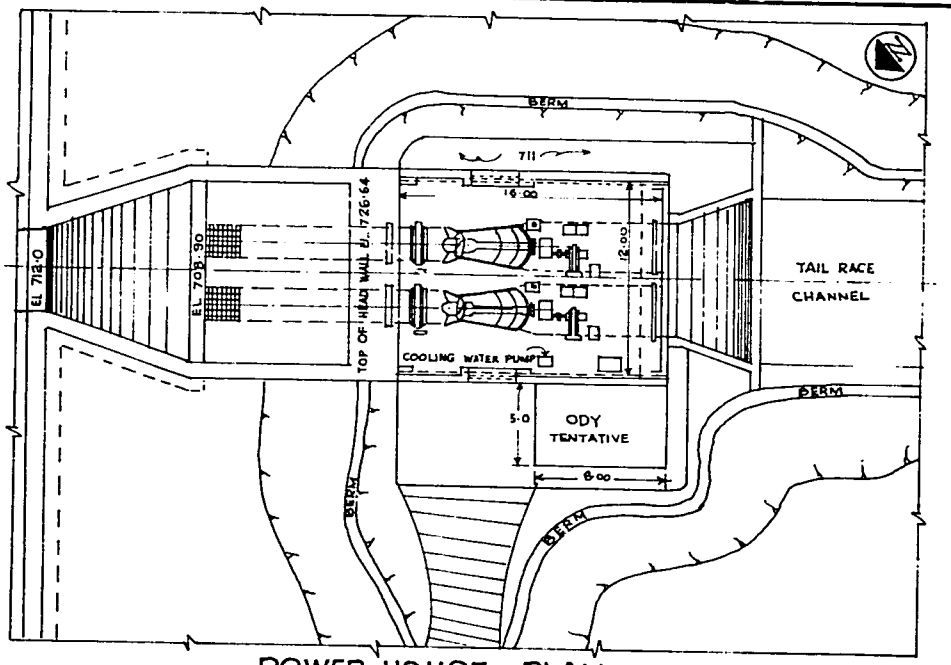
NOTES:

THE DESIGN HEAD HAS TO BE REVIEWED TAKING INTO CONSIDERATION RESERVOIR 'NOT FULL' FOR SEVERAL YEARS.

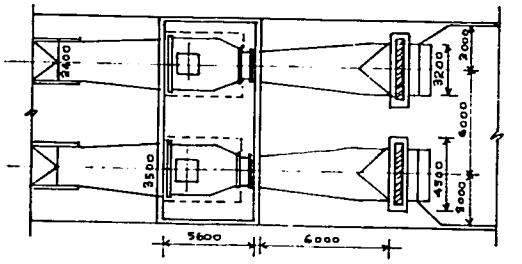
REFER SHEET 2 OF 2 FOR K.P.C.L & E.S.M.A.P. POWER HOUSE DETAILS.

MINI HYDRO POWER PROJECT.
ESMAP STUDY
NUGU DAM & POWER HOUSE
LAY OUT PLAN
KPCL PROPOSAL & ESMAP ALTERNATIVE
SHEET 1 OF 2

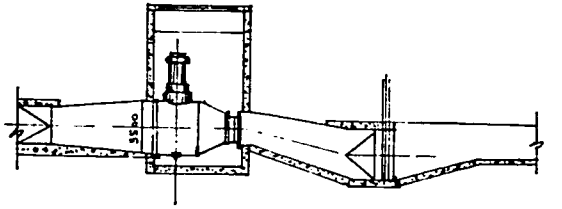
sads/w48595(24)



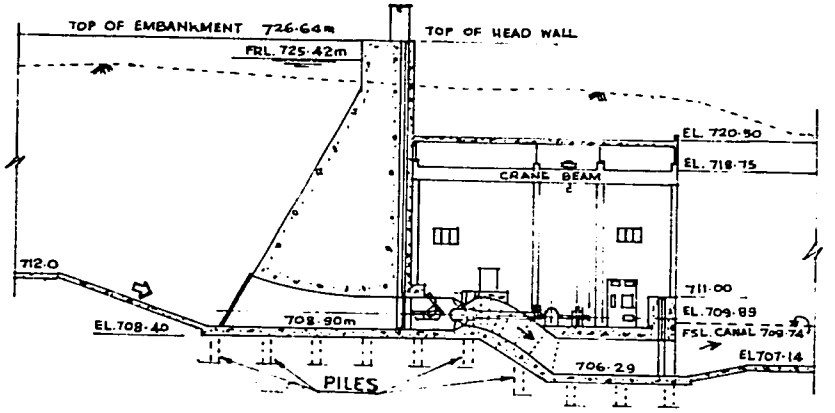
POWER HOUSE PLAN K.P.C.L. PROPOSAL



POWER HOUSE PLAN E.S.M.A.P. ALT.



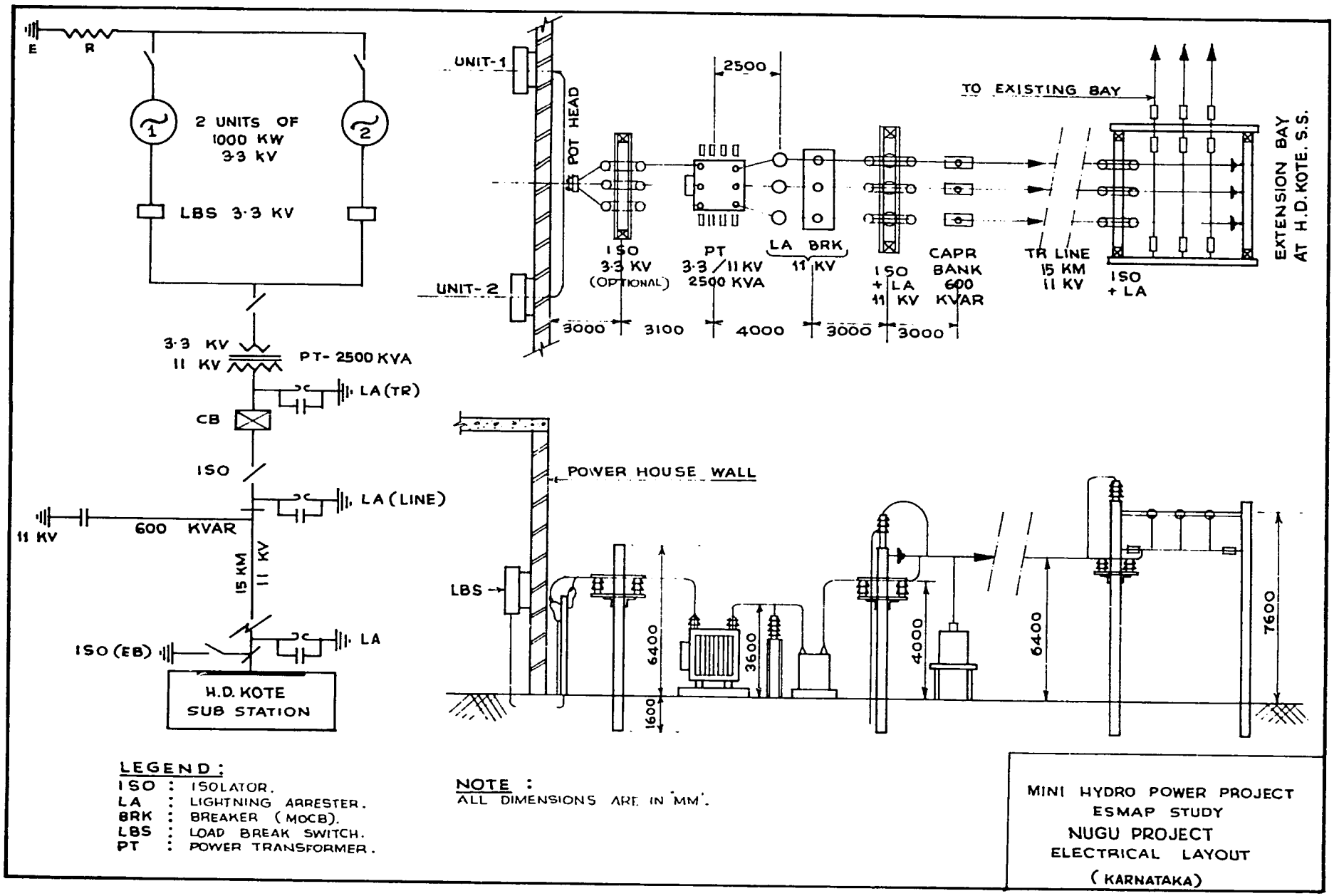
POWER HOUSE SECTION - ESMAP ALT



SECTION K.P.C.L. PROPOSAL

MINI HYDRO POWER PROJECT
ESMAP STUDY
NUGU
POWER HOUSE PLAN & SECTIONS
KPCL PROPOSAL & ESMAP ALTERNATIVE
SHEET 2 OF 2

sads/w48595(25)



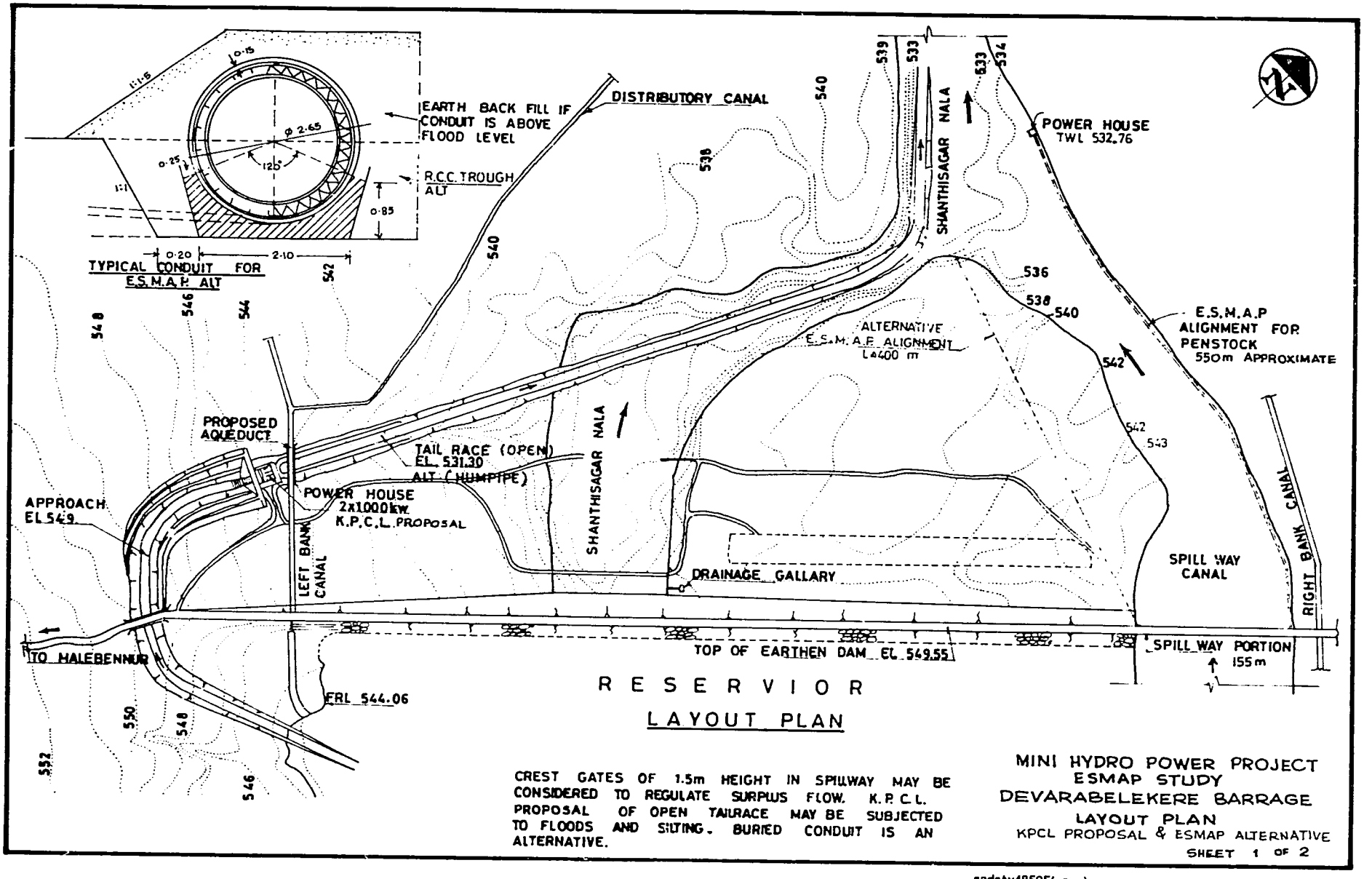
LEGEND:

ISO : ISOLATOR.
LA : LIGHTNING ARRESTER.
BRK : BREAKER (MOCB).
LBS : LOAD BREAK SWITCH.
PT : POWER TRANSFORMER.

NOTE :
ALL DIMENSIONS ARE IN 'MM'.

MINI HYDRO POWER PROJECT
ESMAP STUDY
NUGU PROJECT
ELECTRICAL LAYOUT
(KARNATAKA)

sads/w48595(26)



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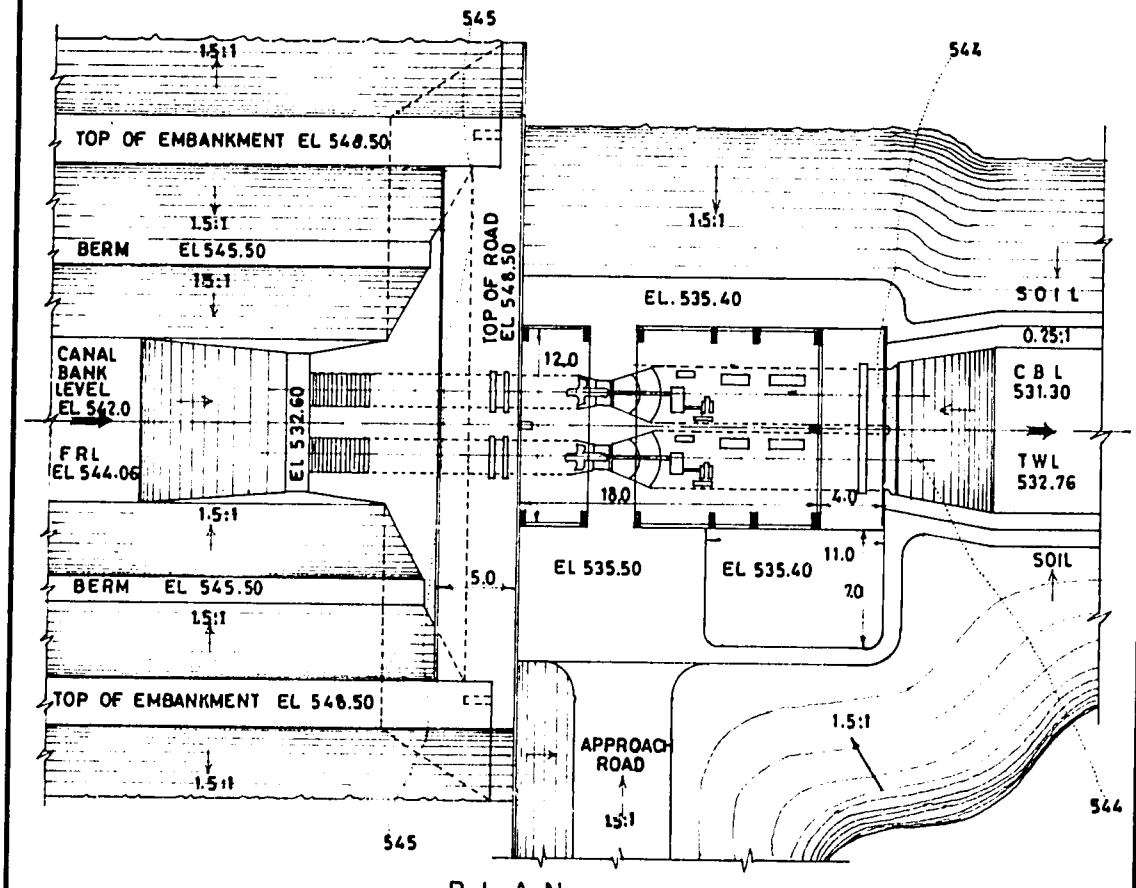
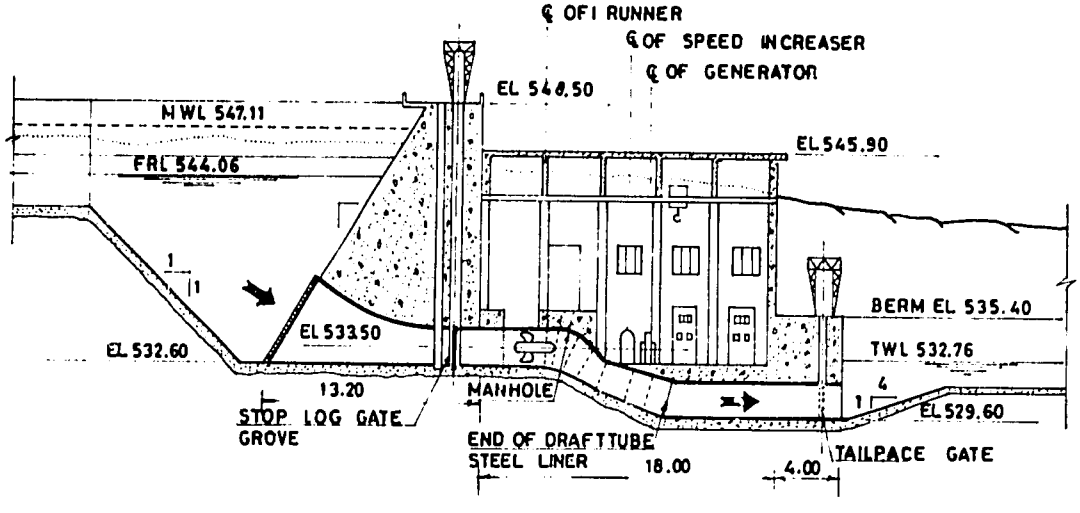


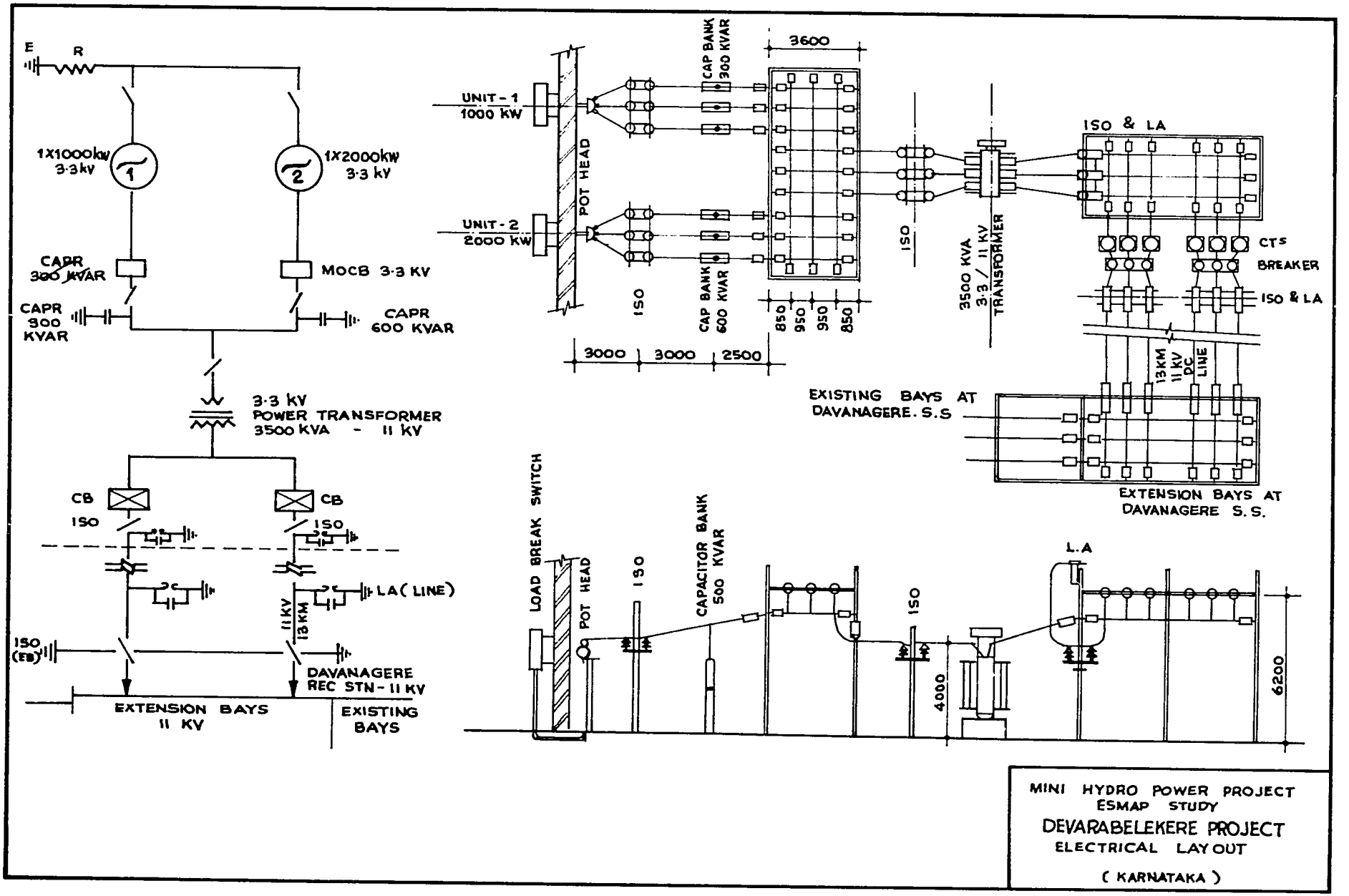
PLAN



SECTION THROUGH UNIT

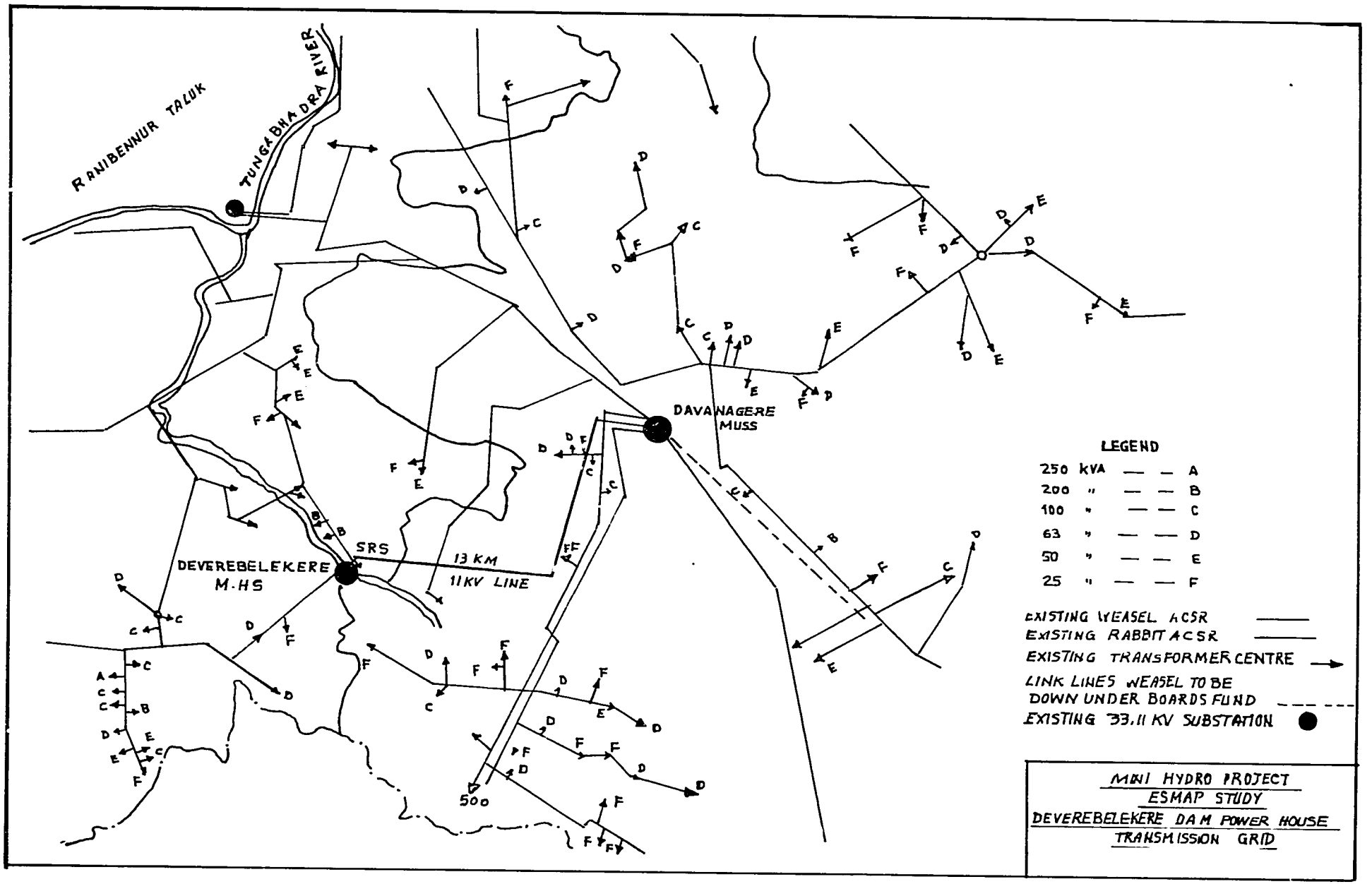
MINI HYDRO POWER PROJECT
ESMAP STUDY
DEVARABELEKERE
POWER HOUSE PLAN & SECTIONS
KPCL PROPOSAL

SHEET 2 OF 2

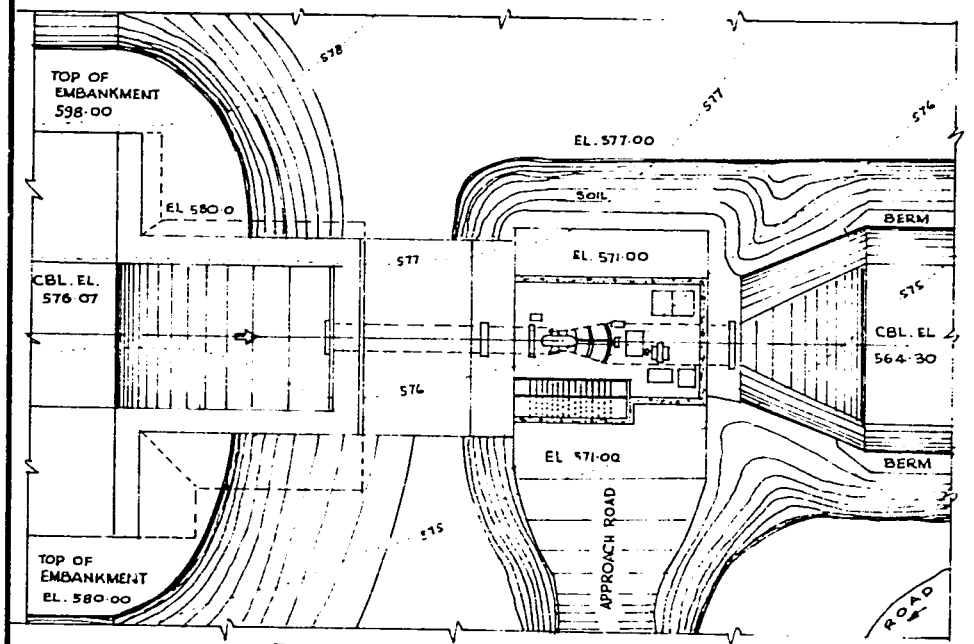


MINI HYDRO POWER PROJECT
ESMAP STUDY
DEVARABELEKERE PROJECT
ELECTRICAL LAYOUT
(KARNATAKA)

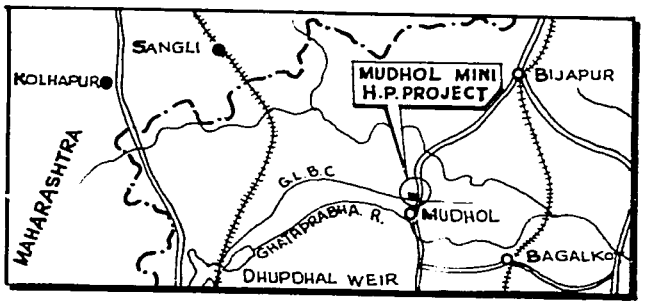
sads/w48595(39)



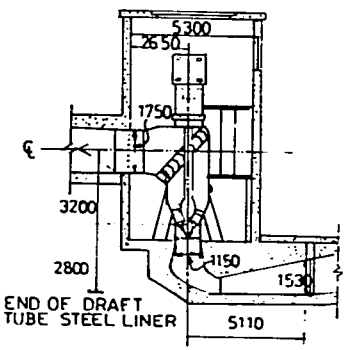
sada/w48595(40)



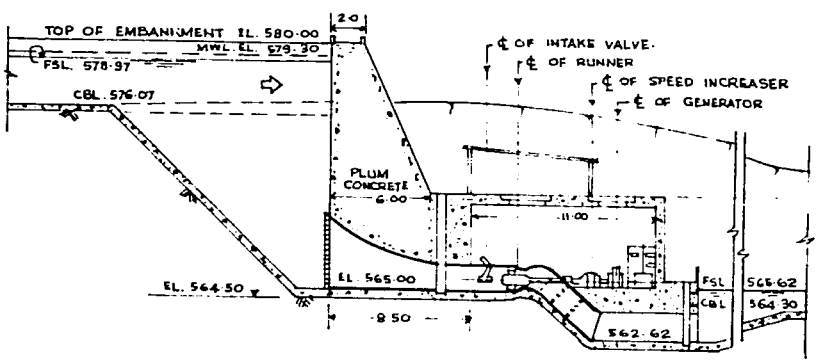
PLAN OF POWER HOUSE K.P.C.L PROPOSAL



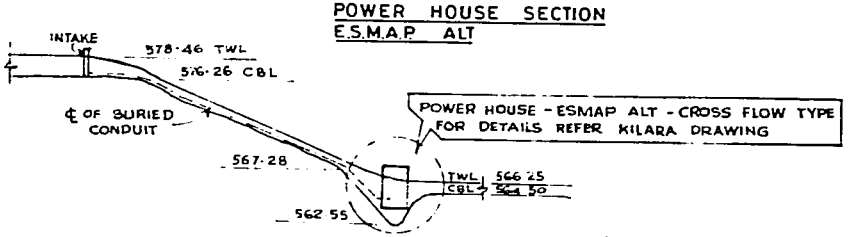
KEY PLAN



POWER HOUSE SECTION
E.S.M.A.P. ALT



SECTION OF POWER HOUSE
K.P.C.L. PROPOSAL



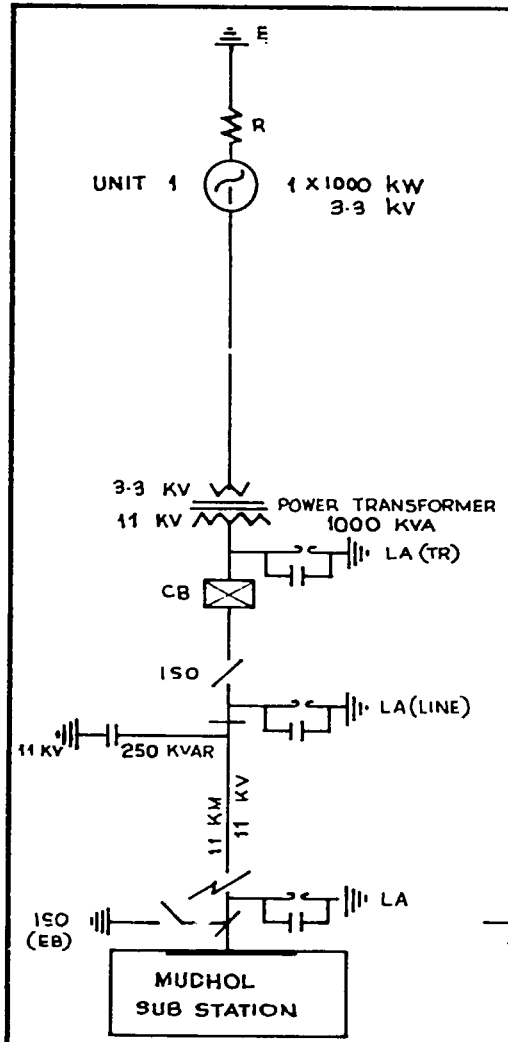
L-SECTION OF CANAL CHUTE
FROM CH: 100·61 TO 101·04

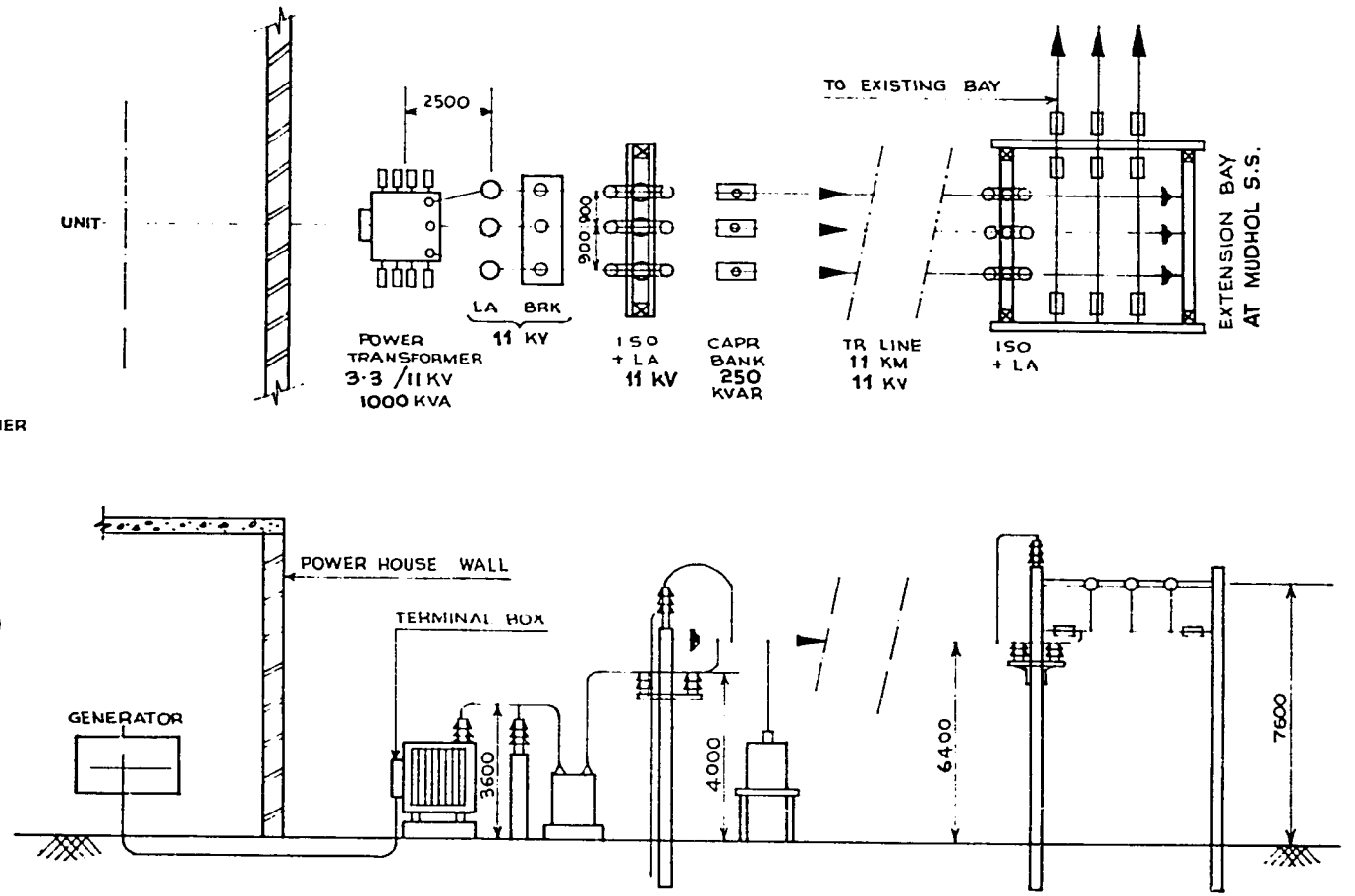
NOTES: THIS DRAWING SHOWS KPC PROPOSAL AND ESMAP ALT UTILIZING EXISTING LINED CHUTE WHEREIN BURIED CONDUITS WITH VERTICAL SHAFT PIT TYPE OR CROSS FLOW TURBINE WITH BYEPASS MAY BE PROVIDED.

MINI HYDRO POWER PROJECT
ESMAP STUDY
MUDHOL POWER HOUSE
PLAN & SECTIONS OF POWER HOUSE
KPCL PROPOSAL & ESMAP ALTERNATIVE.

SHEET-1

sads/w48595(43)





LEGEND :

ISO : ISOLATOR

LA : LIGHTNING ARRESTER

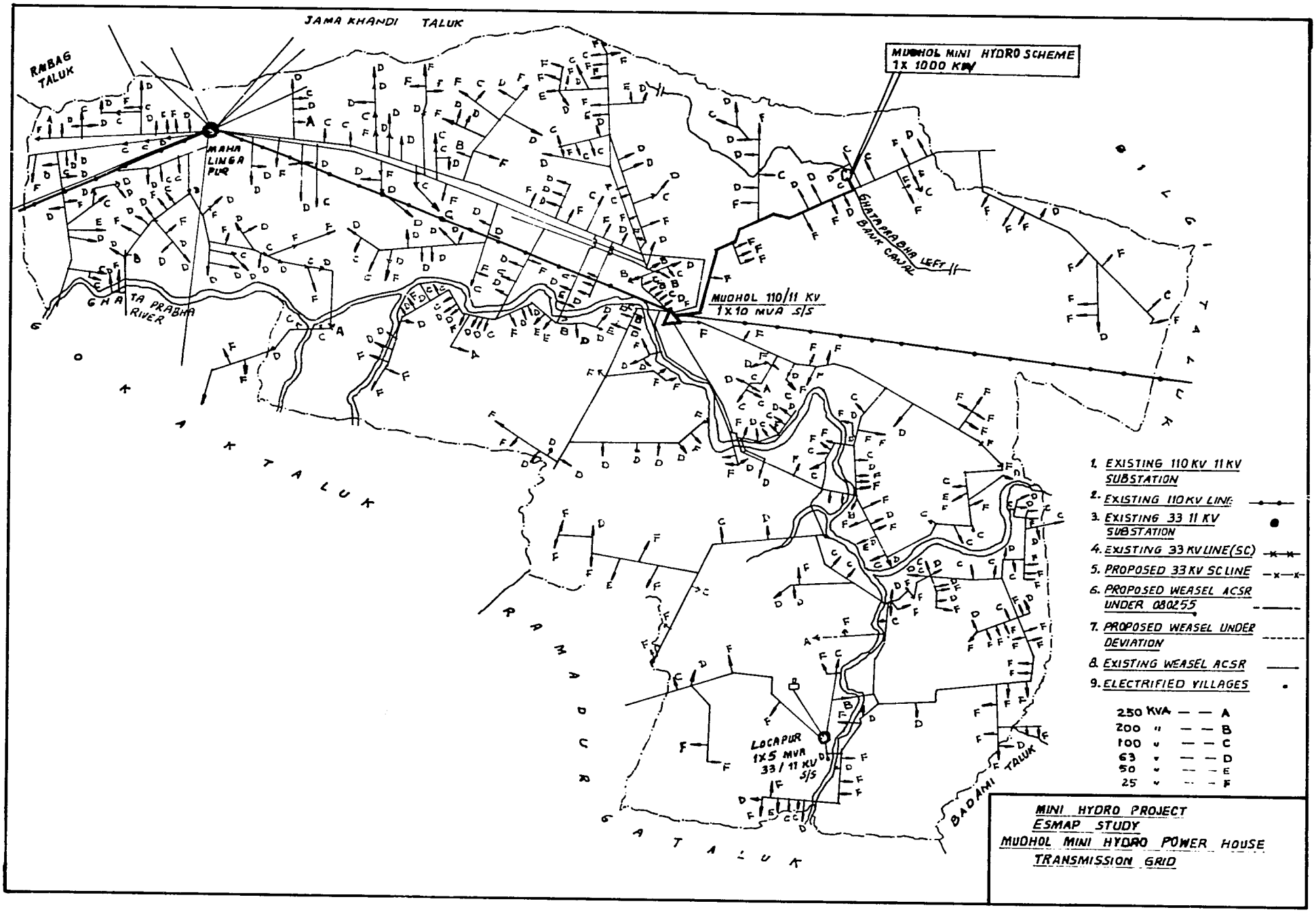
BRK : BREAKER (MOCB)

NOTE :

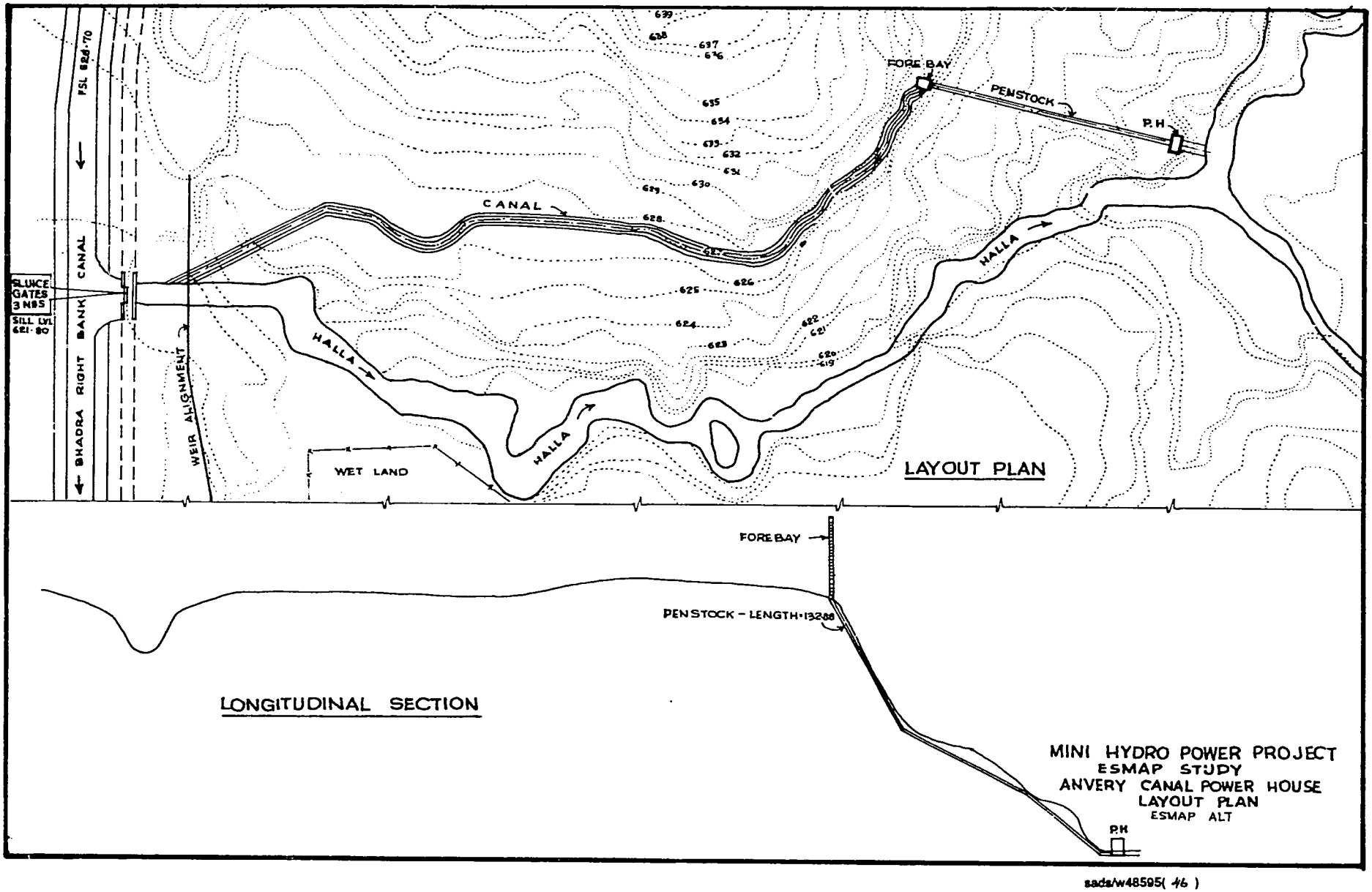
ALL DIMENSIONS ARE IN 'mm'.

MINI HYDRO POWER PROJECT
ESMAP STUDY
MUDHOL PROJECT
ELECTRICAL LAYOUT
(KARNATAKA)

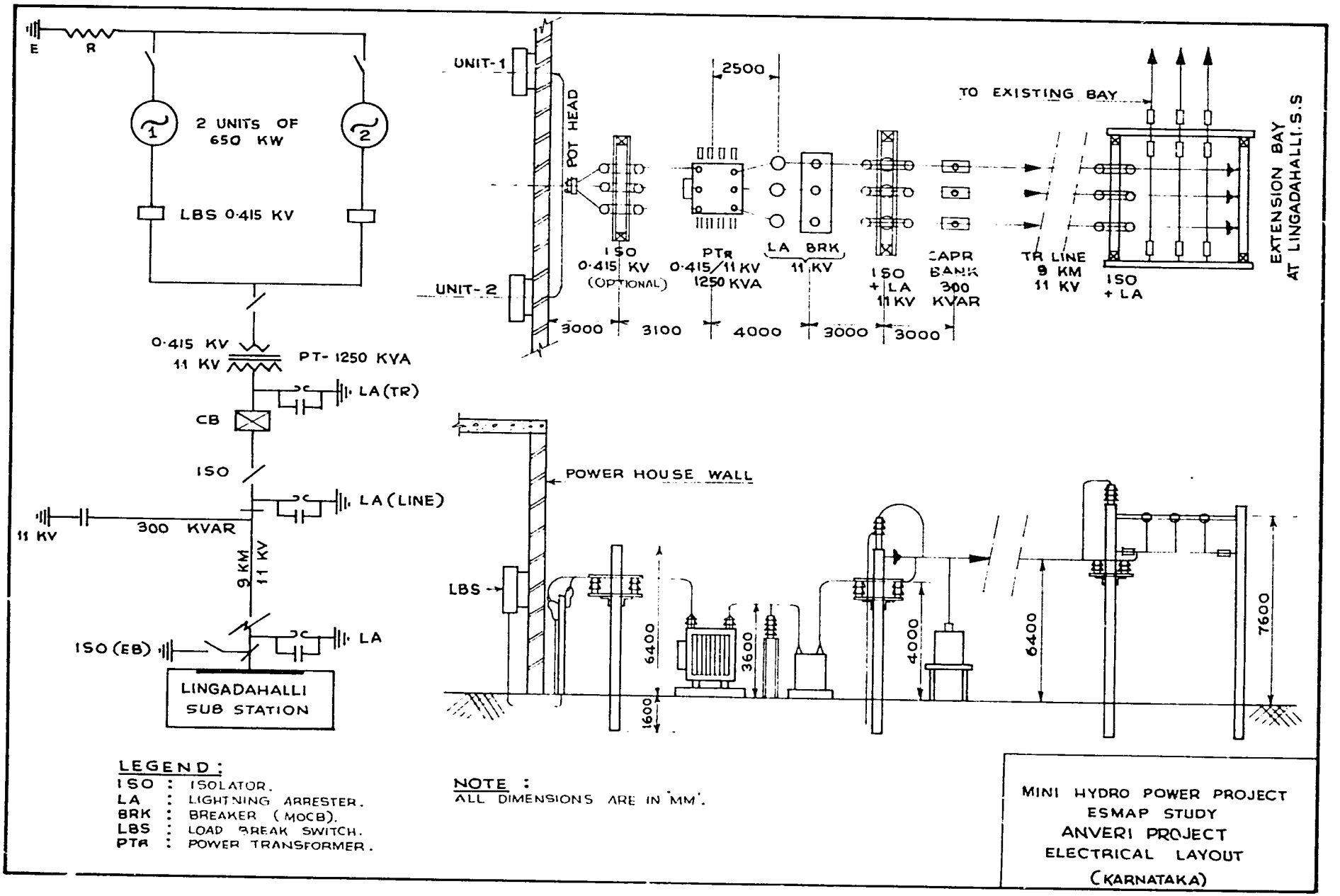
sads/w48595(44)



sads/w48595(45)



sads/w48595(46)



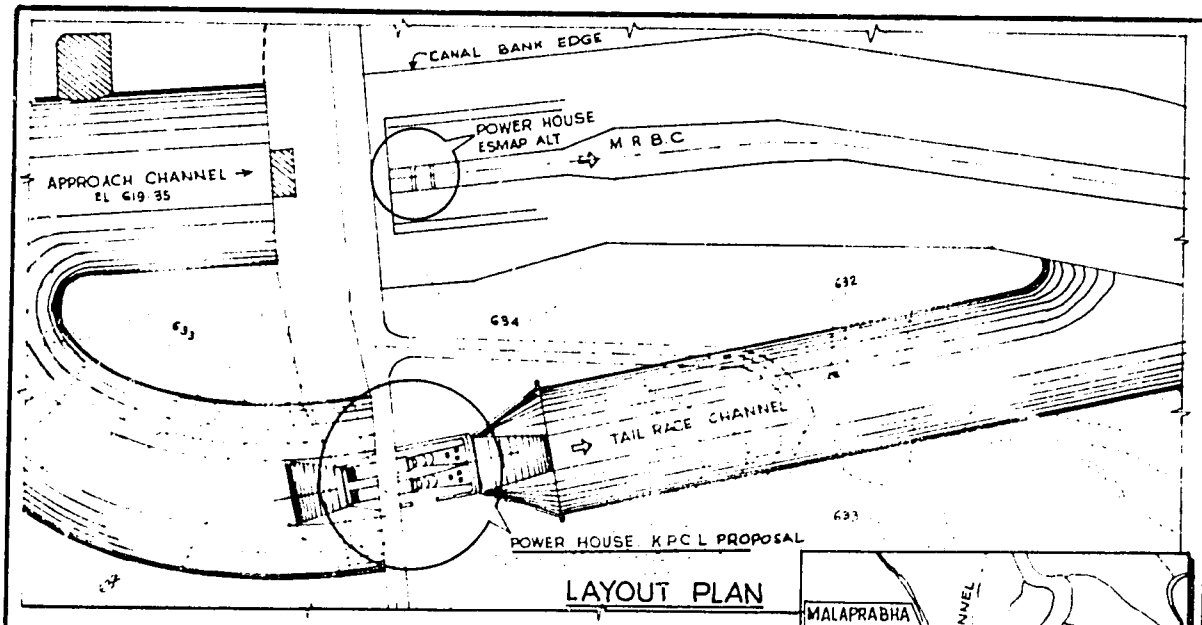
LEGEND :

ISO : ISOLATOR.
LA : LIGHTNING ARRESTER.
BRK : BREAKER (MOCB).
LBS : LOAD BREAK SWITCH.
PTR : POWER TRANSFORMER.

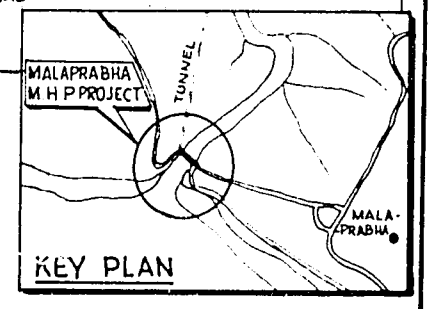
NOTE :
ALL DIMENSIONS ARE IN 'MM'.

MINI HYDRO POWER PROJECT
ESMAP STUDY
ANVERI PROJECT
ELECTRICAL LAYOUT
(KARNATAKA)

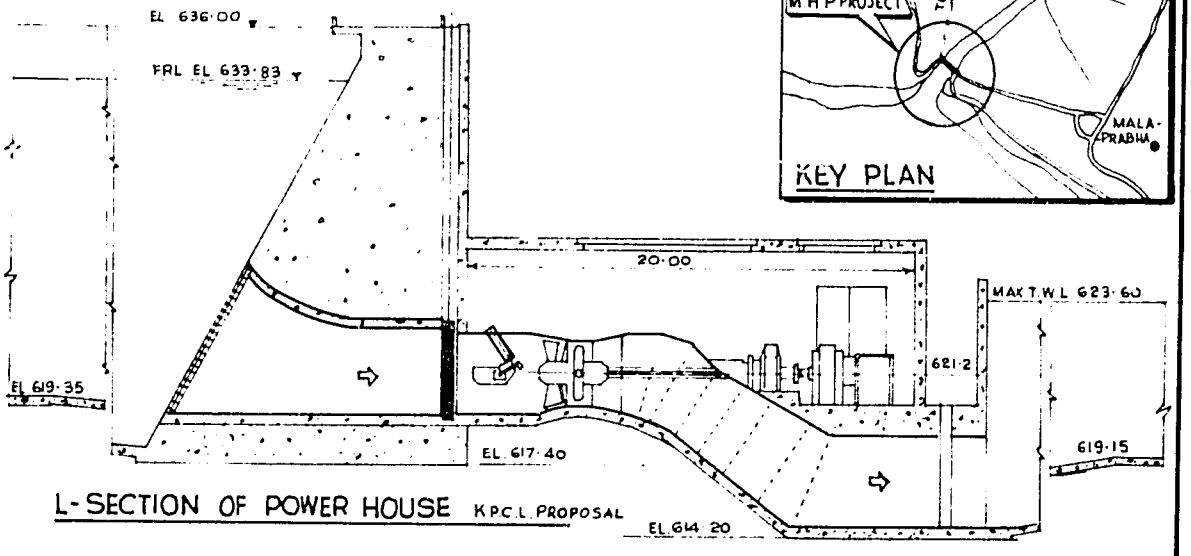
sads/w48595(47)



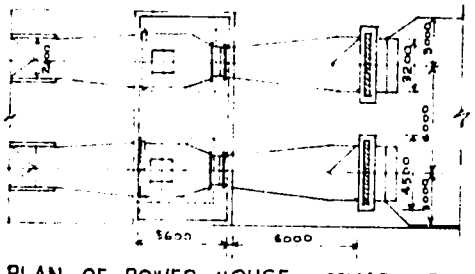
LAYOUT PLAN



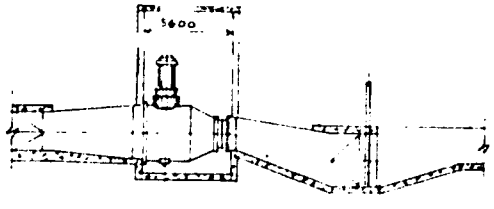
KEY PLAN



L-SECTION OF POWER HOUSE K.P.C.L PROPOSAL



PLAN OF POWER HOUSE - ESMAP ALT



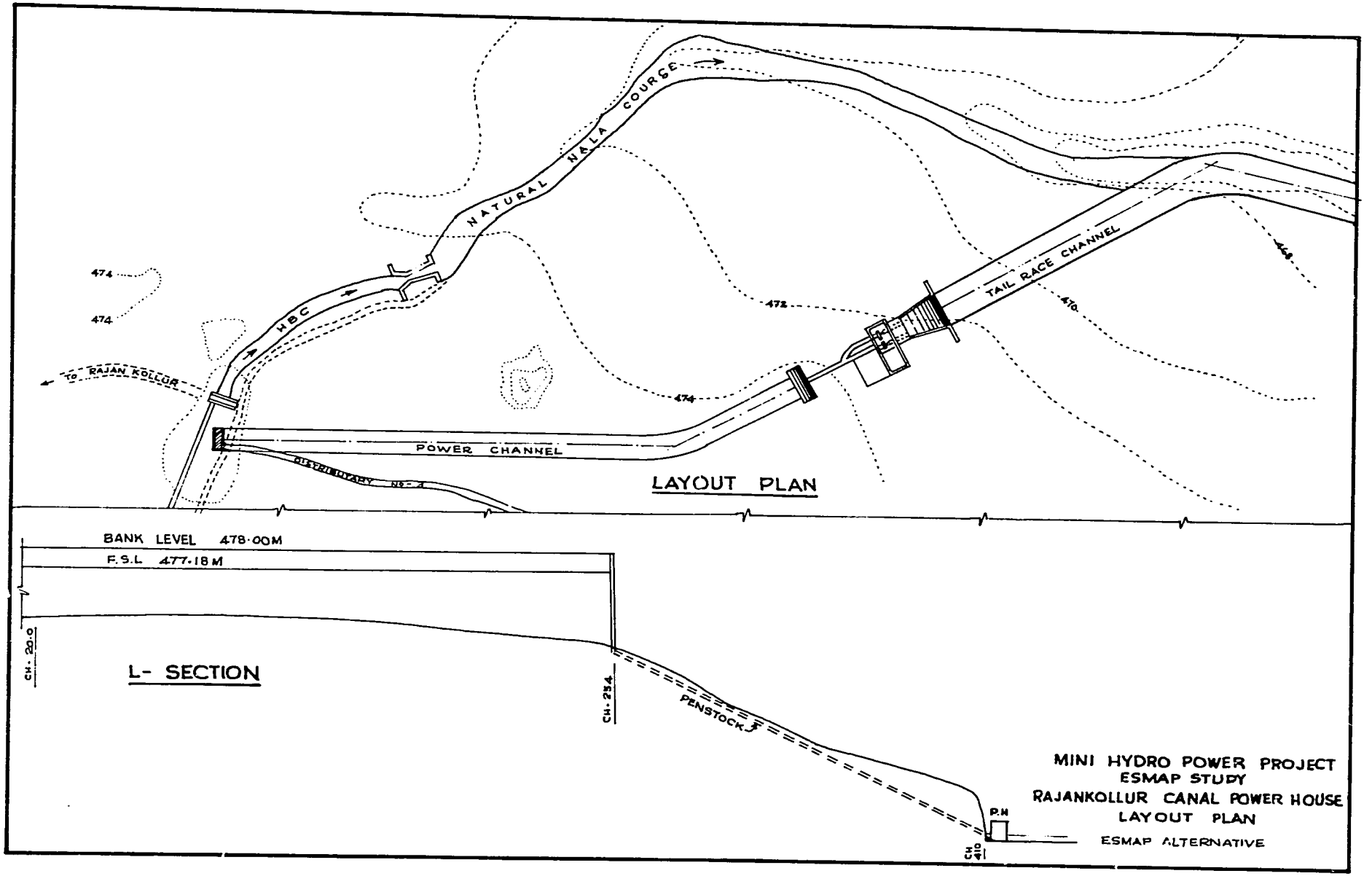
SECTION OF POWER HOUSE

NOTES :

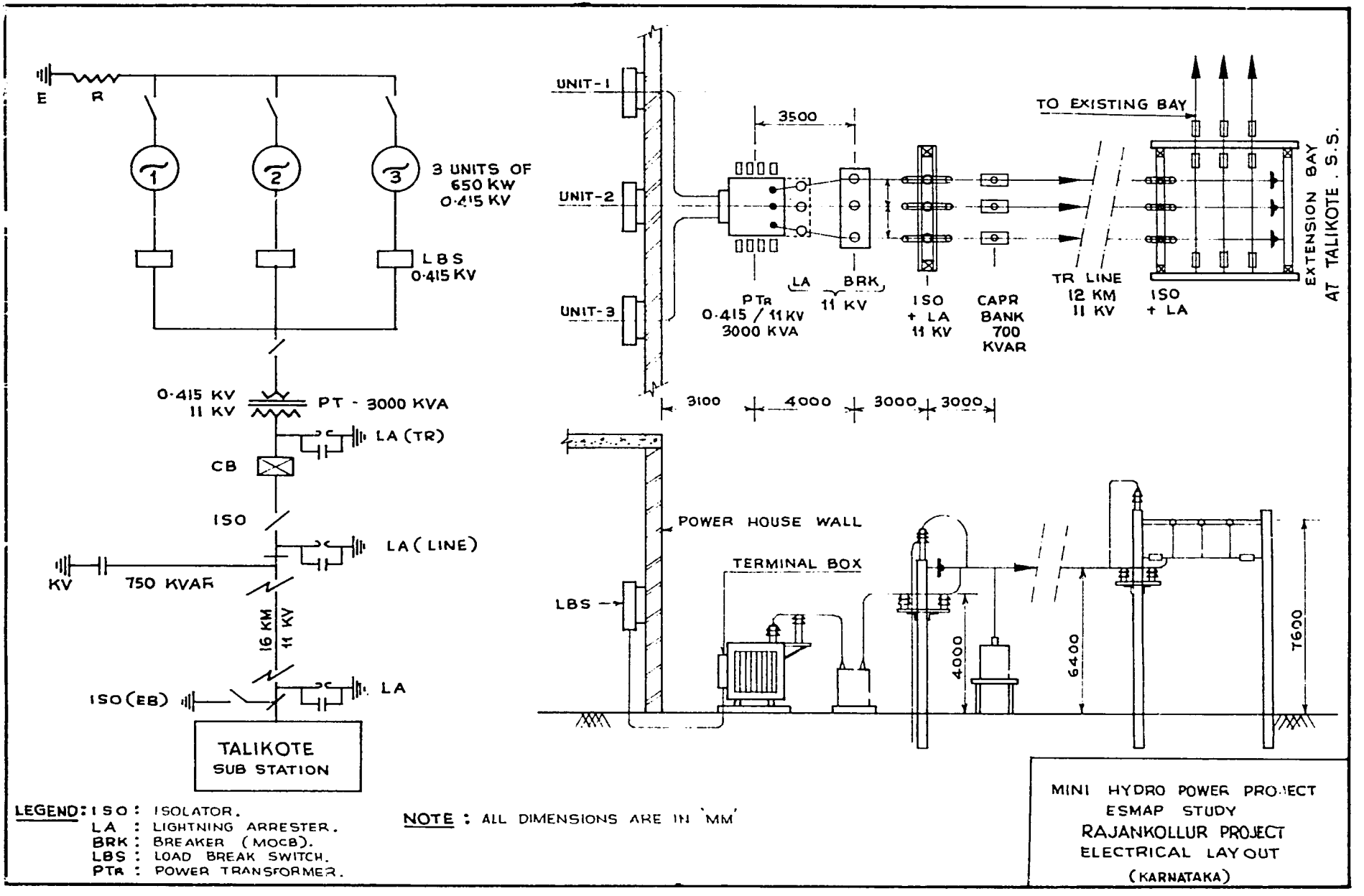
ESMAP ALTERNATIVE IS DUE TO HARD ROCK AND DEEP EXCAVATION REQUIRED FOR DIVERSION CHANNEL OF K.P.C.L PROPOSAL

MINI HYDRO POWER PROJECT
ESMAP STUDY
MALAPRABHA DAM AND
POWER HOUSE DETAILS
KPCL PROPOSAL & ESMAP ALTERNATIVE
SHEET-1

sads/w48595(48)



sads/w48595(41)

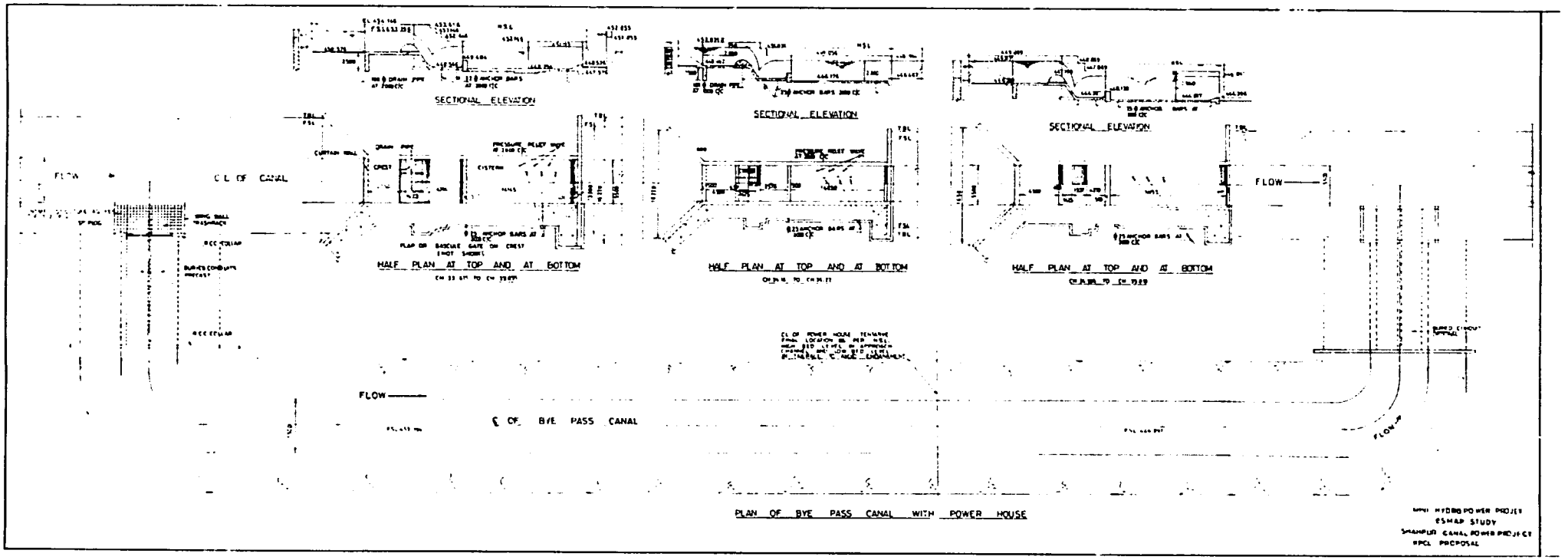


LEGEND: ISO : ISOLATOR.
LA : LIGHTNING ARRESTER.
BRK : BREAKER (MOCB).
LBS : LOAD BREAK SWITCH.
PTR : POWER TRANSFORMER.

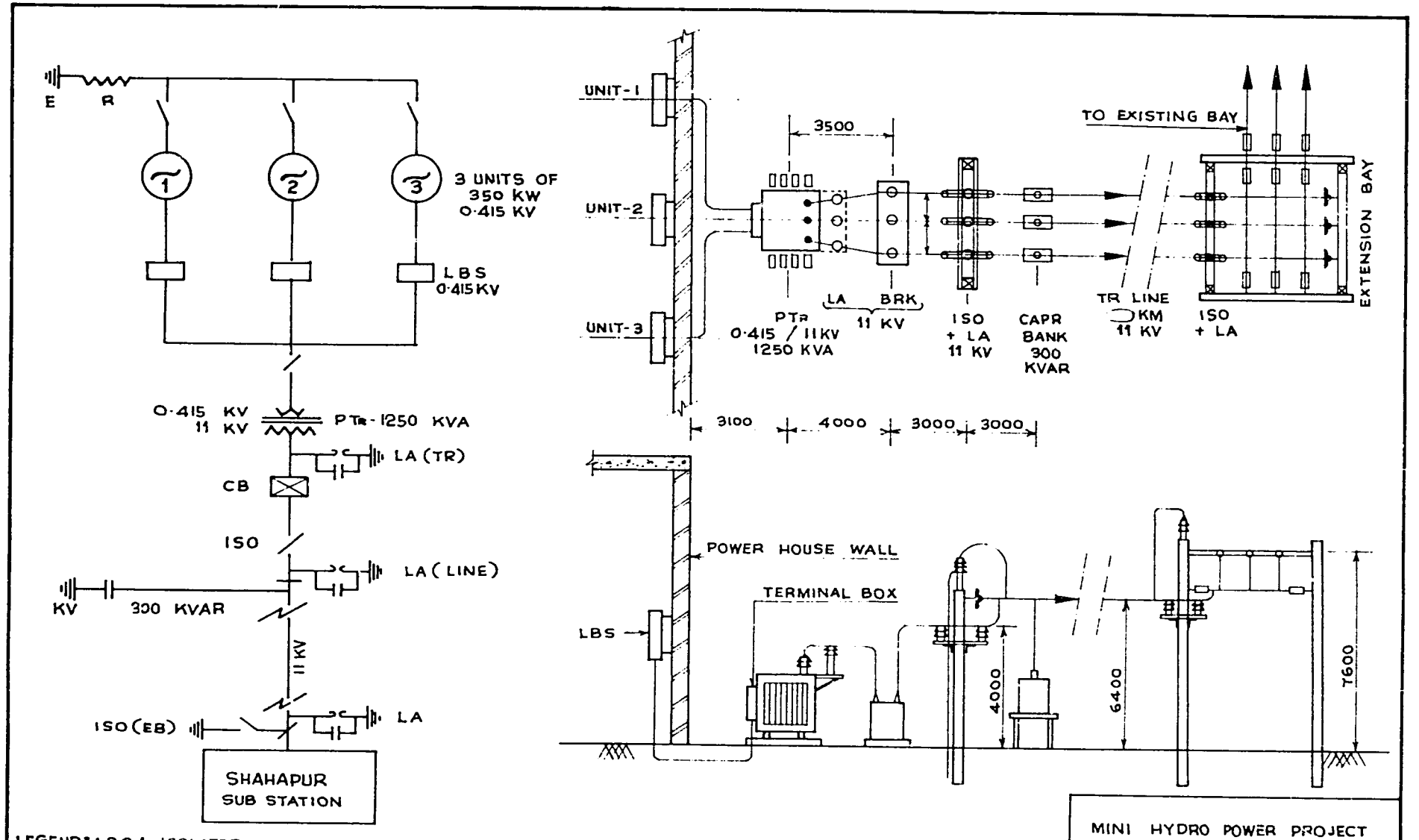
NOTE : ALL DIMENSIONS ARE IN 'MM'

MINI HYDRO POWER PROJECT
ESMAP STUDY
RAJANKOLLUR PROJECT
ELECTRICAL LAYOUT
(KARNATAKA)

sads/w 18595(42)



sads/w48595(100)

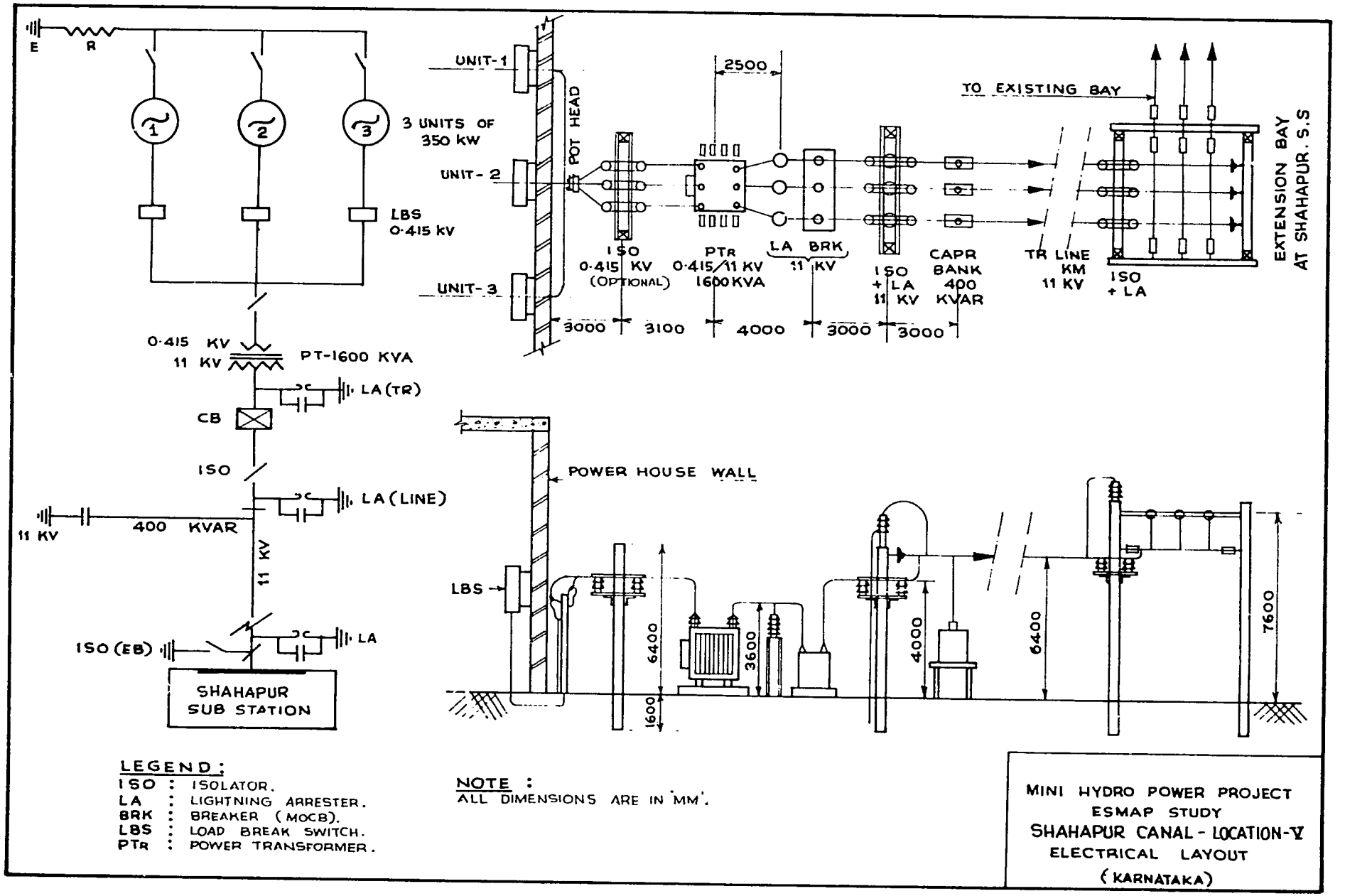


LEGEND: ISO : ISOLATOR.
LA : LIGHTNING ARRESTER.
BRK : BREAKER (MOCB).
LBS : LOAD BREAK SWITCH.
PTR : POWER TRANSFORMER.

NOTE : ALL DIMENSIONS ARE IN 'MM'

MINI HYDRO POWER PROJECT
ESMAP STUDY
SHAHAPUR CANAL-BR-2 (LOC I, II, III, IV
ELECTRICAL LAYOUT
(KARNATAKA)

sads/w48595(33).



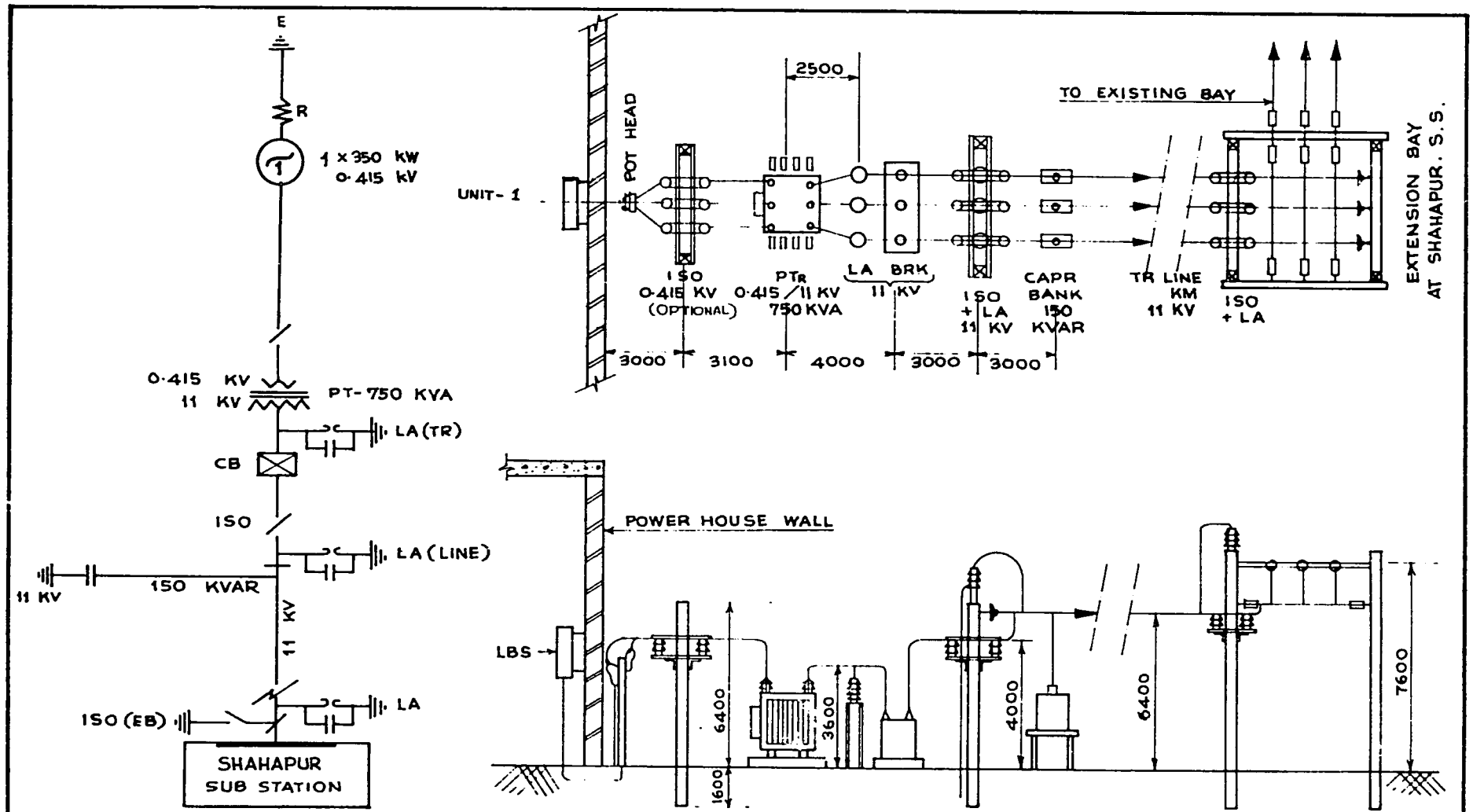
LEGEND:

ISO : ISOLATOR.
LA : LIGHTNING ARRESTER.
BRK : BREAKER (MOCB).
LBS : LOAD BREAK SWITCH.
PTR : POWER TRANSFORMER.

NOTE :
ALL DIMENSIONS ARE IN 'MM'.

MINI HYDRO POWER PROJECT
ESMAP STUDY
SHAHAPUR CANAL - LOCATION-V
ELECTRICAL LAYOUT
(KARNATAKA)

sada/w48595(34)



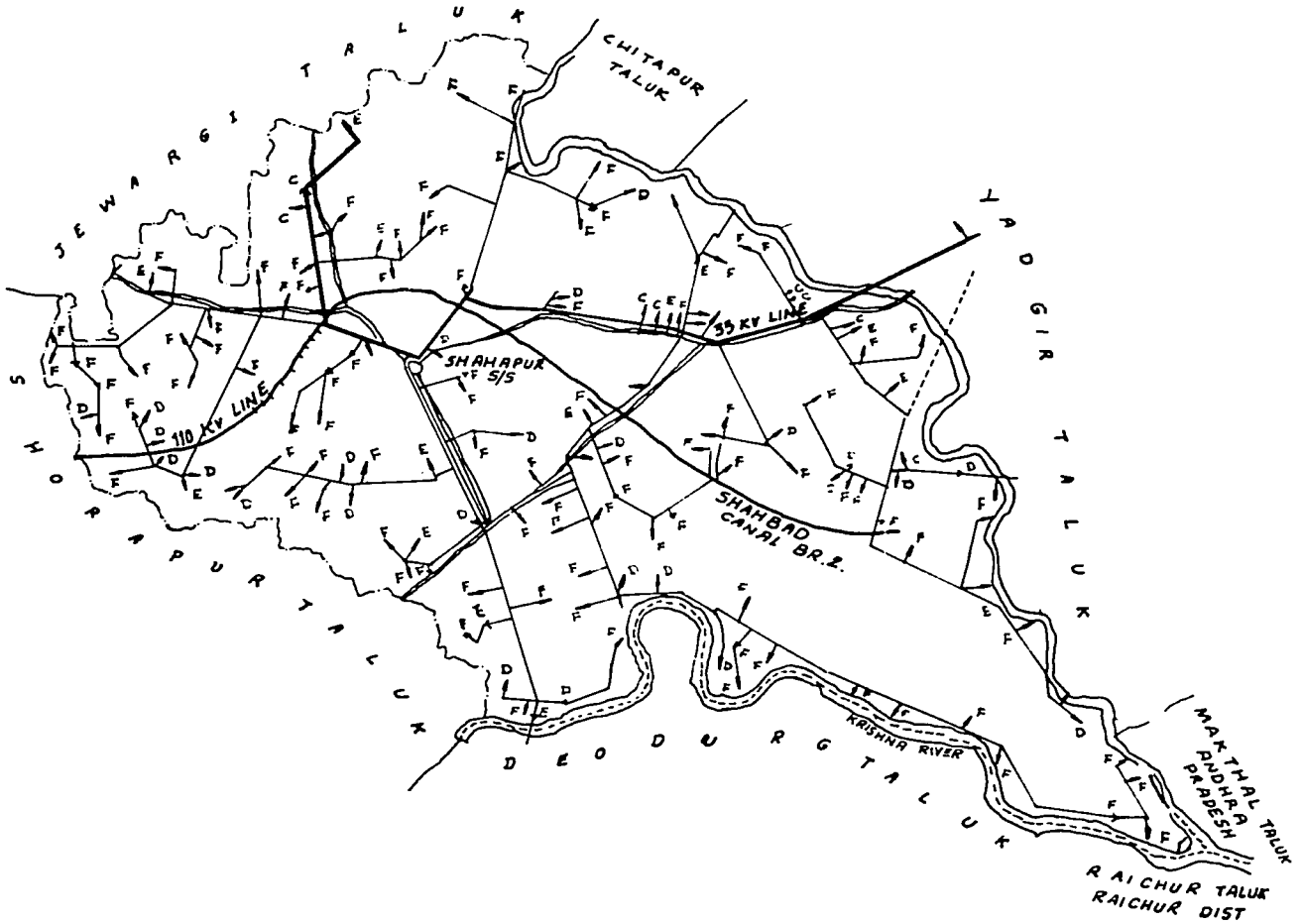
LEGEND:

ISO : ISOLATOR.
LA : LIGHTNING ARRESTER.
BRK : BREAKER (MOCB).
LBS : LOAD BREAK SWITCH.
PTR : POWER TRANSFORMER.

NOTE :
ALL DIMENSIONS ARE IN 'MM'.

MINI HYDRO POWER PROJECT
ESMAP STUDY
SHAHAPUR CANAL - LOCATION-VI
ELECTRICAL LAYOUT
(KARNATAKA)

sada/w48505(35)



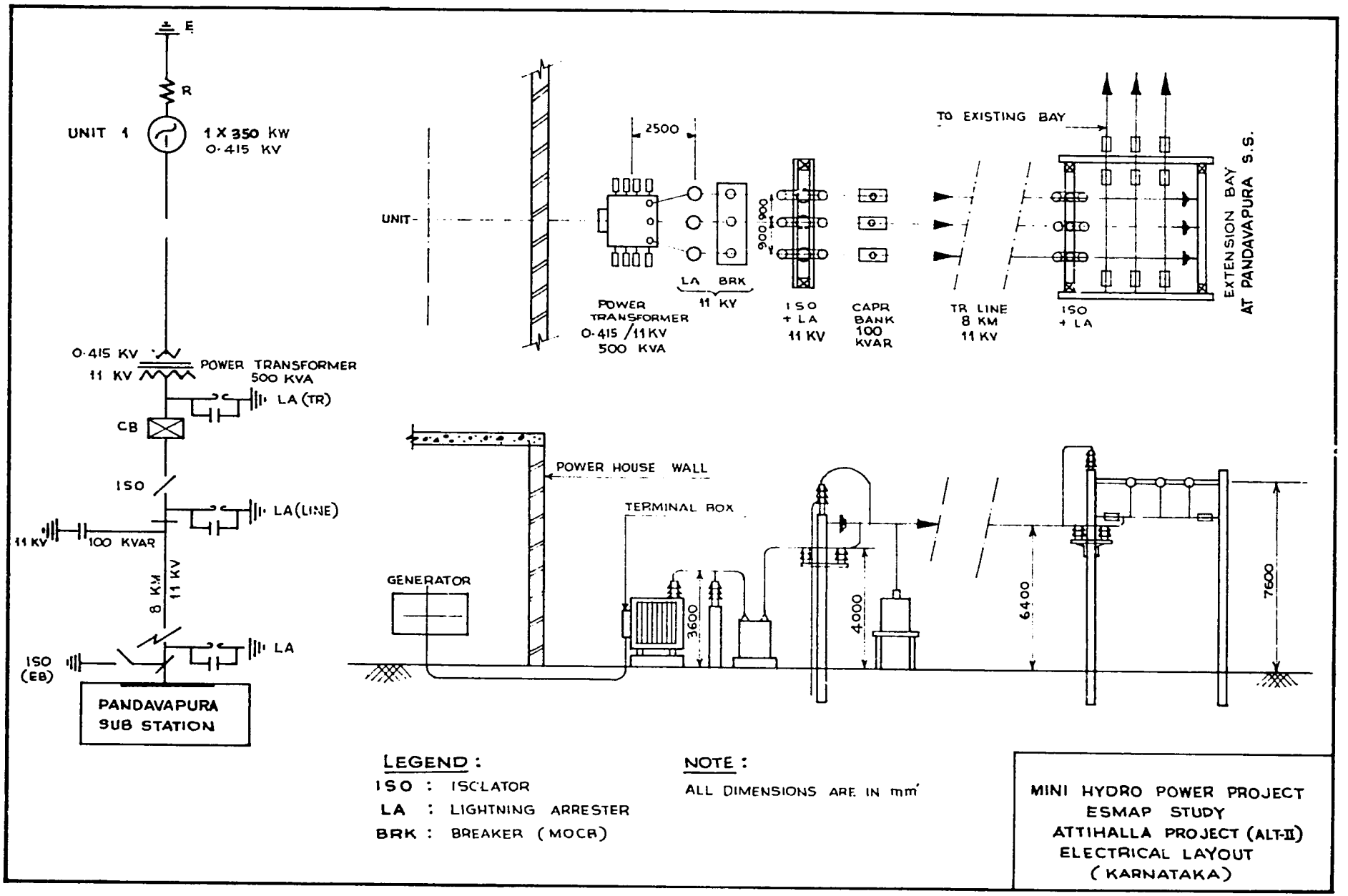
LEGEND

250 kVA	— —	A
200 "	— —	B
100 "	— —	C
63 "	— · —	D
50 "	— —	E
25 "	— · ·	F
15 "	— · ·	G

1. EXISTING SUB STATION 110/33/11 KV ▲
2. EXISTING 11 KV LINE WITH WEASEL ALSR —
3. EXISTING 11 KV LINE WITH RABBIT ALSR —
4. EXISTING TRANSFORMER CENTRES —
5. ELECTRIFIED VILLAGES •
6. RIVER

MINI HYDRO PROJECT
ESMAP STUDY
SHAHAPUR CANAL PSS
TRANSMISSION GRID

sads/w48595(36)



LEGEND :

ISO : ISOLATOR

LA : LIGHTNING ARRESTER

BRK : BREAKER (MOCB)

NOTE :

ALL DIMENSIONS ARE IN mm

MINI HYDRO POWER PROJECT
ESMAP STUDY
ATTIHALLA PROJECT (ALT-II)
ELECTRICAL LAYOUT
(KARNATAKA)

sada/w48595(20)

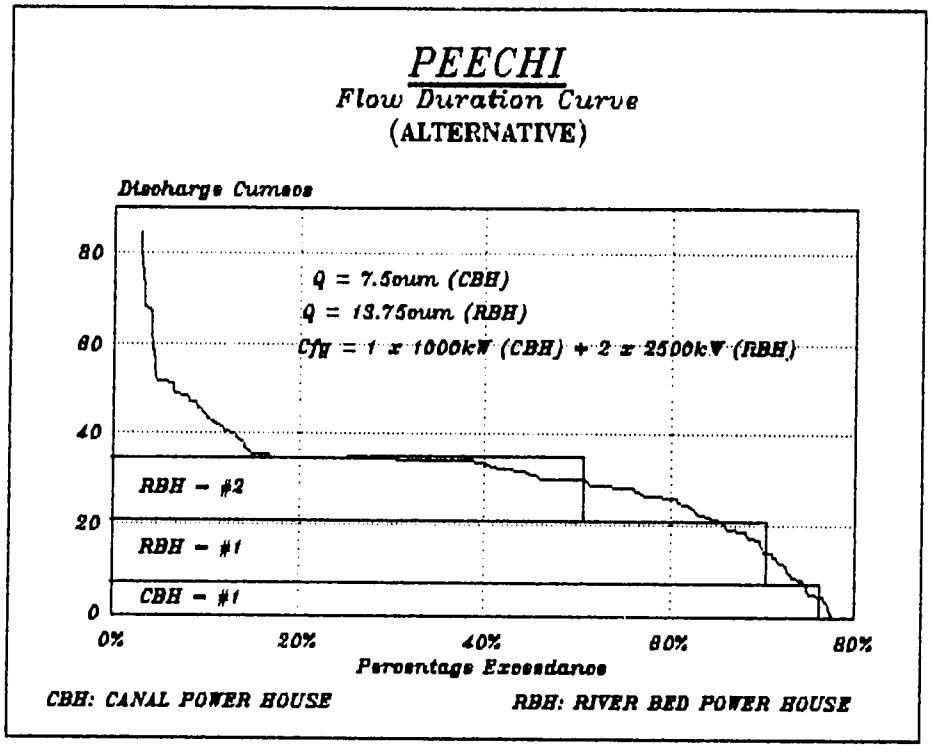
73A

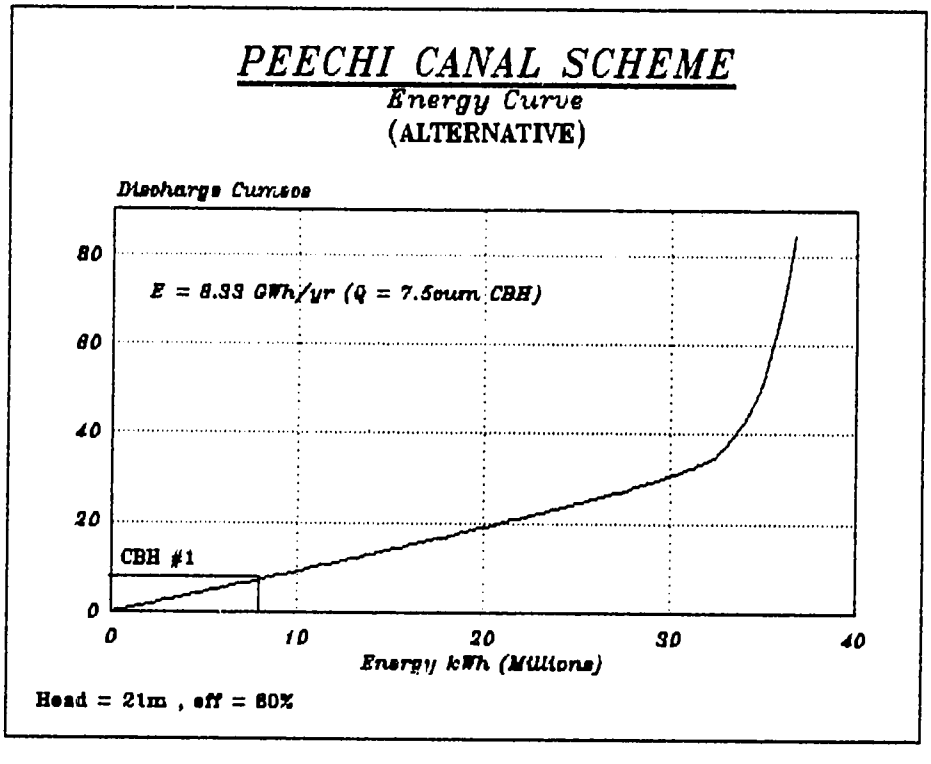
SECTION III - KERALA

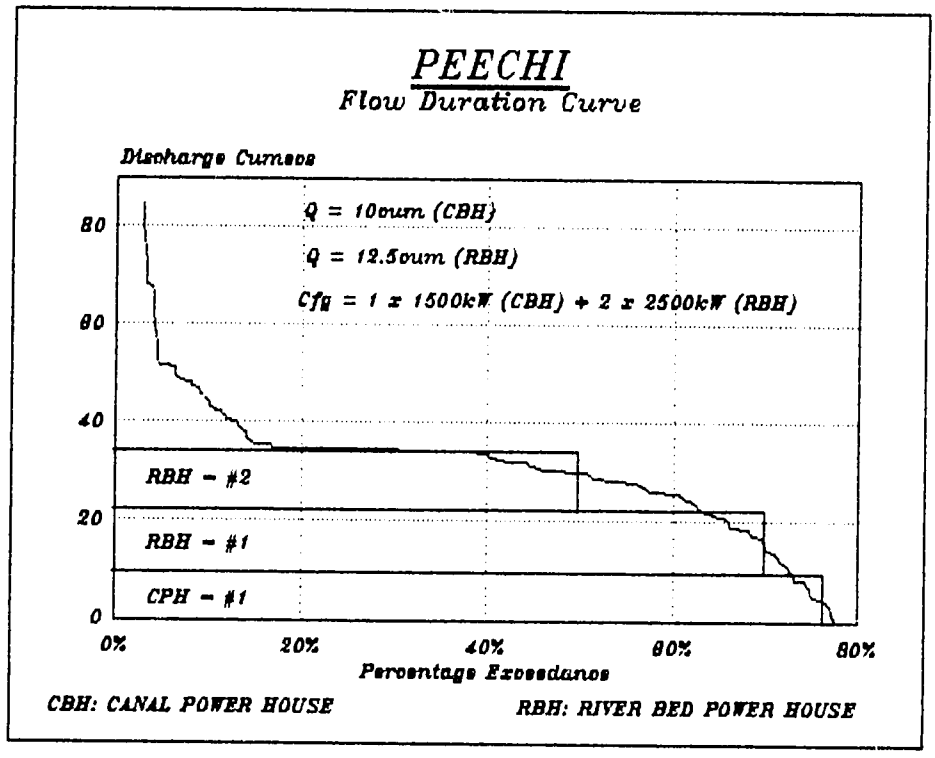
Peechi Dam
Maniyar Barrage
Kuttiyadi Dam Tailrace
Mangalam Dam

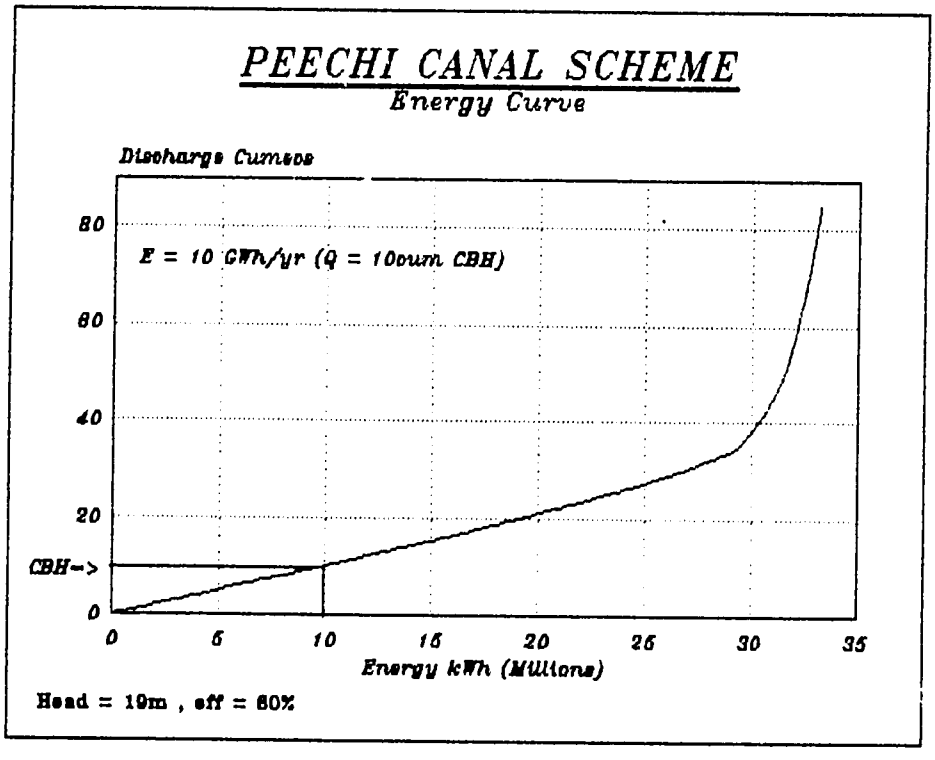
Contents:

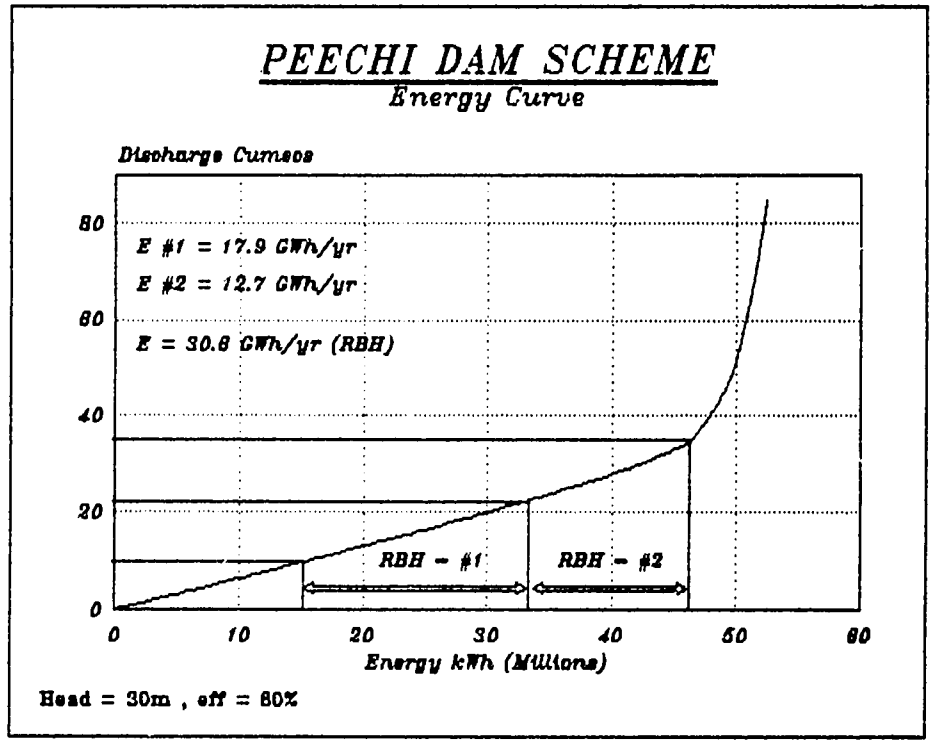
1. ***Design Graphs***
   (Flow duration curves, Energy curves)
2. ***Technical Drawings***
   (Layouts, Electrical Schemes, Grid-Tie Arrangements)

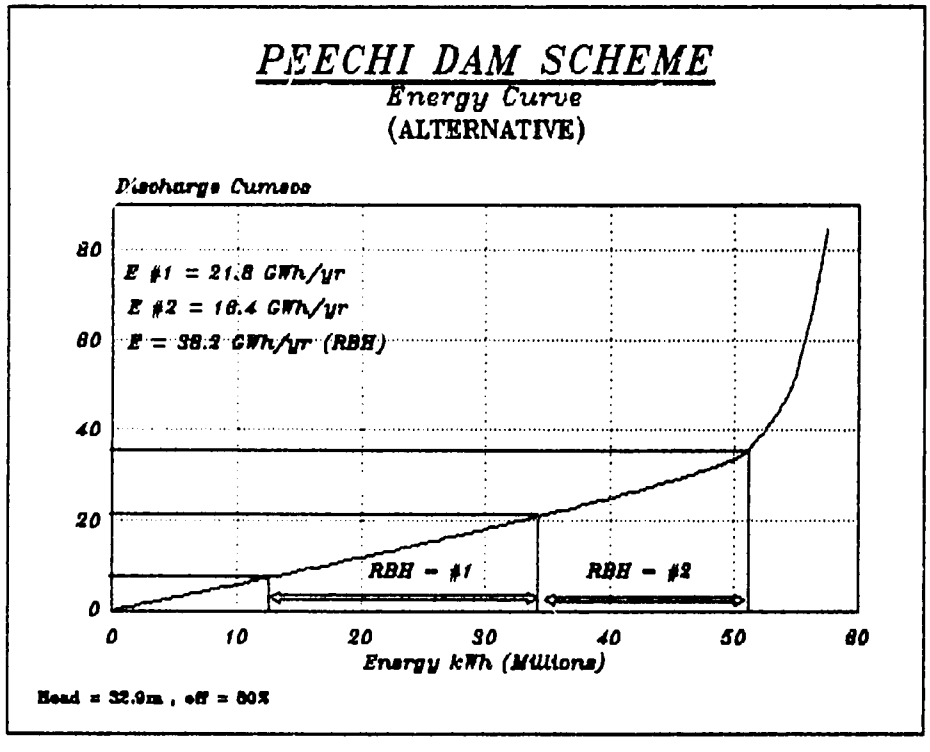

PEECHI
Flow Duration Curve
(ALTERNATIVE)
Discharge Cumecs
80
60
40
20
0
Q = 7.5cum (CBH)
Q = 13.75cum (RBH)
Cfg = 1 x 1000kW (CBH) + 2 x 2500kW (RBH)
RBH - #2
RBH - #1
CBH - #1
0%
20%
40%
60%
80%
Percentage Exceedance
CBH: CANAL POWER HOUSE
RBH: RIVER BED POWER HOUSE

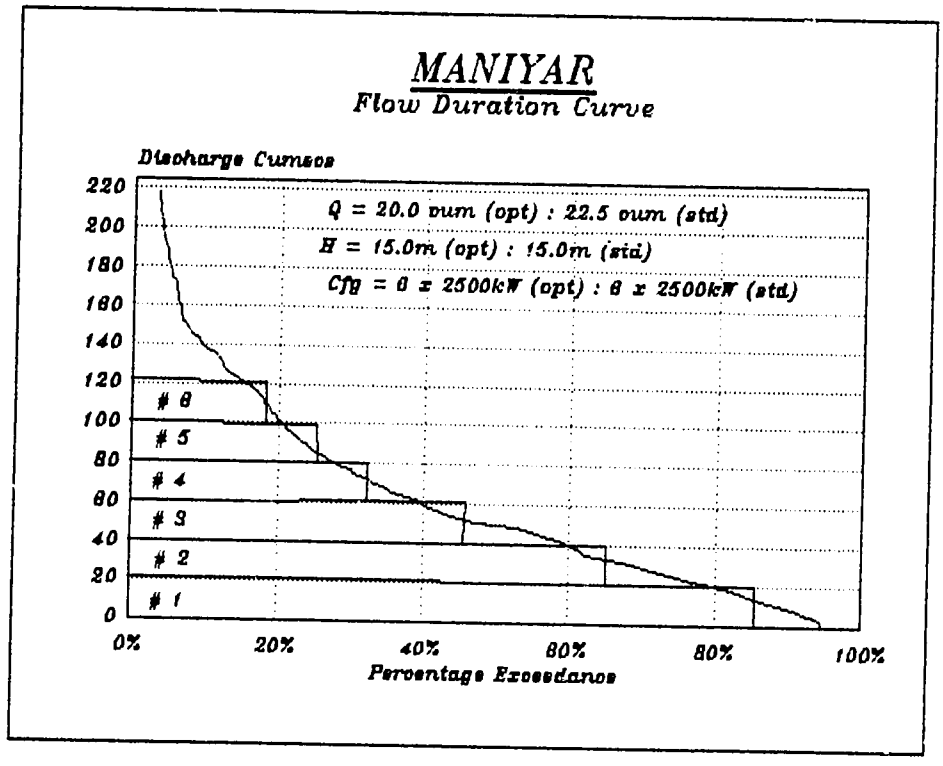

PEECHI CANAL SCHEME
Energy Curve
(ALTERNATIVE)
Discharge Cumecs
80
60
40
20
0
E = 8.33 GWh/yr (Q = 7.5cum CBH)
CBH #1
0
10
20
30
40
Energy kWh (Millions)
Head = 21m , eff = 80%

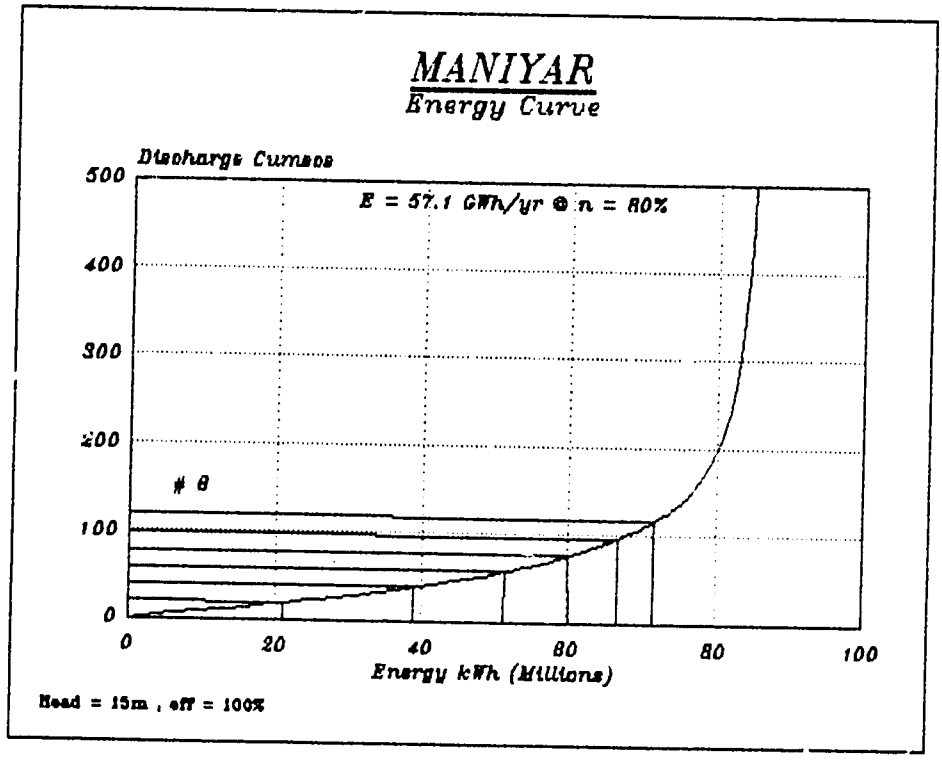

PEECHI
Flow Duration Curve
Discharge Cumecs
Q = 10cum (CBH)
Q = 12.5cum (RBH)
Cfg = 1 x 1500kW (CBH) + 2 x 2500kW (RBH)
RBH - #2
RBH - #1
CPH - #1
80
60
40
20
0
0%
20%
40%
60%
80%
Percentage Exceedance
CBH: CANAL POWER HOUSE
RBH: RIVER BED POWER HOUSE

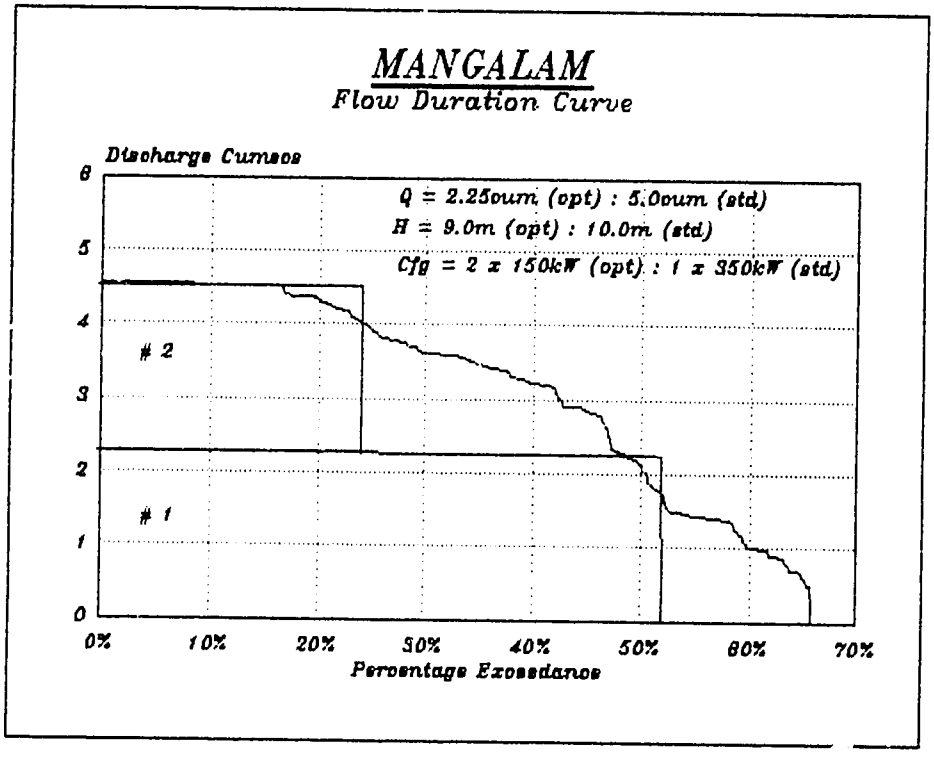

PEECHI CANAL SCHEME
Energy Curve
Discharge Cumecs
E = 10 GWh/yr (Q = 10cum CBH)
CBH->
80
60
40
20
0
0
5
10
15
20
25
30
35
Energy kWh (Millions)
Head = 19m , eff = 60%

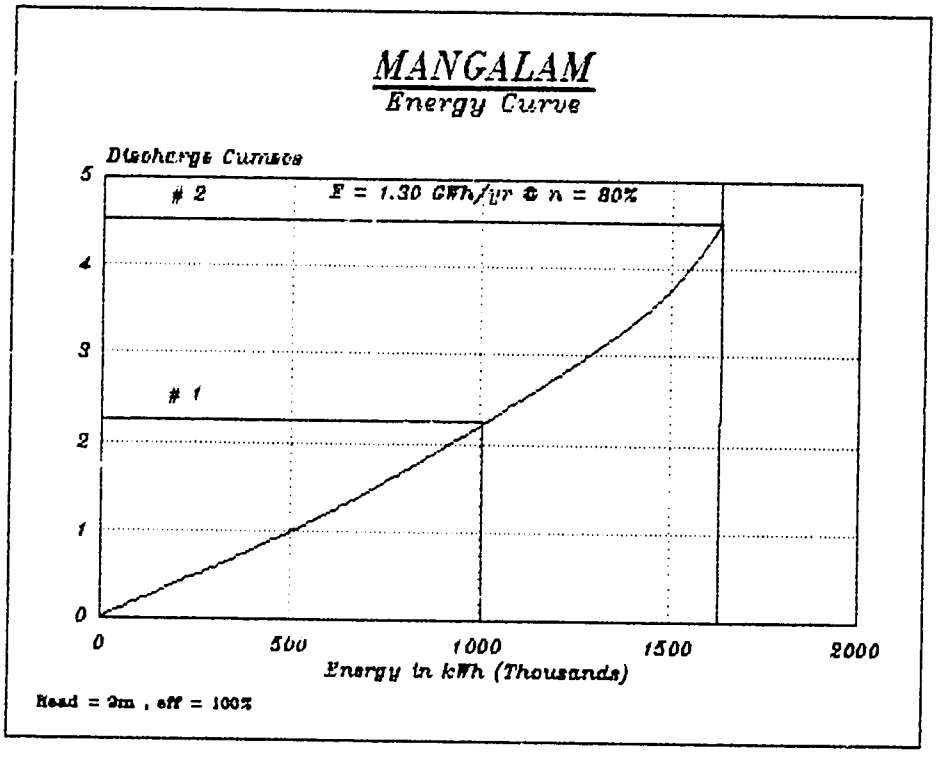

PEECHI DAM SCHEME
Energy Curve
Discharge Cumecs
E #1 = 17.9 GWh/yr
E #2 = 12.7 GWh/yr
E = 30.6 GWh/yr (RBH)
RBH - #1
RBH - #2
0
20
40
60
80
0
10
20
30
40
50
60
Energy kWh (Millions)
Head = 30m , eff = 80%

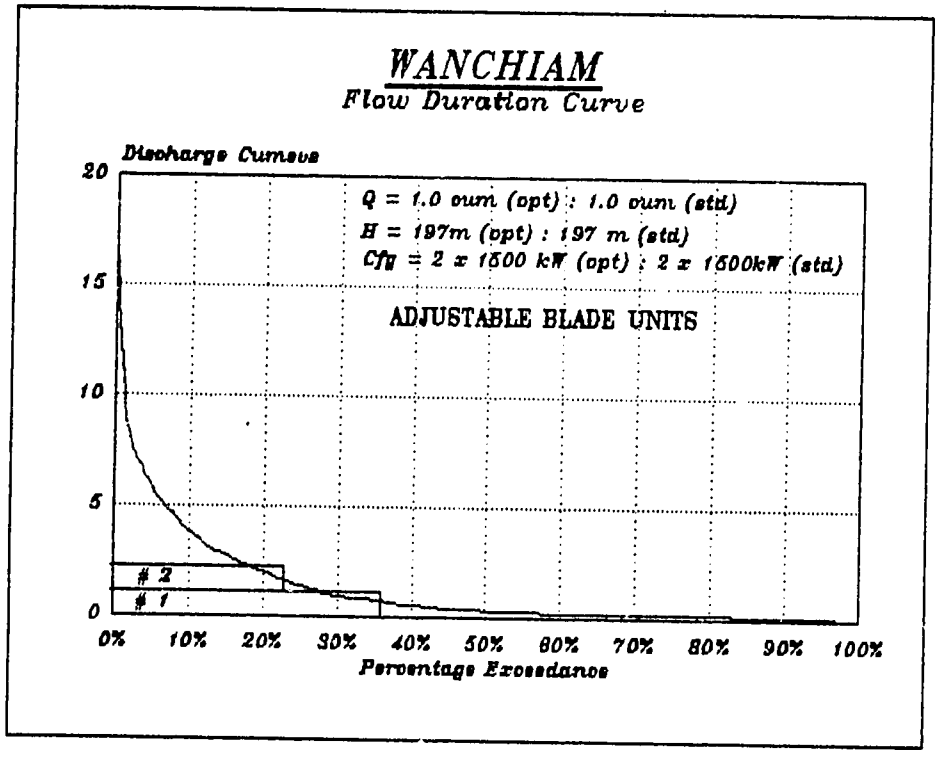

PEECHI DAM SCHEME
Energy Curve
(ALTERNATIVE)
Discharge Cumecs
E #1 = 21.8 GWh/yr
E #2 = 16.4 GWh/yr
E = 38.2 GWh/yr (RBH)
RBH - #1
RBH - #2
0
20
40
60
80
0
10
20
30
40
50
60
Energy kWh (Millions)
Head = 32.9m , eff = 80%

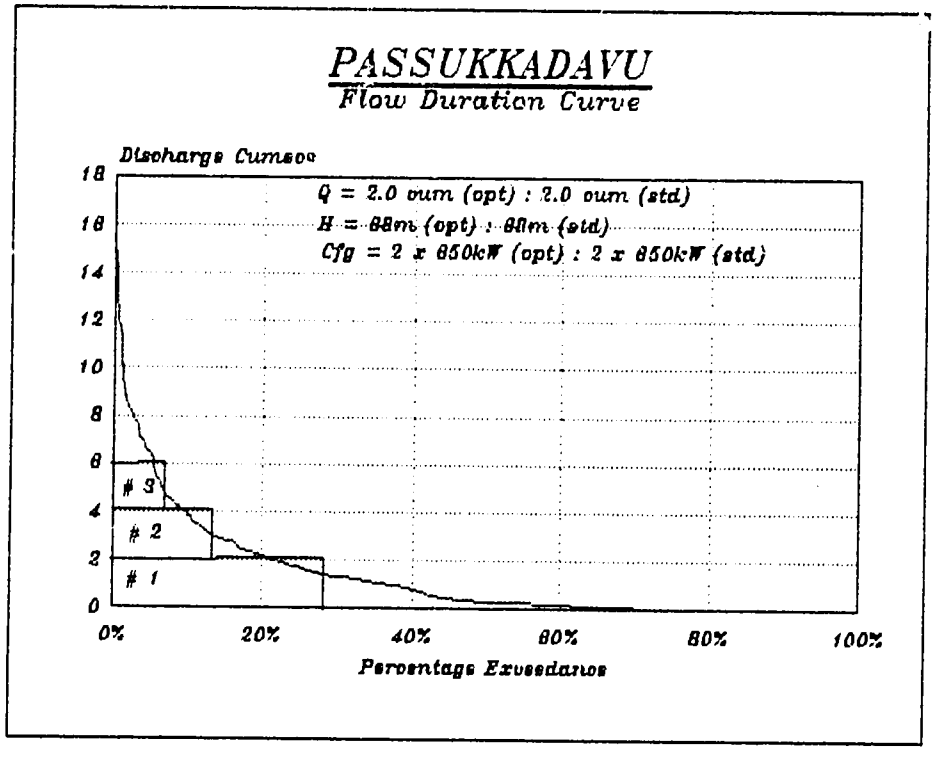

MANIYAR
Flow Duration Curve
Discharge Cumecs
Q = 20.0 cum (opt) : 22.5 cum (std)
H = 15.0m (opt) : 15.0m (std)
Cfg = 8 x 2500kW (opt) : 8 x 2500kW (std)
# 8
# 5
# 4
# 3
# 2
# 1
220
200
180
160
140
120
100
80
60
40
20
0
0%
20%
40%
60%
80%
100%
Percentage Exceedance

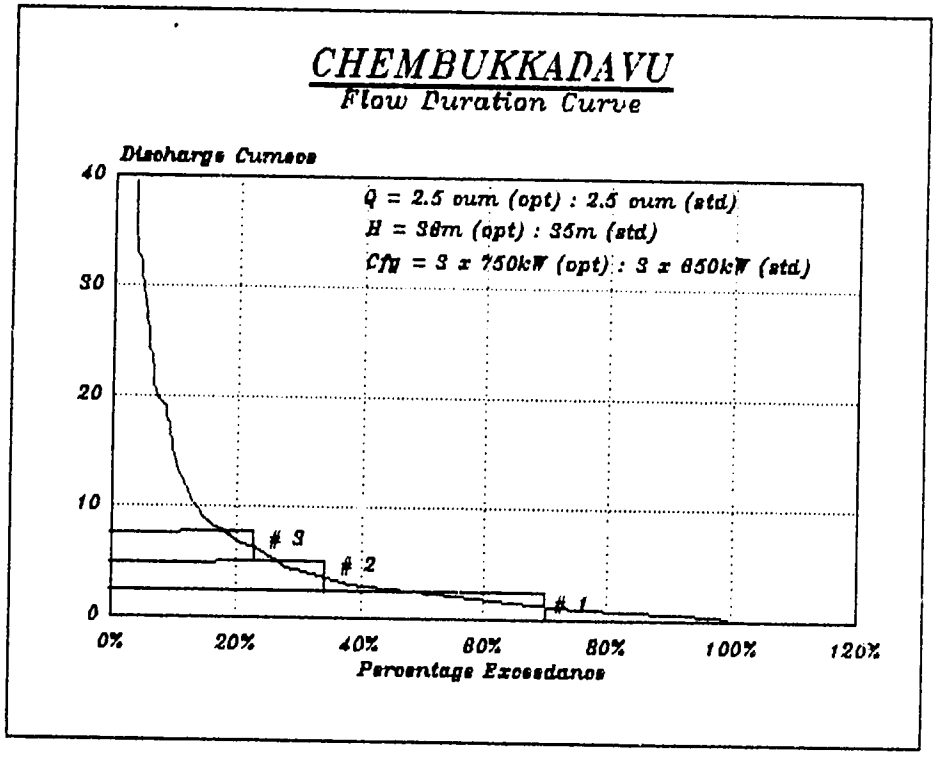

MANIYAR
Energy Curve
Discharge Cumecs
E = 57.1 GWh/yr @ n = 80%
# 8
500
400
300
200
100
0
0
20
40
60
80
100
Energy kWh (Millions)
Head = 15m , eff = 100%

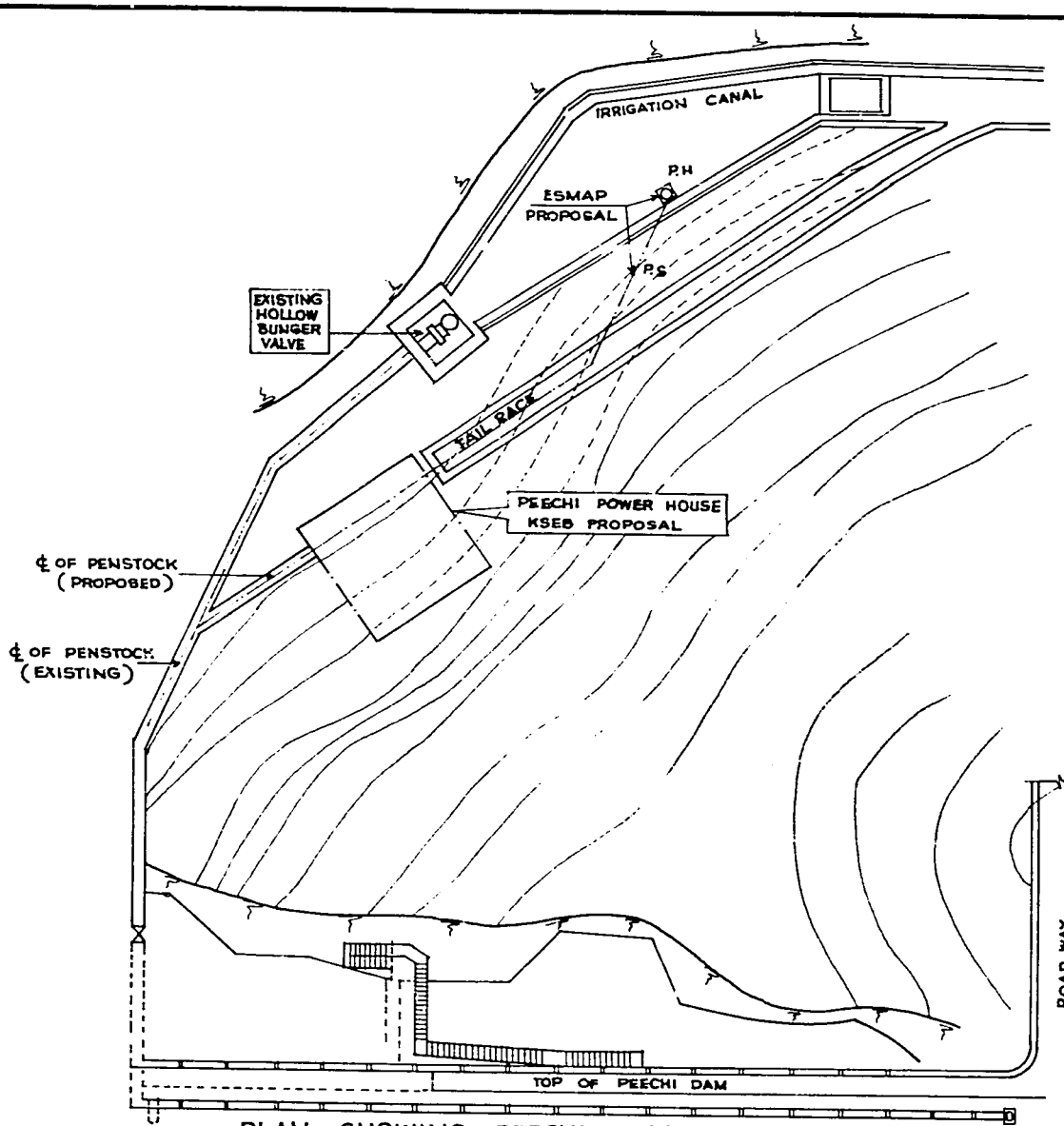

MANGALAM
Flow Duration Curve
Discharge Cumecs
Q = 2.25cum (opt) : 5.0cum (std)
H = 9.0m (opt) : 10.0m (std)
Cfg = 2 x 150kW (opt) : 1 x 350kW (std)
# 2
# 1
0
1
2
3
4
5
6
0%
10%
20%
30%
40%
50%
60%
70%
Percentage Exceedance


MANGALAM
Energy Curve
Discharge Cumecs
# 2
E = 1.30 GWh/yr @ n = 80%
# 1
0
1
2
3
4
5
0
500
1000
1500
2000
Energy in kWh (Thousands)
Head = 2m , eff = 100%

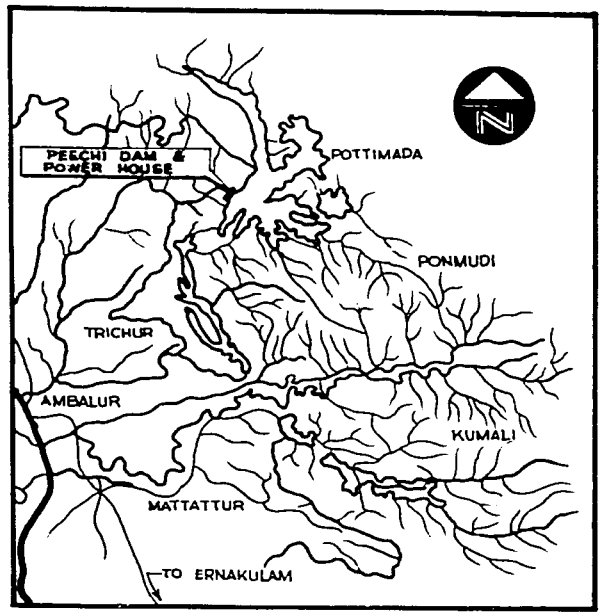

WANCHIAM
Flow Duration Curve
Discharge Cumecs
Q = 1.0 cum (opt) : 1.0 cum (std)
H = 197m (opt) : 197 m (std)
Cfg = 2 x 1500 kW (opt) : 2 x 1500kW (std)
ADJUSTABLE BLADE UNITS
2
1
20
15
10
5
0
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Percentage Exceedance


PASSUKKADAVU
Flow Duration Curve
Discharge Cumecs
Q = 2.0 cum (opt) : 2.0 cum (std)
H = 88m (opt) : 88m (std)
Cfg = 2 x 850kW (opt) : 2 x 850kW (std)
# 3
# 2
# 1
0
2
4
6
8
10
12
14
16
18
0%
20%
40%
60%
80%
100%
Percentage Exceedance


CHEMBUKKADAVU
Flow Duration Curve
Discharge Cumecs
Q = 2.5 cum (opt) : 2.5 cum (std)
H = 38m (opt) : 35m (std)
Cfg = 3 x 750kW (opt) : 3 x 650kW (std)
40
30
20
10
0
3
2
1
0%
20%
40%
60%
80%
100%
120%
Percentage Exceedance



PLAN SHOWING PEECHI DAM & POWER HOUSE



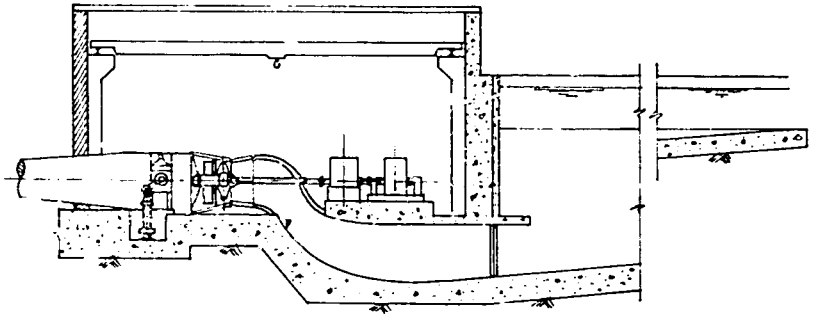
KEY PLAN

THE EXISTINGm 1.2m PENSTOCK WILL BE GAS CUT AND A STEEL LATERAL INTRODUCED.

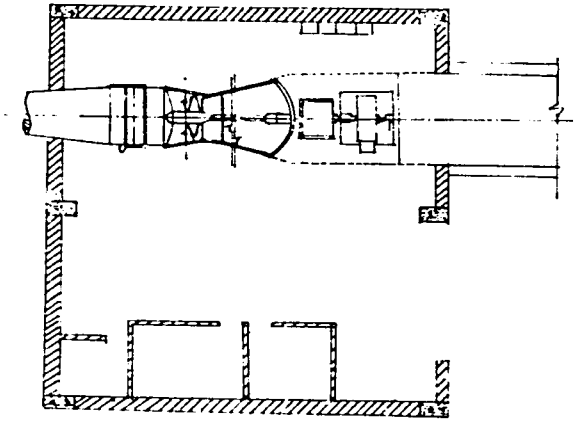
S TYPE TUBULAR IS ONE ALTERNATIVE AND THE SECOND ONE IS PIT TYPE SUBMERGED TURBINE, SHEET 2 OF 2 GIVES BOTH ALTERNATIVES.

MINI HYDRO POWER PROJECT
ESMAP STUDY
PEECHI DAM, PENSTOCK & POWER HOUSE
LAY OUT PLAN
KSEB PROPOSAL & ESMAP ALTERNATIVE
SHEET: 1 OF 2

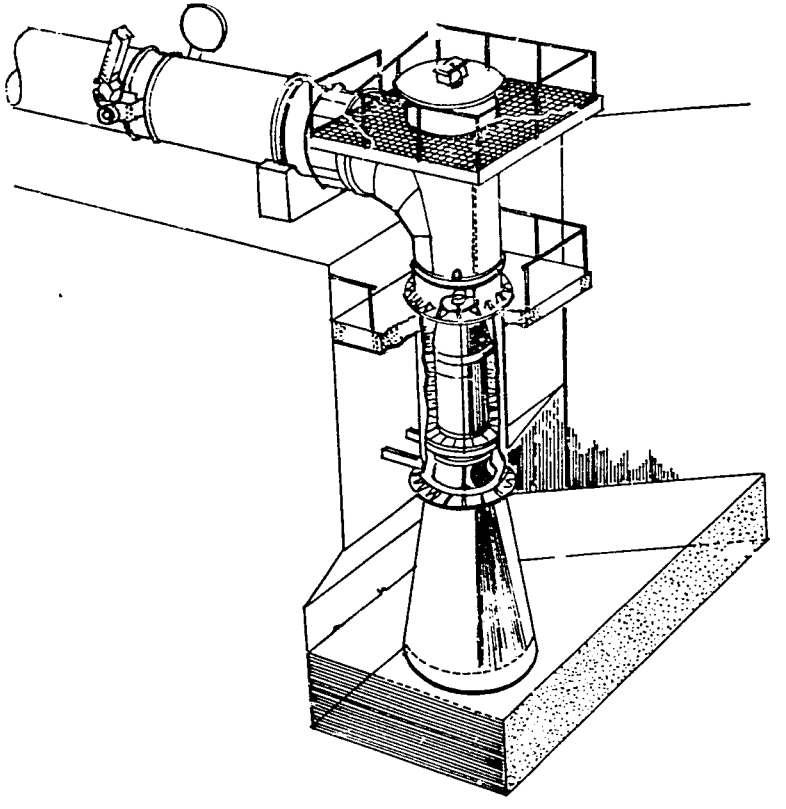
sads/w48595(50)



SECTION



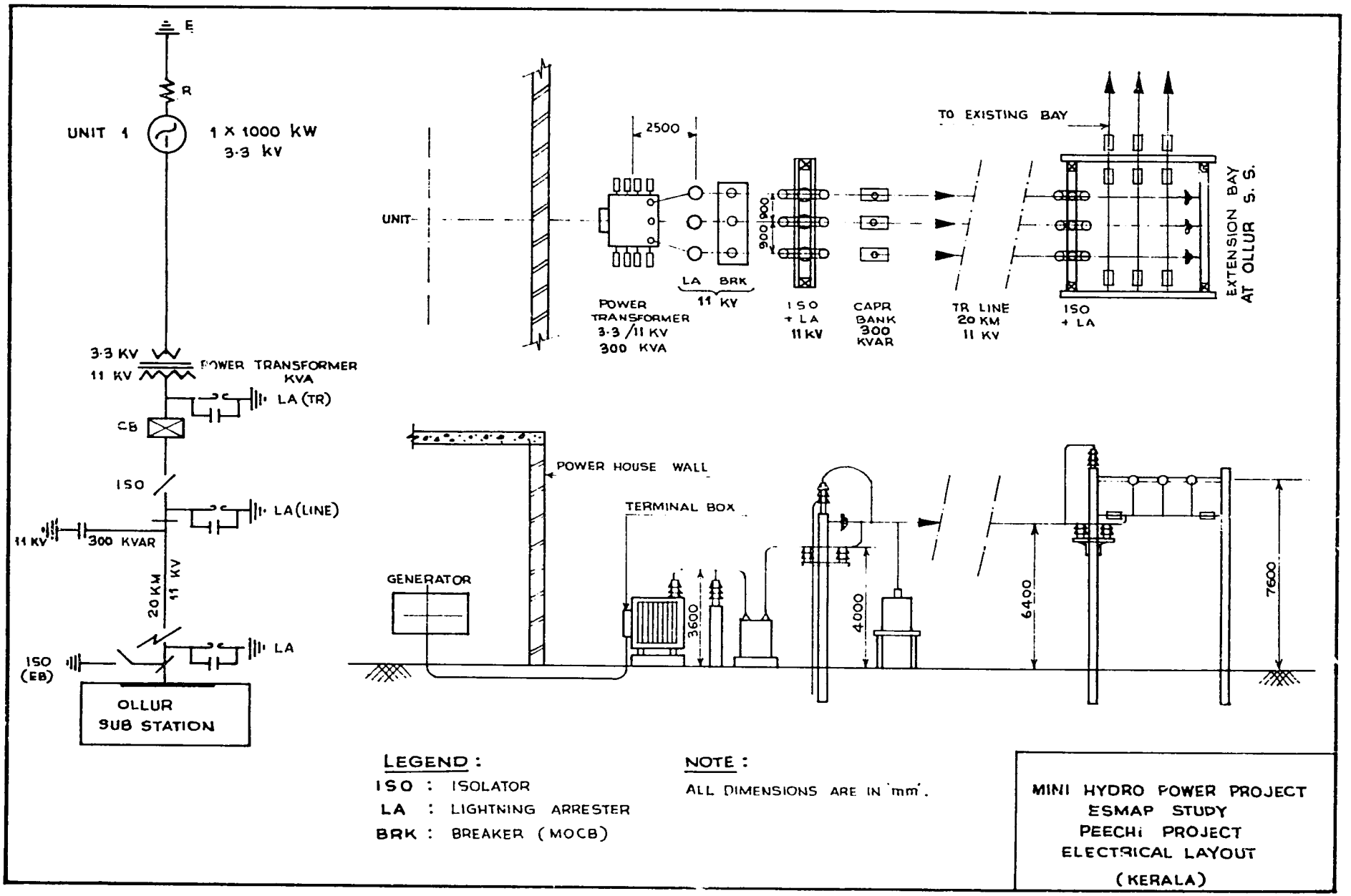
POWER HOUSE PLAN
(KSEB PROPOSAL)



POWER HOUSE (ESMAP ALTERNATIVE)

MINI HYDRO POWER PROJECT
ESMAP STUDY
PEECHI
POWER HOUSE
KSEB PROPOSAL & ESMAP ALTERNATIVE
SHEET: 2 OF 2

sads/w48595(S1)



LEGEND :

ISO : ISOLATOR

LA : LIGHTNING ARRESTER

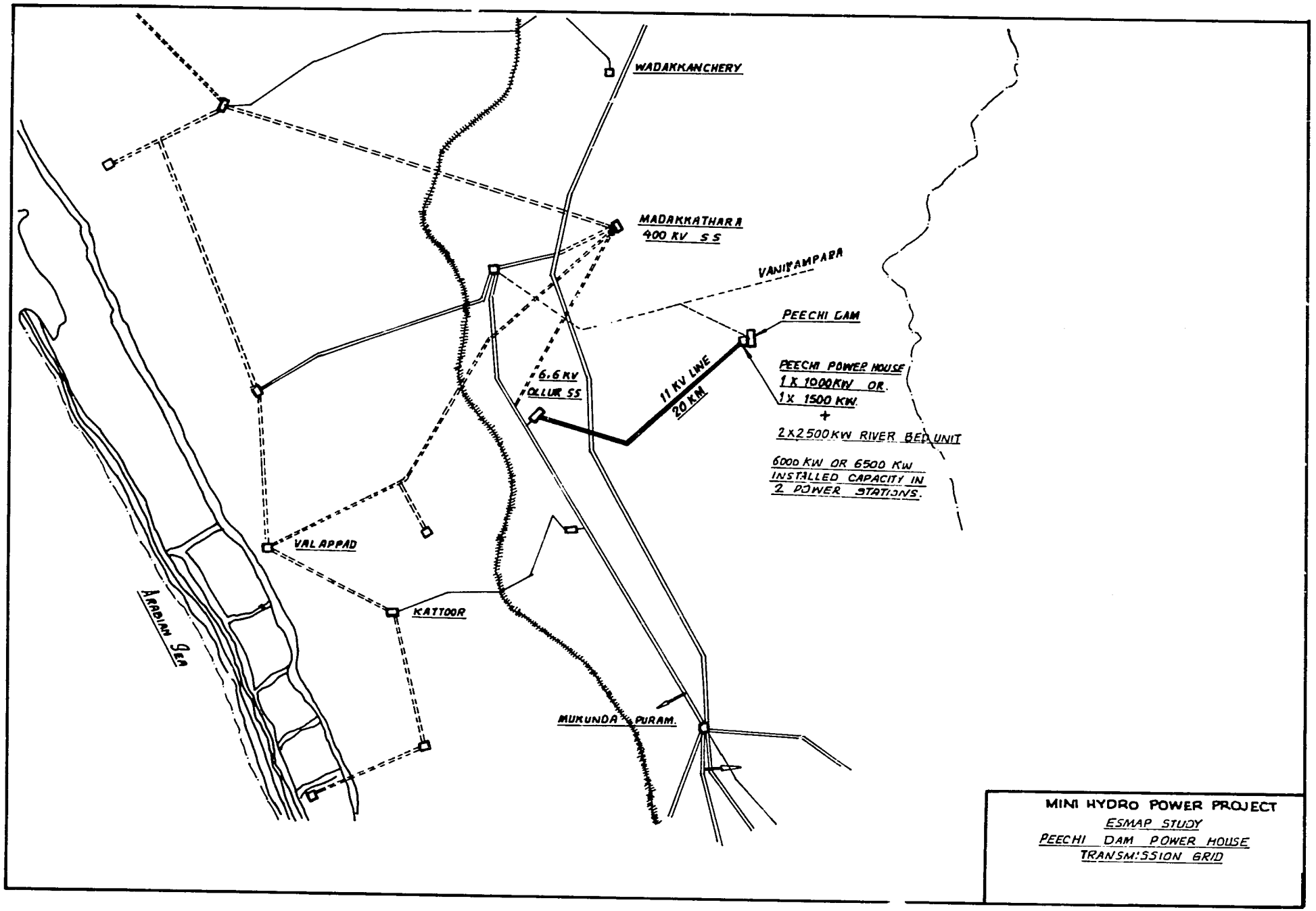
BRK : BREAKER (MOCB)

NOTE :

ALL DIMENSIONS ARE IN 'mm'.

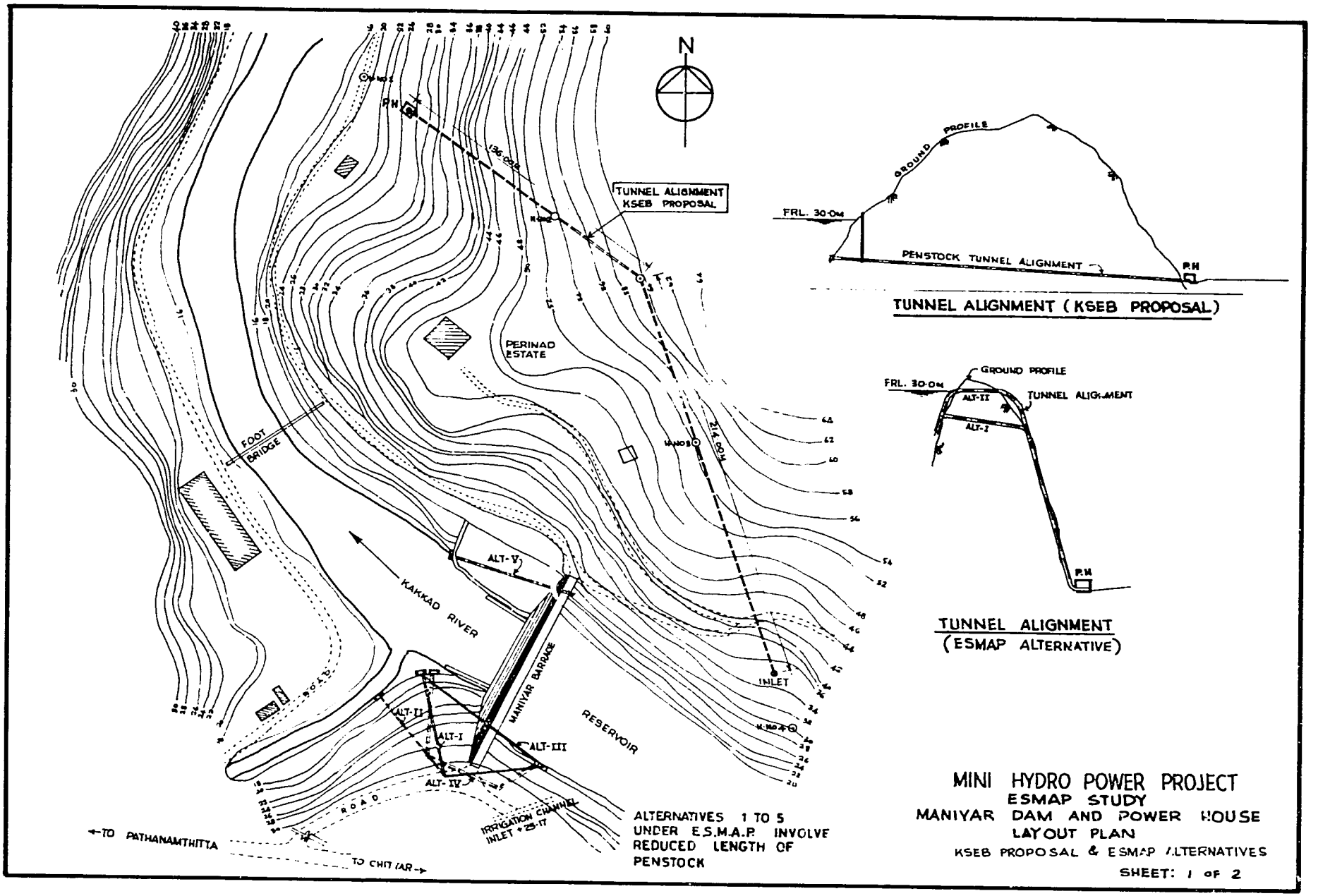
MINI HYDRO POWER PROJECT
ESMAP STUDY
PEECHI PROJECT
ELECTRICAL LAYOUT
(KERALA)

sada/w48595(62)

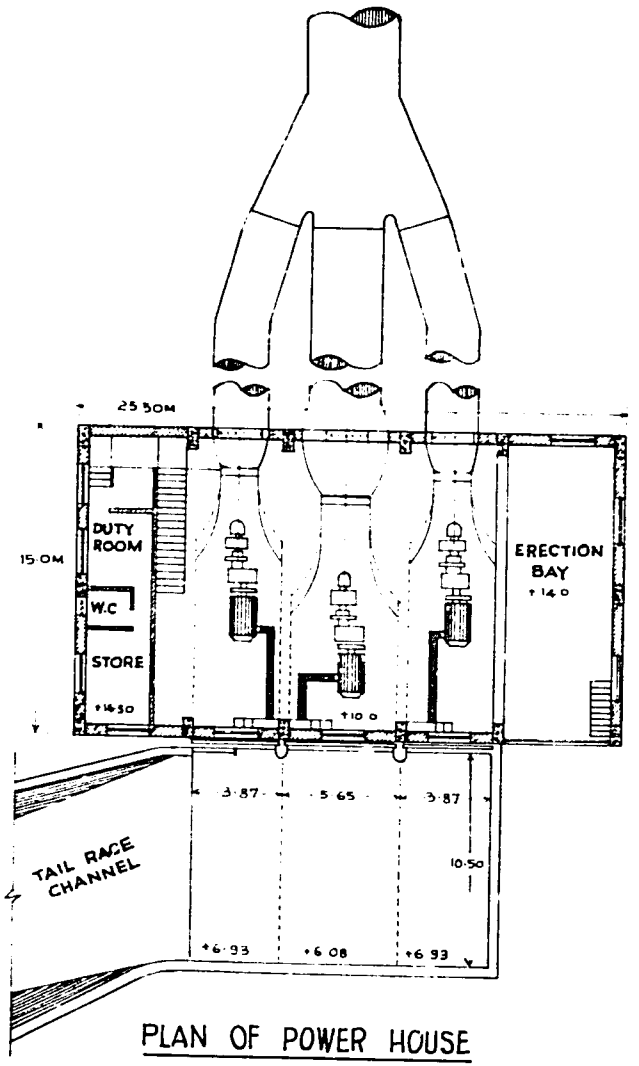


MINI HYDRO POWER PROJECT
ESMAP STUDY
PEECHI DAM POWER HOUSE
TRANSMISSION GRID

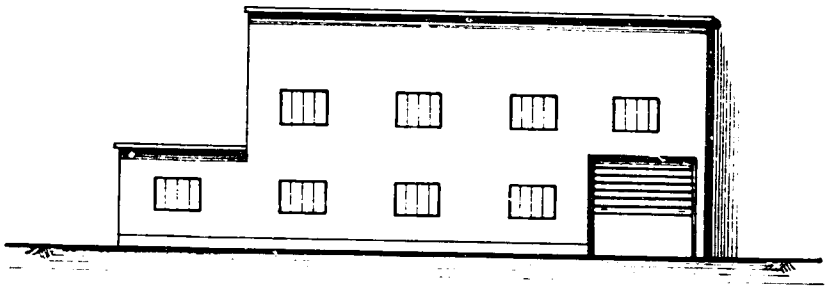
sads/w48595(£3)



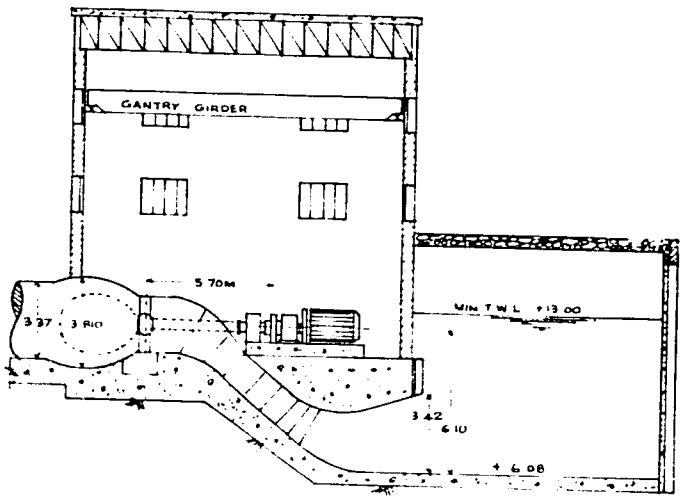
sada/w48595(54)



PLAN OF POWER HOUSE



FRONT ELEVATION

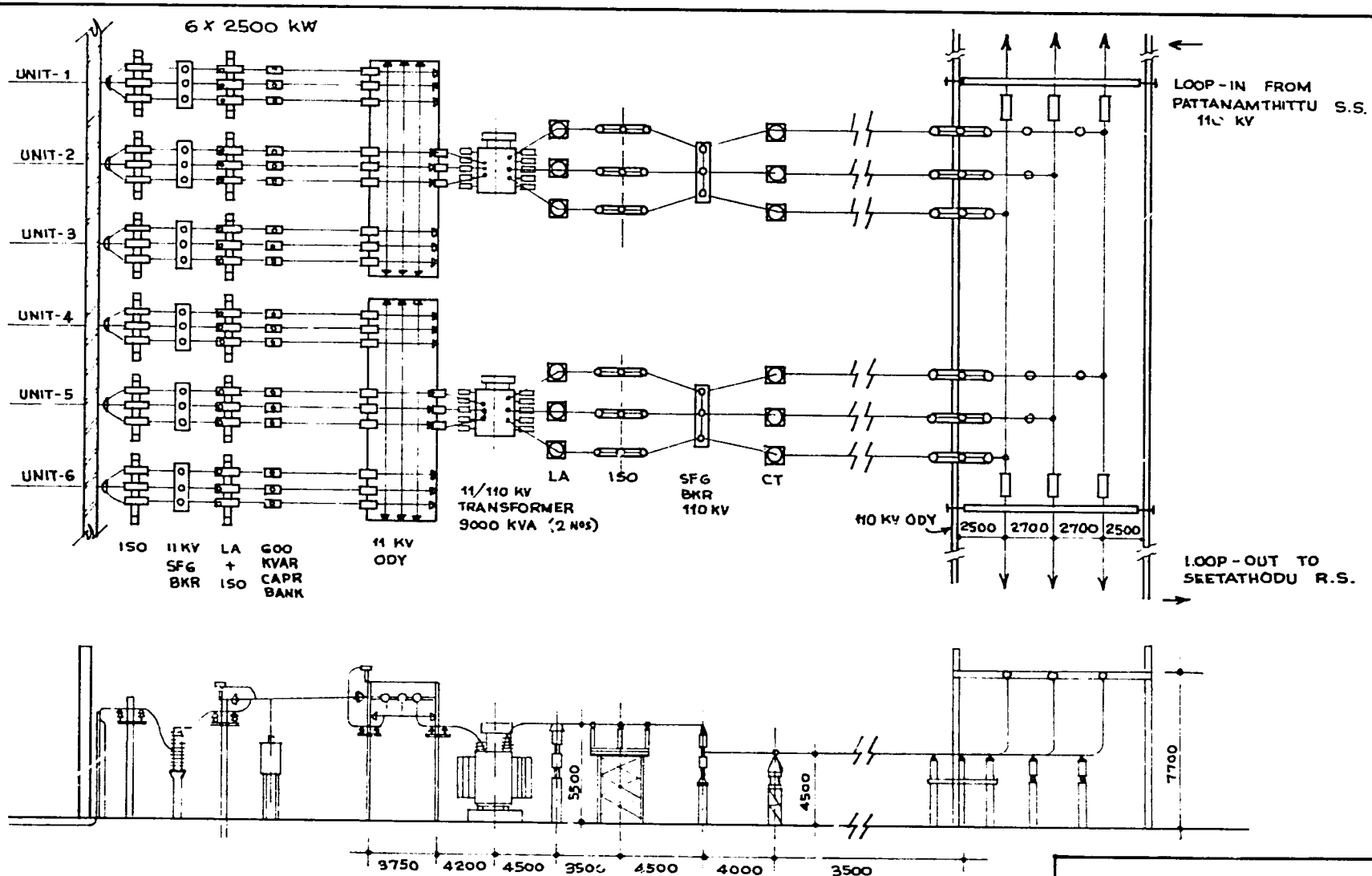


LONGITUDINAL SECTION

MINI HYDRO POWER PROJECT
ESMAP STUDY
MANIYAR
POWER HOUSE PLAN & SECTIONS
KSEB PROPOSAL

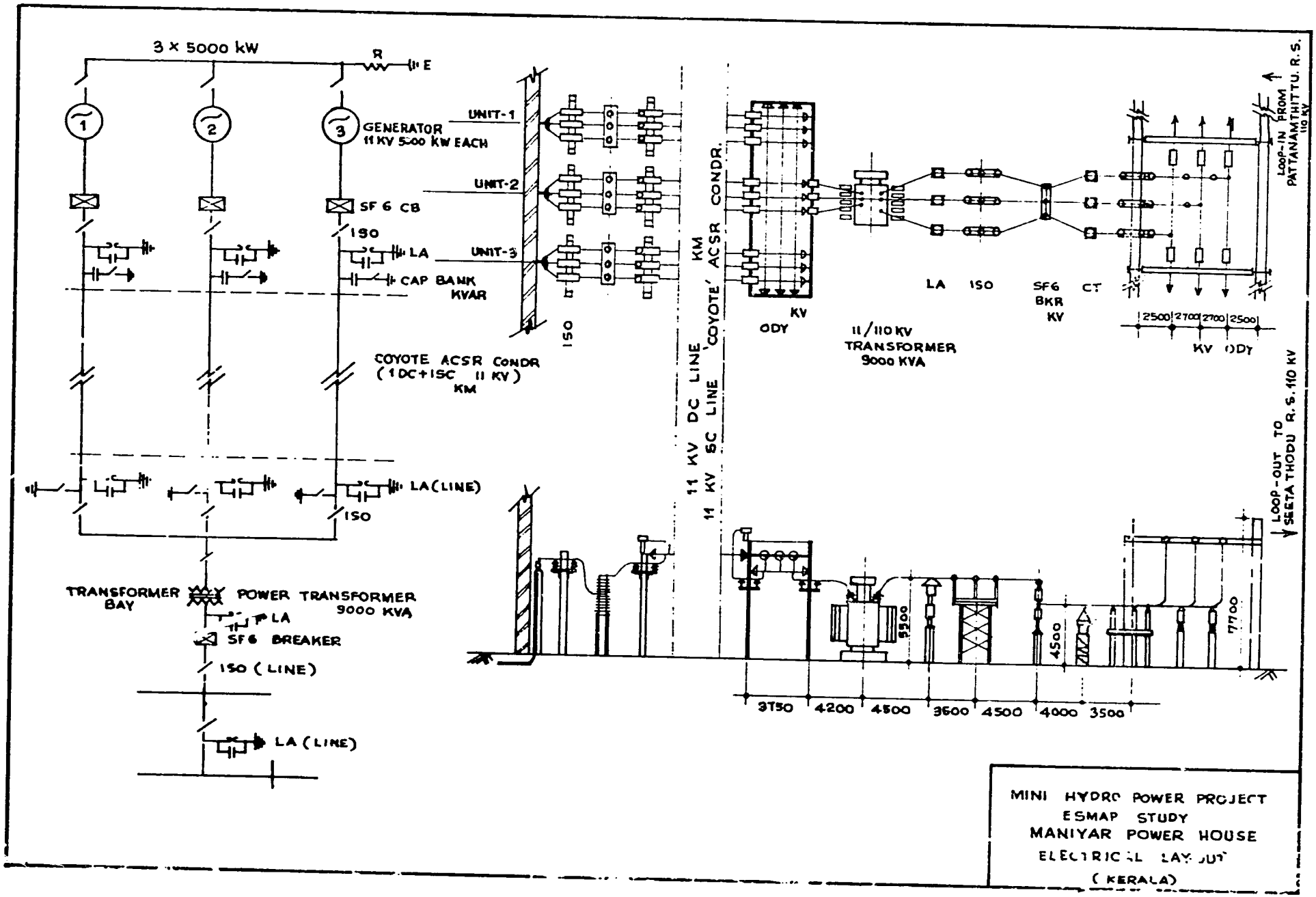
SHEET: 2 OF 2

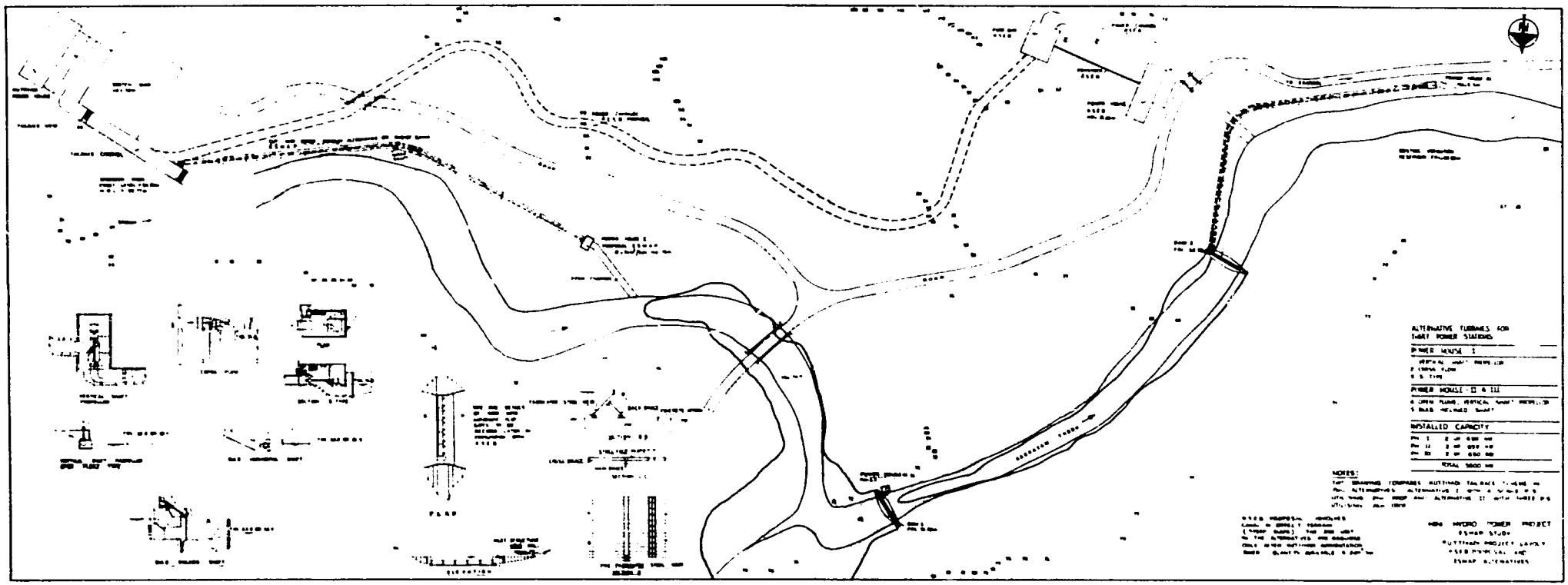
sads/w48595(55)



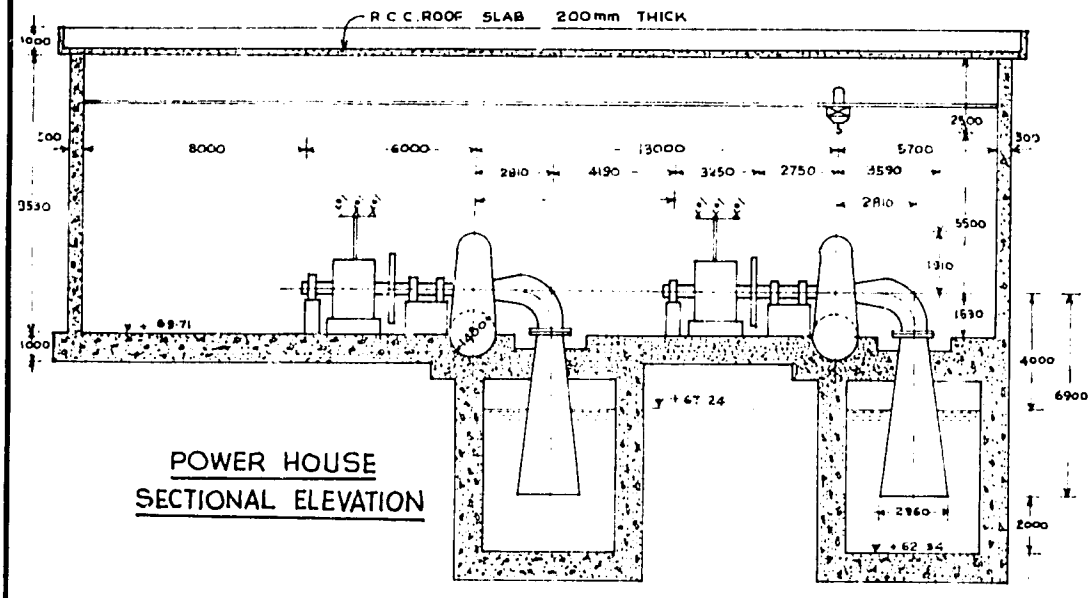
MINI HYDRO POWER PROJECT
ESMAP STUDY
MANIYAR PROJECT
ELECTRICAL LAYOUT
(KERALA)

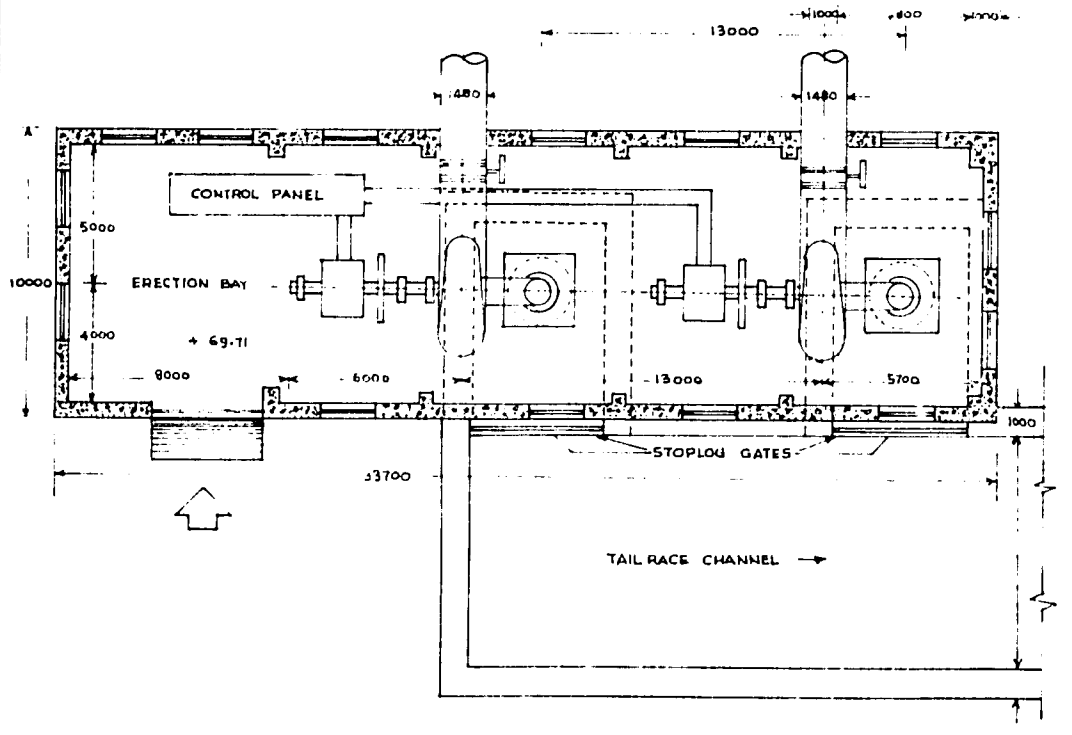
sads/w48595(56)


3 × 5000 kW
R
E
GENERATOR
11 KV 5000 KW EACH
UNIT-1
UNIT-2
UNIT-3
SF 6 CB
ISO
LA
CAP BANK
KVAR
COYOTE ACSR CONDR
(1 DC+1SC 11 KV)
KM
11 KV DC LINE
11 KV SC LINE
COYOTE ACSR CONDR.
KM
KV
ODY
11/110 KV
TRANSFORMER
9000 KVA
LA
ISO
SF6
BKR
KV
CT
2500 2700 2700 2500
KV ODY
LOOP-IN FROM
PATTANAMTHITTU R.S.
110 KV
LOOP-OUT TO
SEETATHODU R.S. 110 KV
LA (LINE)
TRANSFORMER
BAY
POWER TRANSFORMER
9000 KVA
SF6 BREAKER
ISO (LINE)
LA (LINE)
9500
4500
7700
3750 4200 4500 3600 4500 4000 3500
MINI HYDRO POWER PROJECT
ESMAP STUDY
MANIYAR POWER HOUSE
ELECTRICAL LAYOUT
(KERALA)



sads/w46595(113)

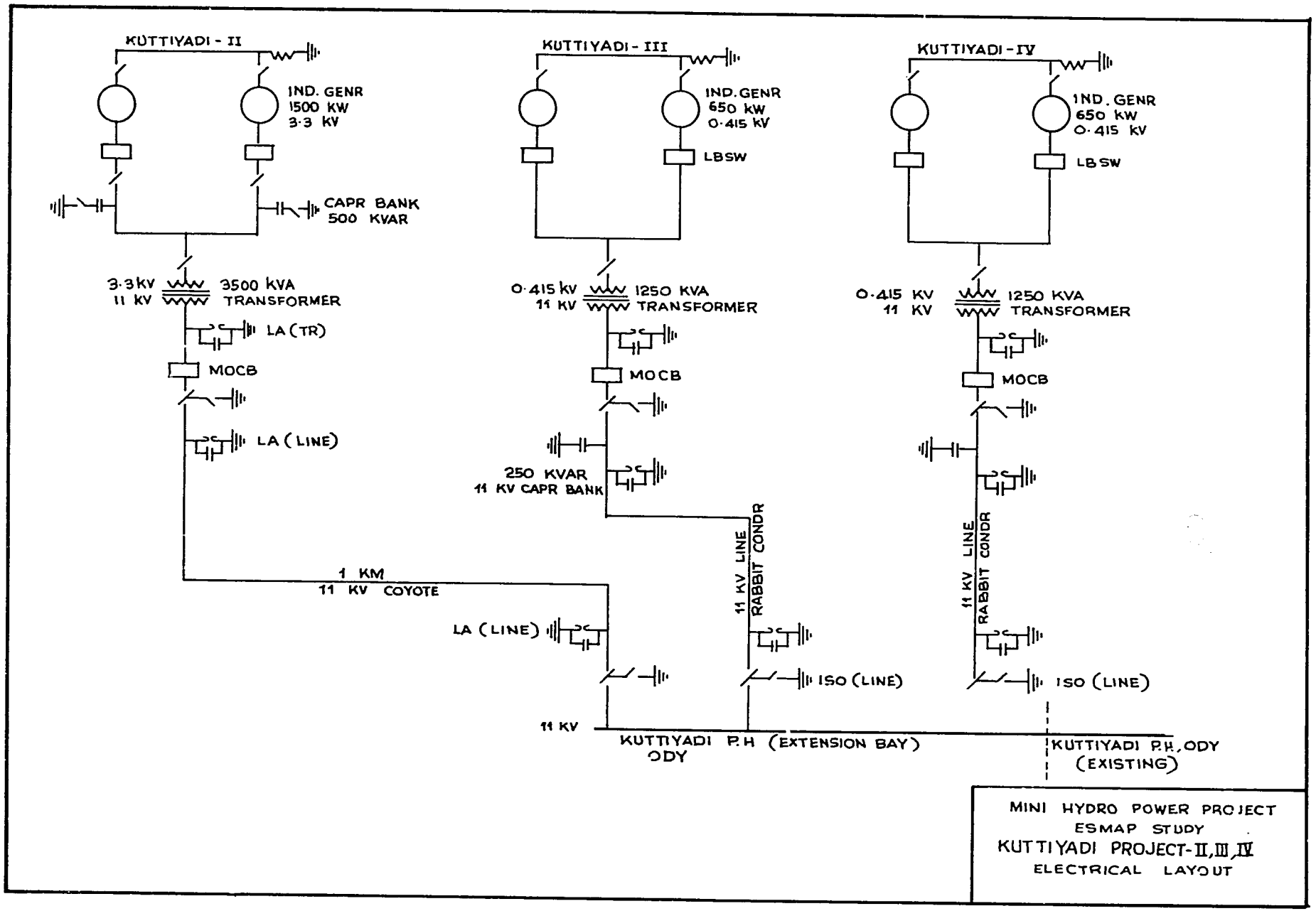




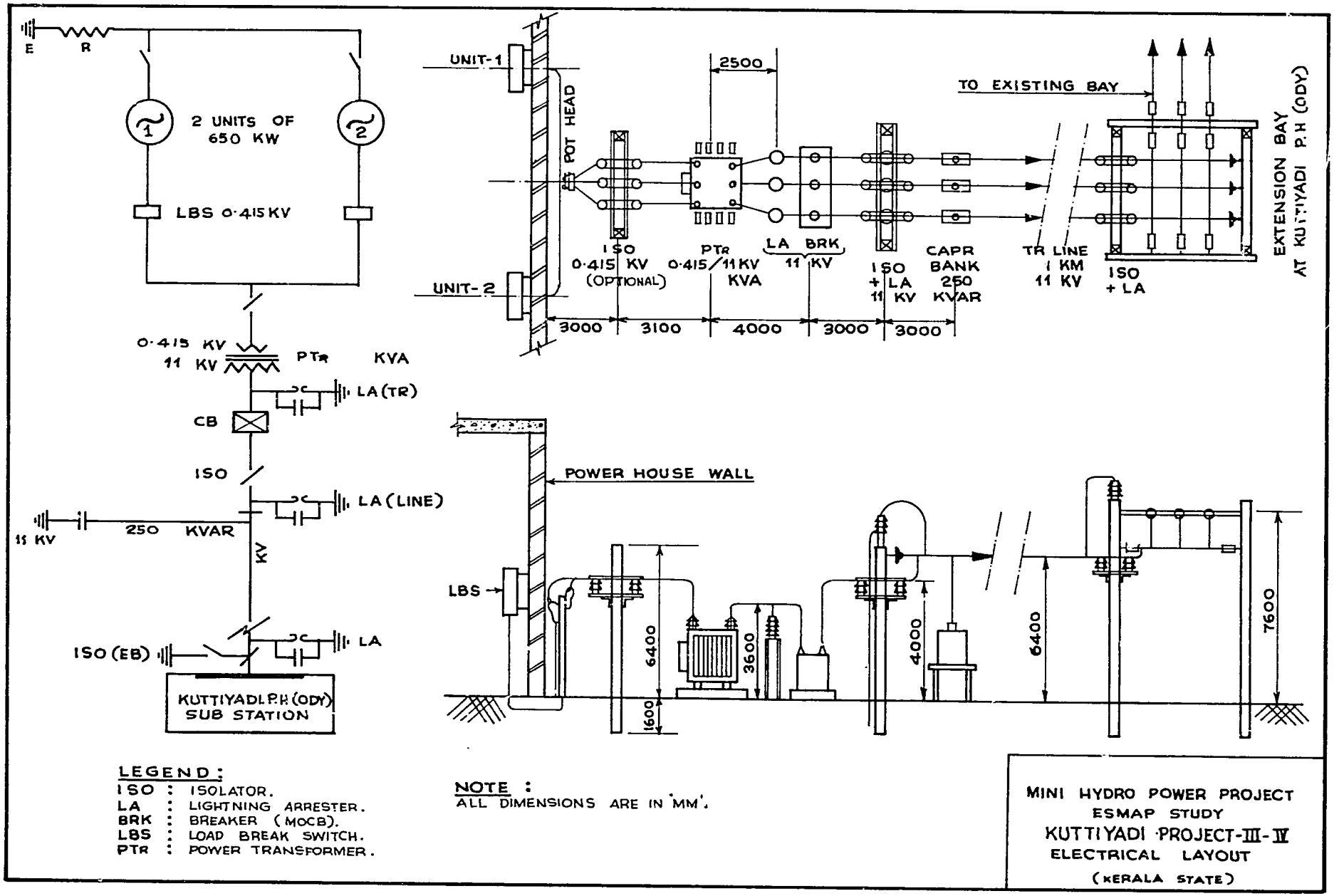
POWER HOUSE PLAN

MINI HYDRO POWER PROJECT
ESMAP STUDY
KUTTIYADI
POWER HOUSE DETAILS
KSEB PROPOSAL

SHEET:



sads/w48595(65)



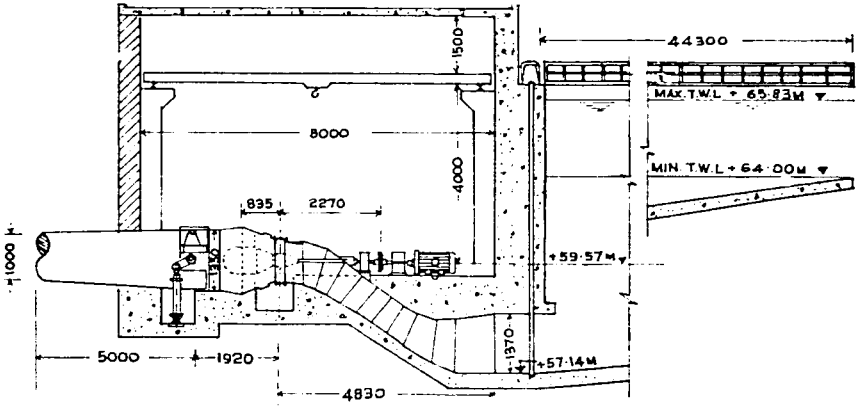
LEGEND:

ISO : ISOLATOR.
LA : LIGHTNING ARRESTER.
BRK : BREAKER (MOCB).
LBS : LOAD BREAK SWITCH.
PTR : POWER TRANSFORMER.

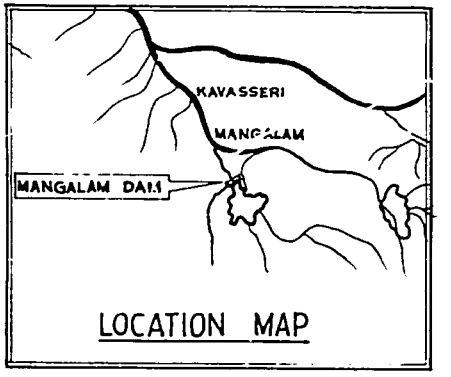
NOTE :
ALL DIMENSIONS ARE IN 'MM'.

MINI HYDRO POWER PROJECT
ESMAP STUDY
KUTTIYADI PROJECT-III-IV
ELECTRICAL LAYOUT
(KERALA STATE)

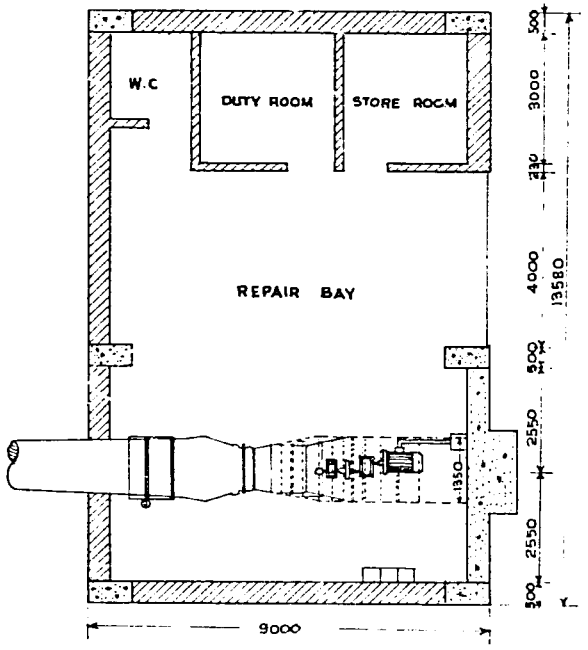
sads/w48595(60)



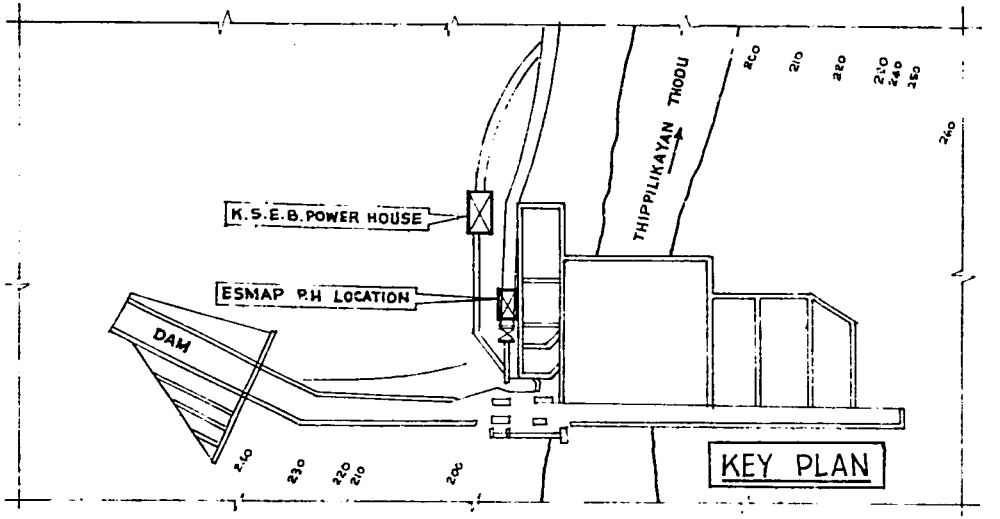
SECTION



LOCATION MAP



POWER HOUSE PLAN

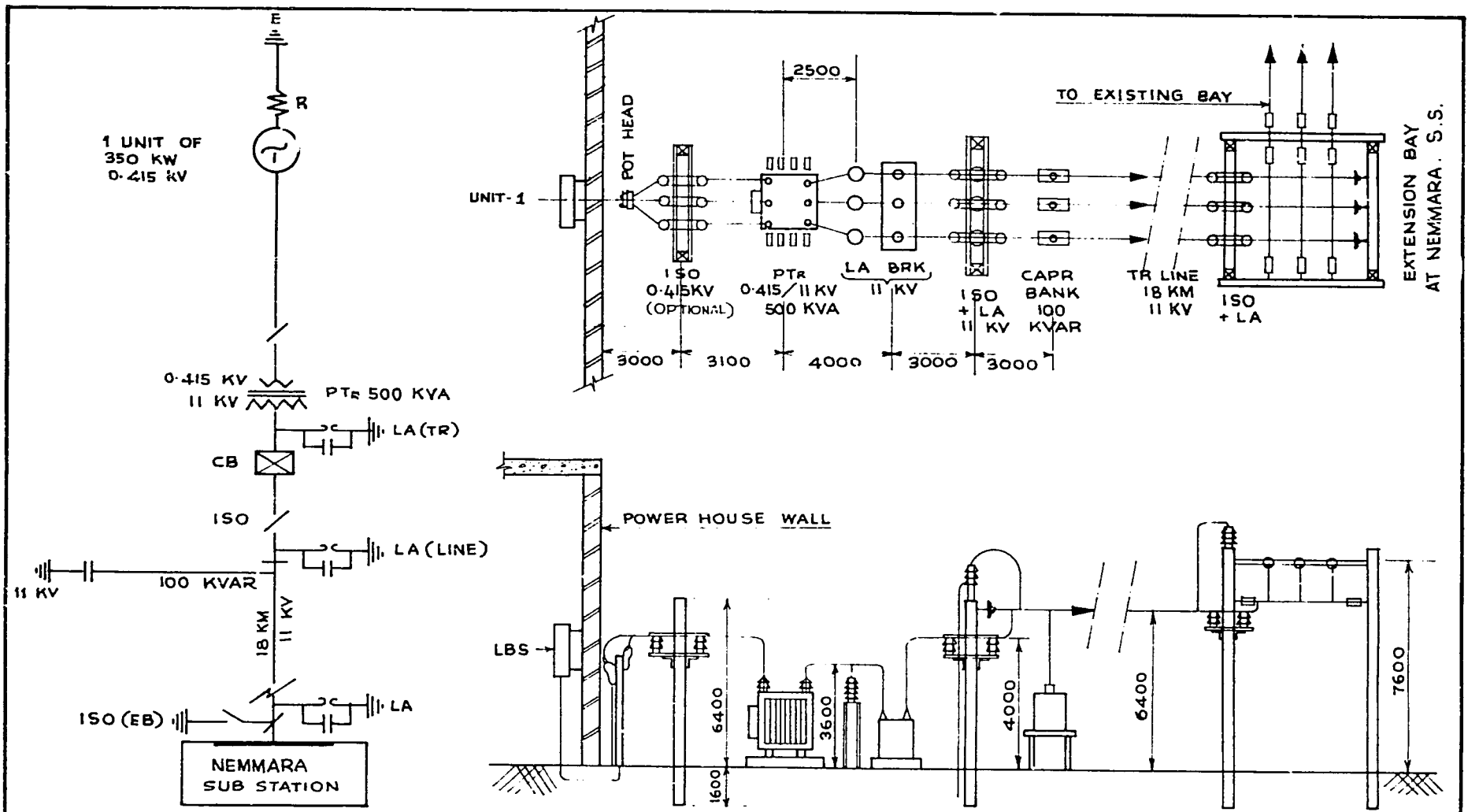


KEY PLAN

NOTE:
THE DETAILS ARE AS PER PROJECT REPORT OF K.S.E.B.
E.S.M.A.P. ALTERNATIVE IS AT SLUICE END

MINI HYDRO POWER PROJECT
ESMAP STUDY
MANGALAM DAM
& POWER HOUSE DETAILS
KSEB PROPOSAL & ESMAP ALTERNATIVES
SHEET:

sads/w48595(6 /)



LEGEND :

ISO : ISOLATOR.
LA : LIGHTNING ARRESTER.
BRK : BREAKER (MOCB).
LBS : LOAD BREAK SWITCH.
PTR : POWER TRANSFORMER.

NOTE :
ALL DIMENSIONS ARE IN 'MM'.

MINI HYDRO POWER PROJECT
ESMAP STUDY
MANGALAM PROJECT
ELECTRICAL LAYOUT
(KERALA)

sads/w48595(61)

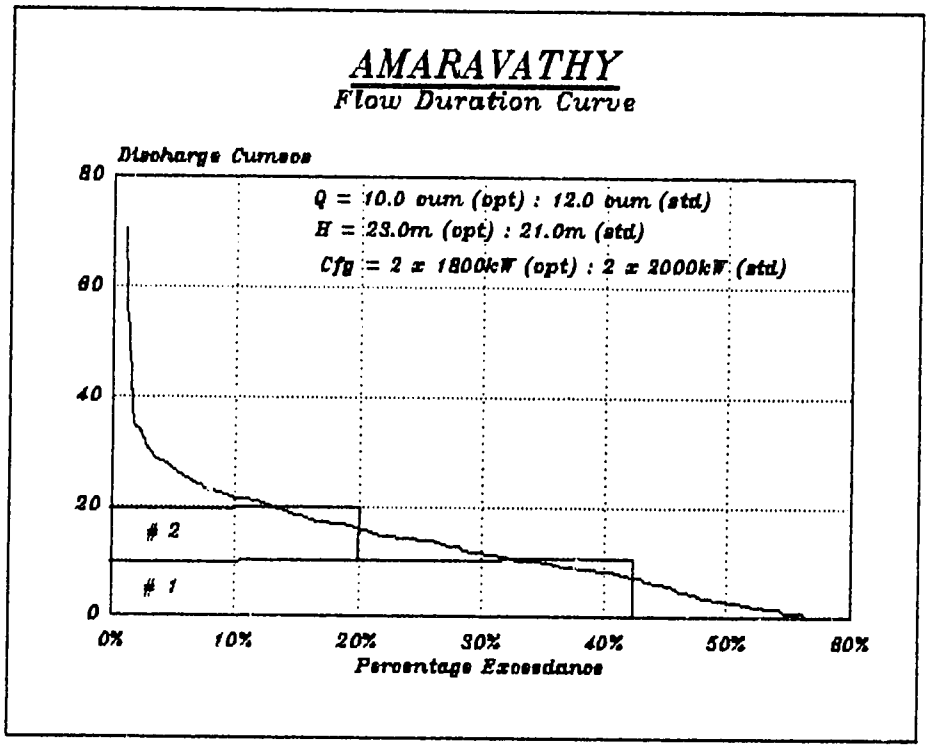
958

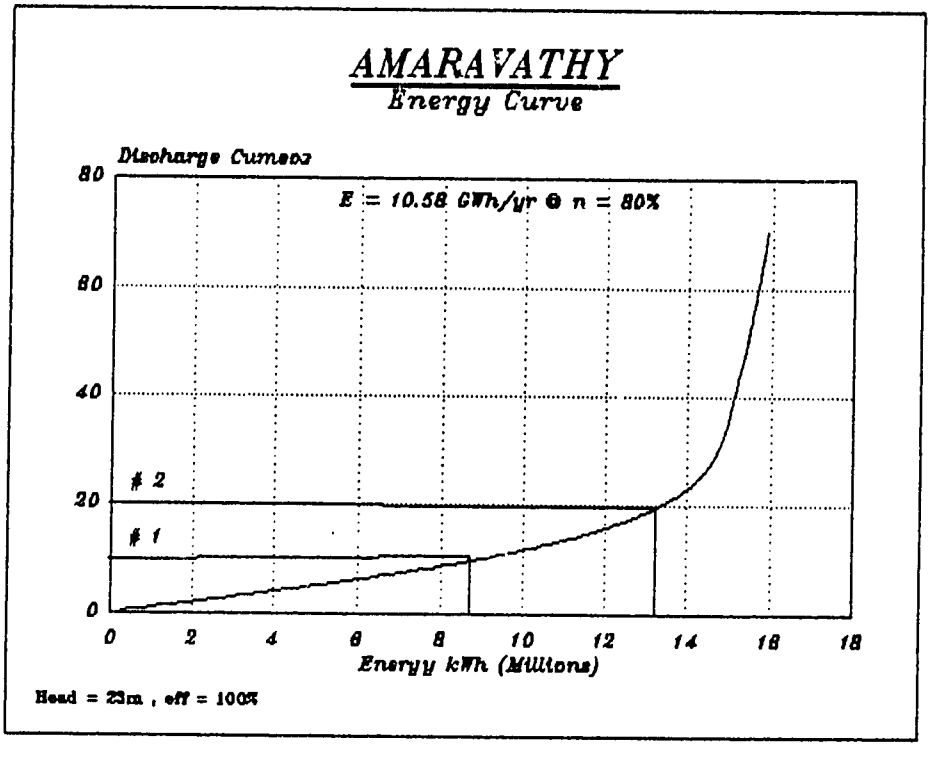
SECTION IV - TAMIL NADU

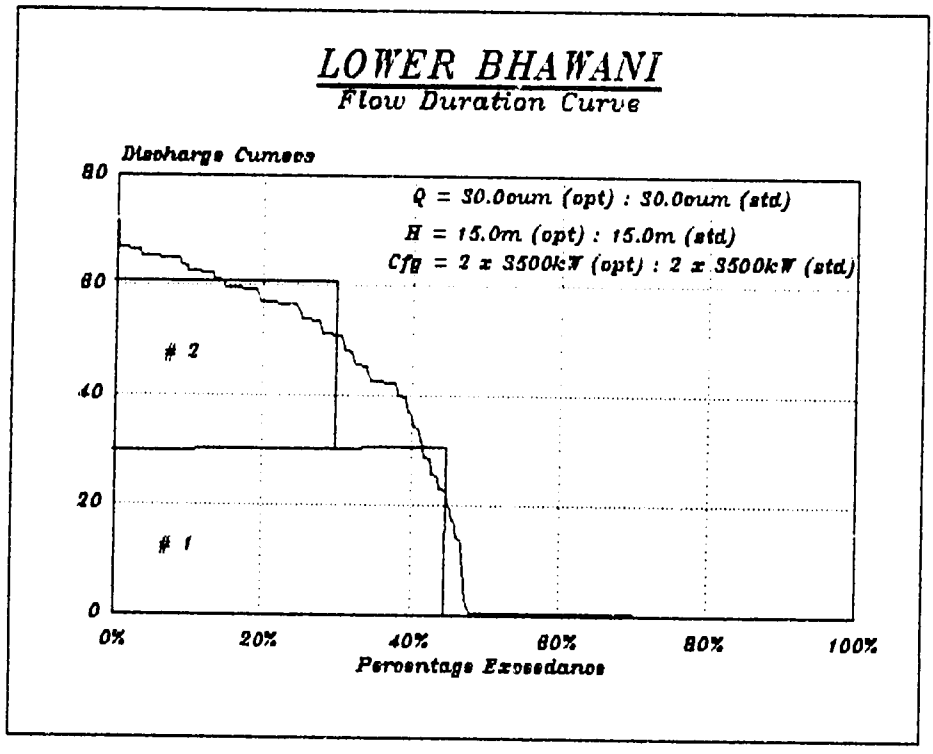
Lower Bhavani
Thirumurthy Dam
Amararathy Dam
Sathanur Dam
Pechi Parai Dam
Perunchani Dam
Aliyar Dam

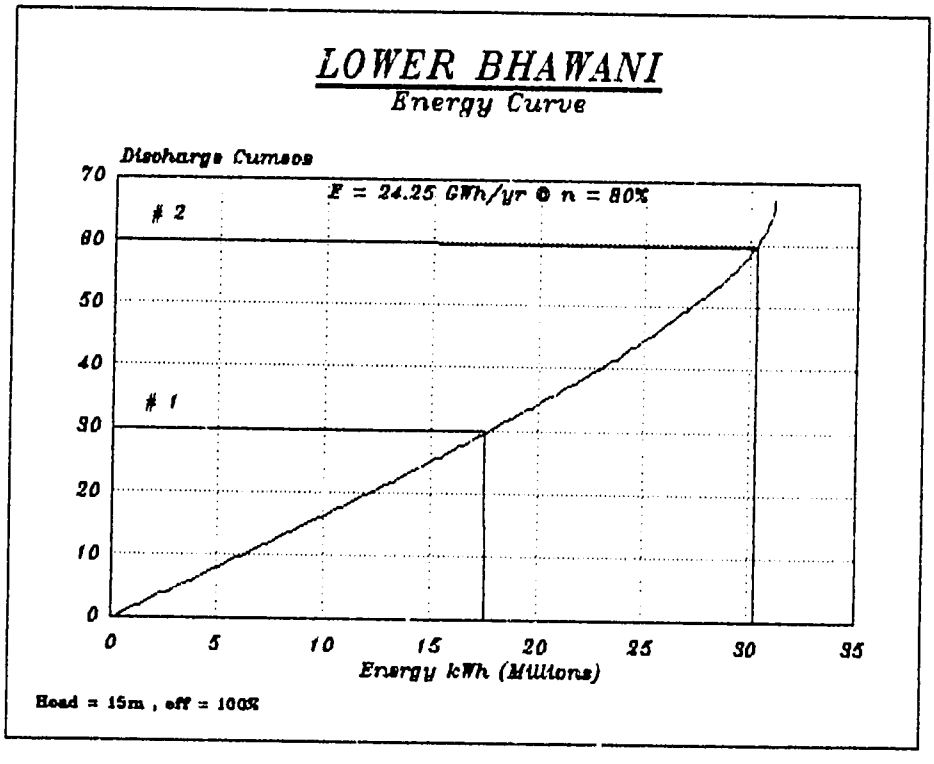
Contents:

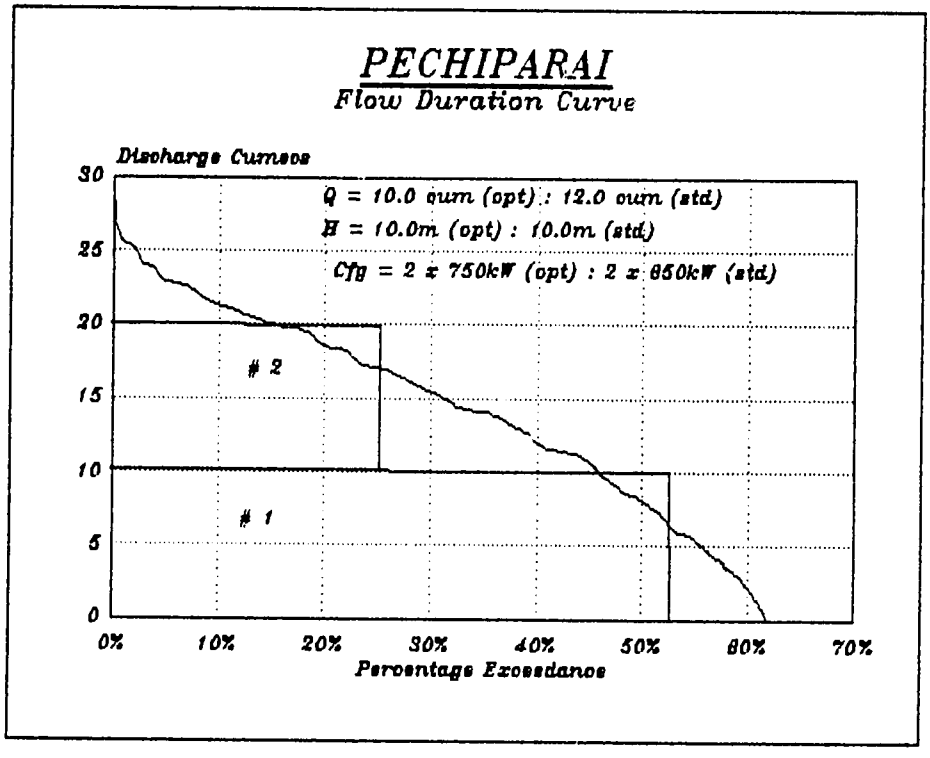
1. ***Design Graphs***
   (Flow duration curves, Energy curves)
2. ***Technical Drawings***
   (Layouts, Electrical Schemes, Grid-Tie Arrangements)

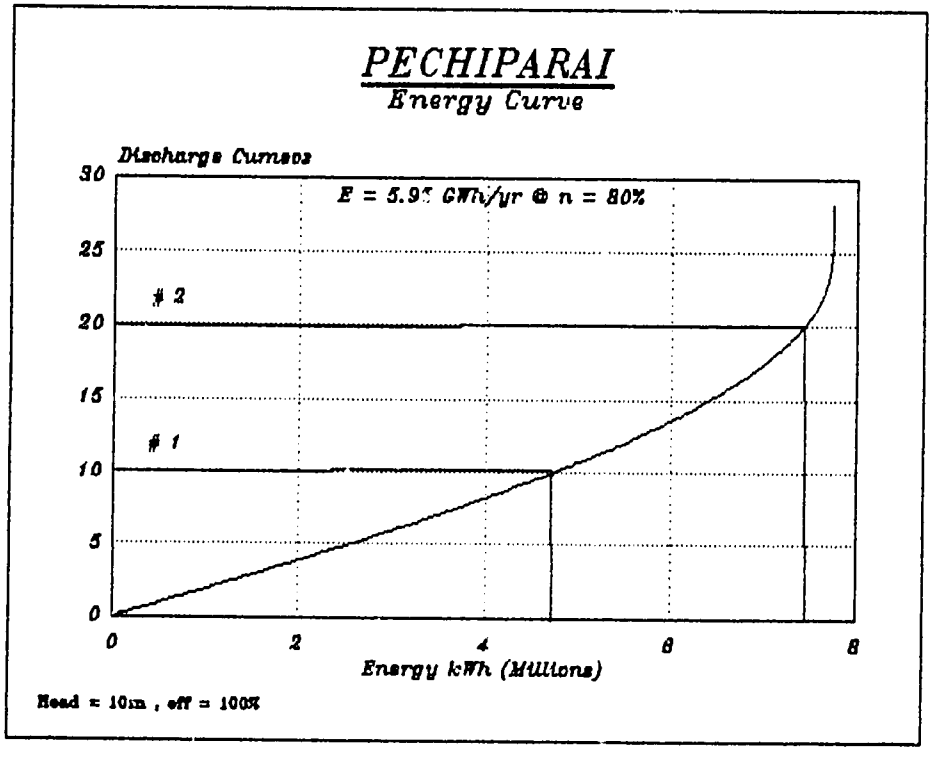

AMARAVATHY
Flow Duration Curve
Discharge Cumecs
Q = 10.0 cum (opt) : 12.0 cum (std)
H = 23.0m (opt) : 21.0m (std)
Cfg = 2 x 1800kW (opt) : 2 x 2000kW (std)
# 2
# 1
0
20
40
60
80
0%
10%
20%
30%
40%
50%
60%
Percentage Exceedance

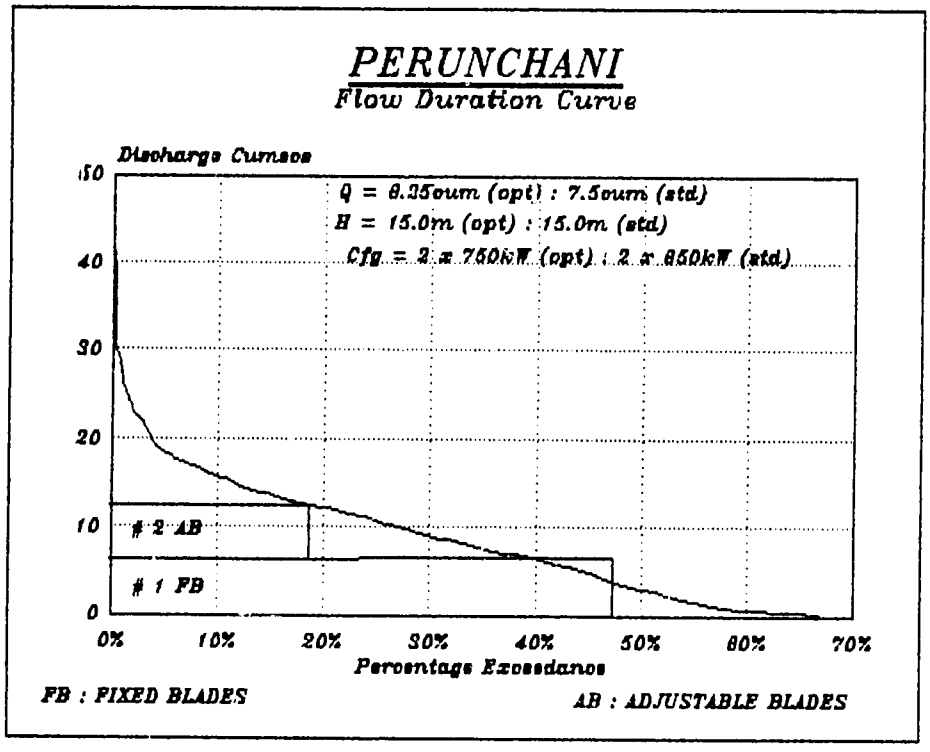

AMARAVATHY
Energy Curve
Discharge Cumecs
E = 10.58 GWh/yr @ n = 80%
# 2
# 1
0
20
40
60
80
0
2
4
6
8
10
12
14
16
18
Energy kWh (Millions)
Head = 23m , eff = 100%

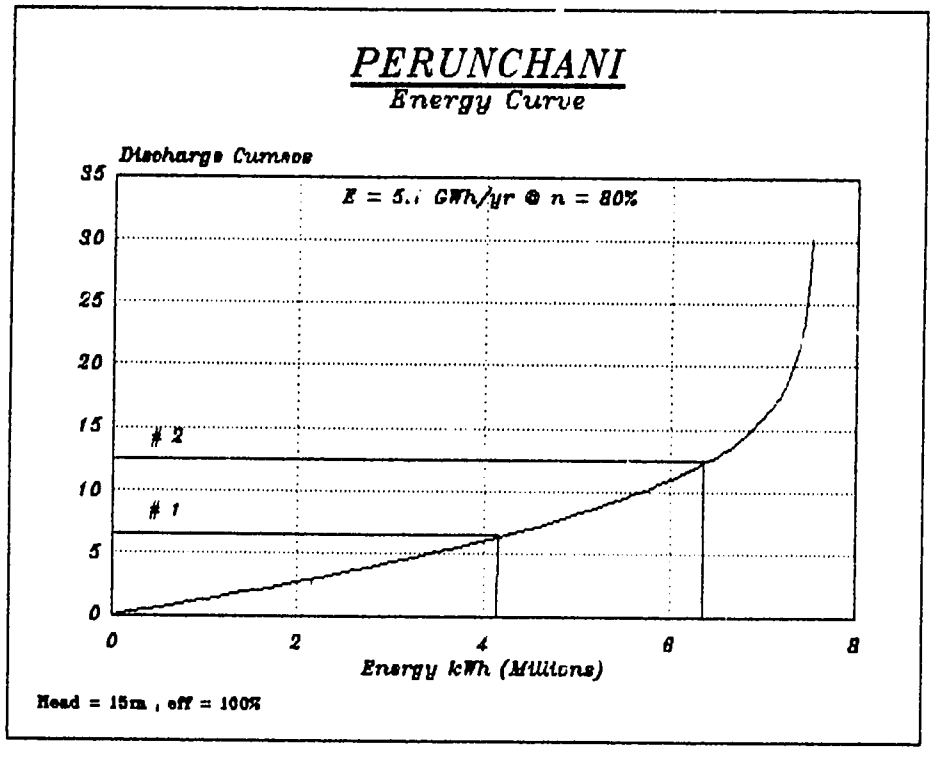

LOWER BHAWANI
Flow Duration Curve
Discharge Cumecs
Q = 30.0cum (opt) : 30.0cum (std)
H = 15.0m (opt) : 15.0m (std)
Cfg = 2 x 3500kW (opt) : 2 x 3500kW (std)
# 2
# 1
80
60
40
20
0
0%
20%
40%
60%
80%
100%
Percentage Exceedance

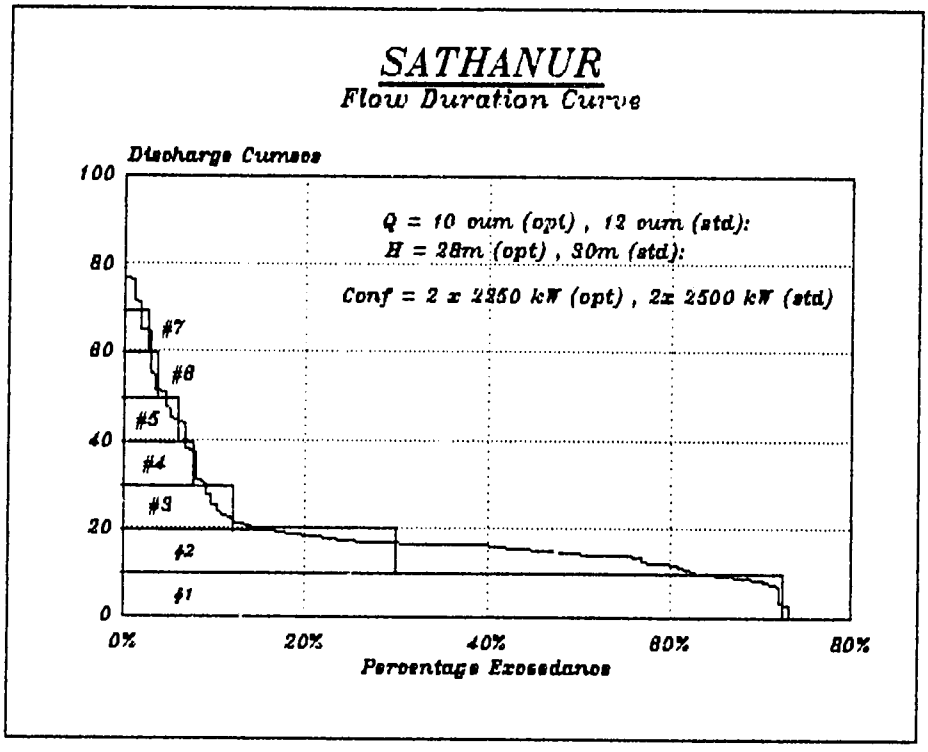

LOWER BHAWANI
Energy Curve
Discharge Cumecs
E = 24.25 GWh/yr @ n = 80%
# 2
# 1
70
60
50
40
30
20
10
0
0
5
10
15
20
25
30
35
Energy kWh (Millions)
Head = 15m , eff = 100%

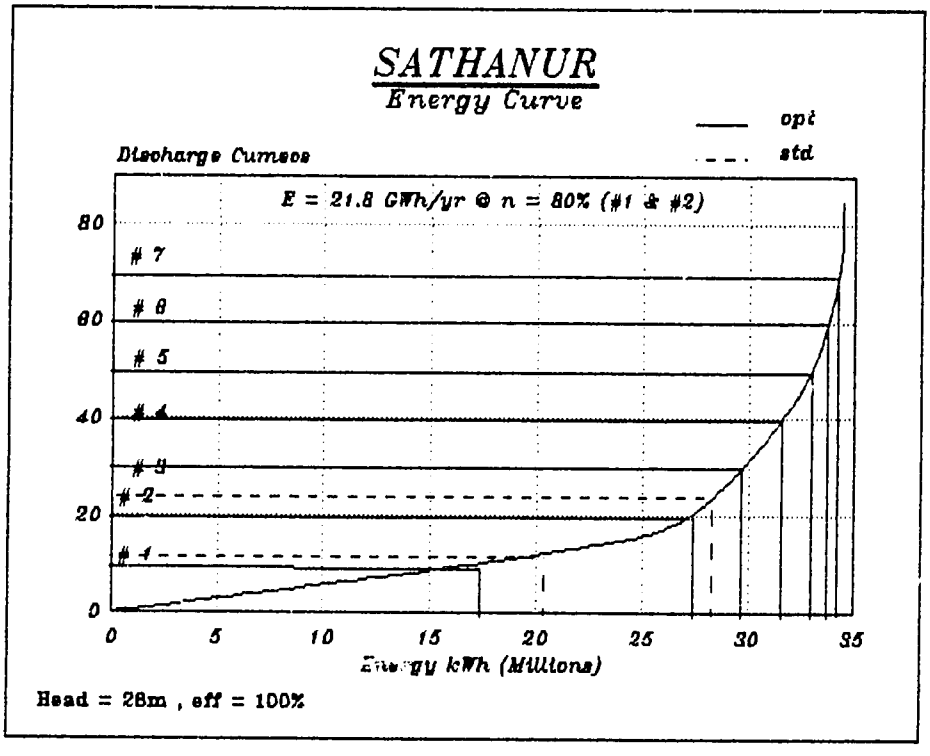

PECHIPARAI
Flow Duration Curve
Discharge Cumecs
Q = 10.0 cum (opt) : 12.0 cum (std)
H = 10.0m (opt) : 10.0m (std)
Cfg = 2 x 750kW (opt) : 2 x 850kW (std)
# 2
# 1
30
25
20
15
10
5
0
0%
10%
20%
30%
40%
50%
60%
70%
Percentage Exceedance

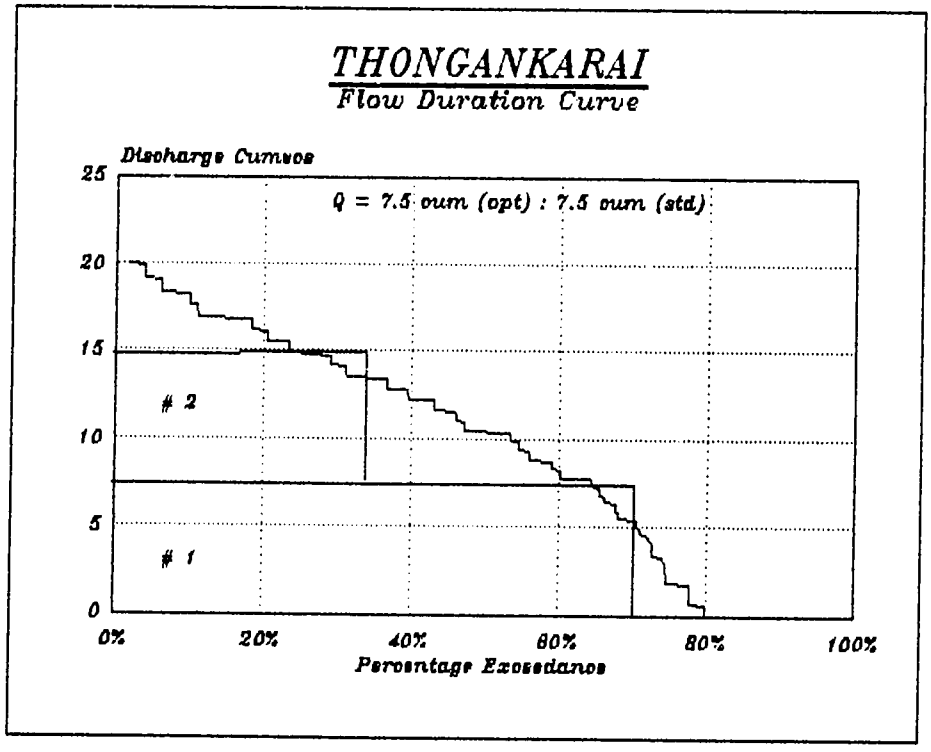

PECHIPARAI
Energy Curve
Discharge Cumecs
E = 5.97 GWh/yr @ n = 80%
# 2
# 1
30
25
20
15
10
5
0
0
2
4
6
8
Energy kWh (Millions)
Head = 10m , eff = 100%

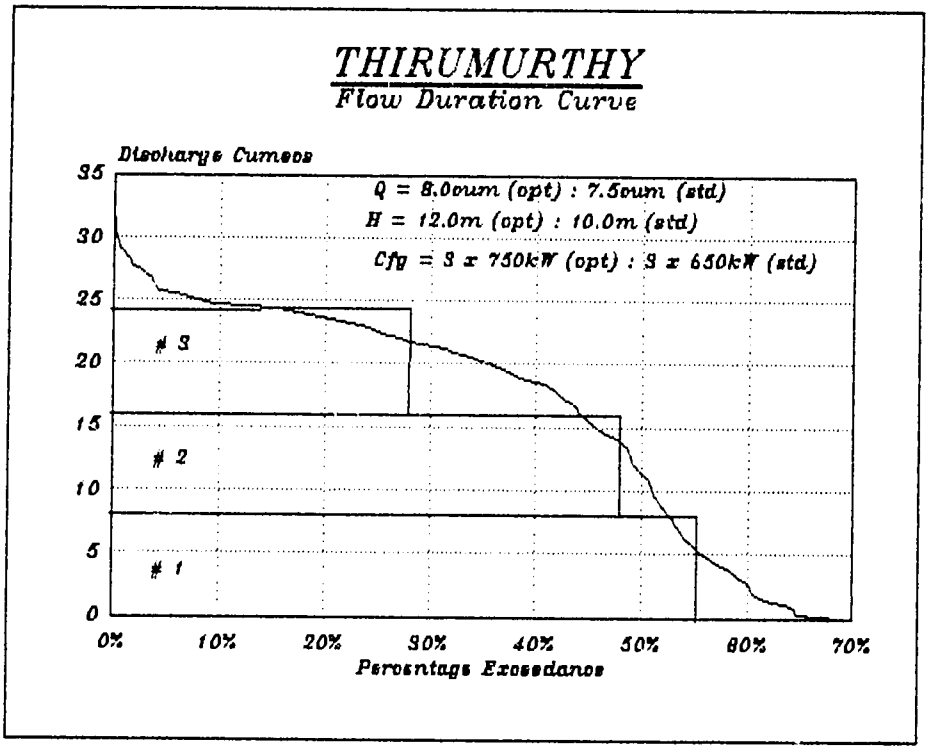

PERUNCHANI
Flow Duration Curve
Discharge Cumecs
Q = 8.25cum (opt) : 7.5cum (std)
H = 15.0m (opt) : 15.0m (std)
Cfg = 2 x 750kW (opt) : 2 x 650kW (std)
50
40
30
20
10
0
2 AB
1 FB
0%
10%
20%
30%
40%
50%
60%
70%
Percentage Exceedance
FB : FIXED BLADES
AB : ADJUSTABLE BLADES

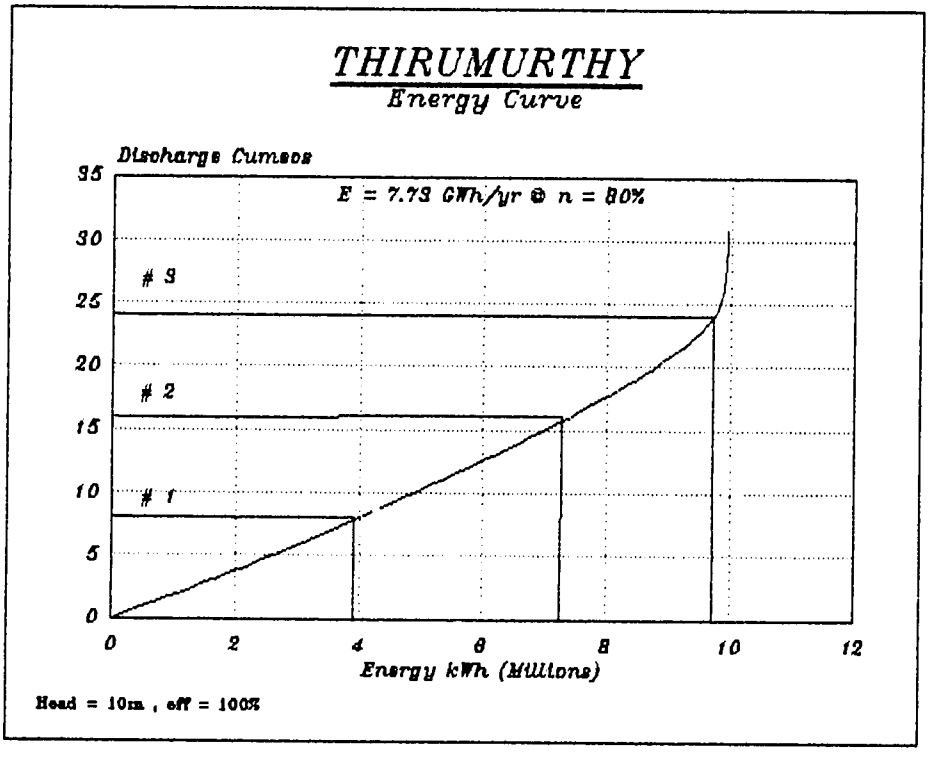

PERUNCHANI
Energy Curve
Discharge Cumecs
E = 5.1 GWh/yr @ n = 80%
35
30
25
20
15
10
5
0
2
1
0
2
4
6
8
Energy kWh (Millions)
Head = 15m , eff = 100%

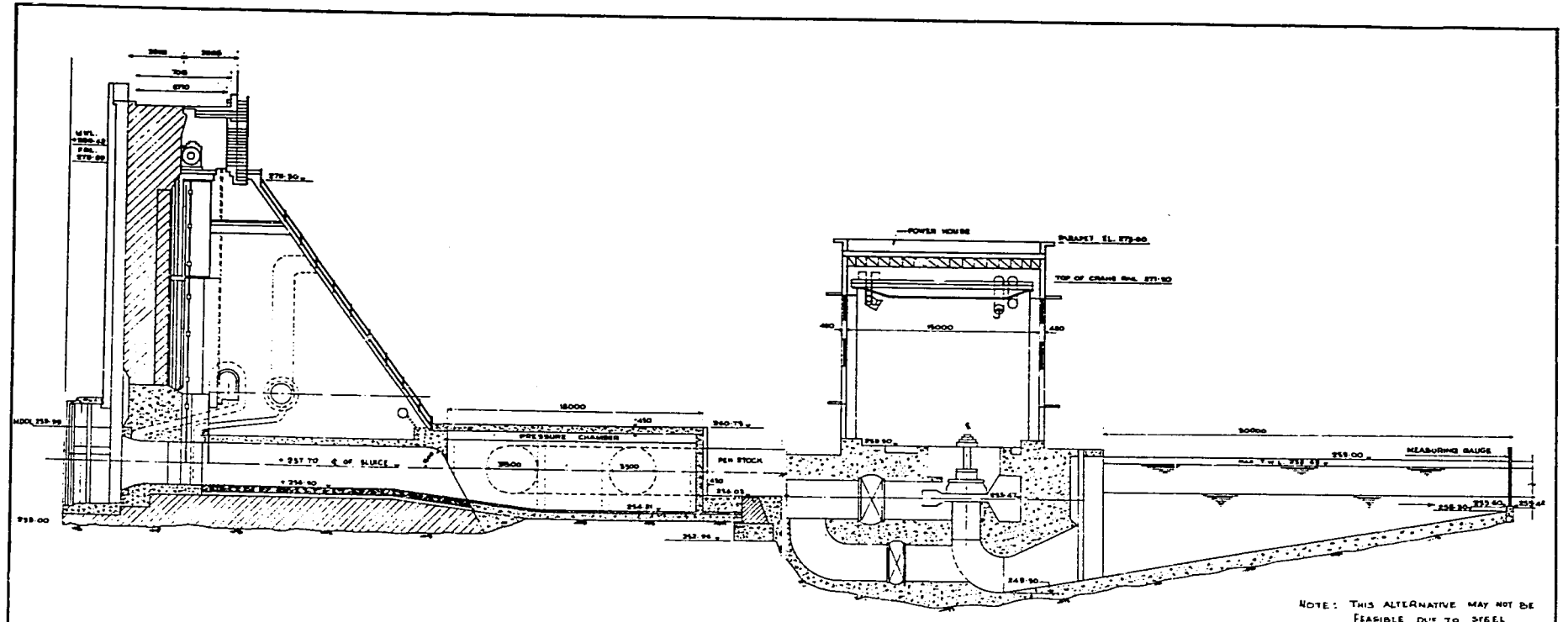

SATHANUR
Flow Duration Curve
Discharge Curves
Q = 10 cum (opt) , 12 cum (std):
H = 28m (opt) , 30m (std):
Conf = 2 x 2350 kW (opt) , 2x 2500 kW (std)
#7
#6
#5
#4
#3
#2
#1
100
80
60
40
20
0
0%
20%
40%
60%
80%
Percentage Exceedance


SATHANUR
Energy Curve
opt
std
Discharge Curves
E = 21.8 GWh/yr @ n = 80% (#1 & #2)
# 7
# 6
# 5
# 4
# 3
# 2
# 1
80
60
40
20
0
0
5
10
15
20
25
30
35
Energy kWh (Millions)
Head = 28m , eff = 100%


THONGANKARAI
Flow Duration Curve
Discharge Cumecs
Q = 7.5 cum (opt) : 7.5 cum (std)
25
20
15
10
5
0
2
1
0%
20%
40%
60%
80%
100%
Percentage Exceedance


THIRUMURTHY
Flow Duration Curve
Discharge Cumecs
Q = 8.0cum (opt) : 7.5cum (std)
H = 12.0m (opt) : 10.0m (std)
Cfg = 3 x 750kW (opt) : 3 x 650kW (std)
# 3
# 2
# 1
35
30
25
20
15
10
5
0
0%
10%
20%
30%
40%
50%
60%
70%
Percentage Exceedance


THIRUMURTHY
Energy Curve
Discharge Cumecs
E = 7.73 GWh/yr @ n = 80%
# 3
# 2
# 1
35
30
25
20
15
10
5
0
0
2
4
6
8
10
12
Energy kWh (Millions)
Head = 10m , eff = 100%

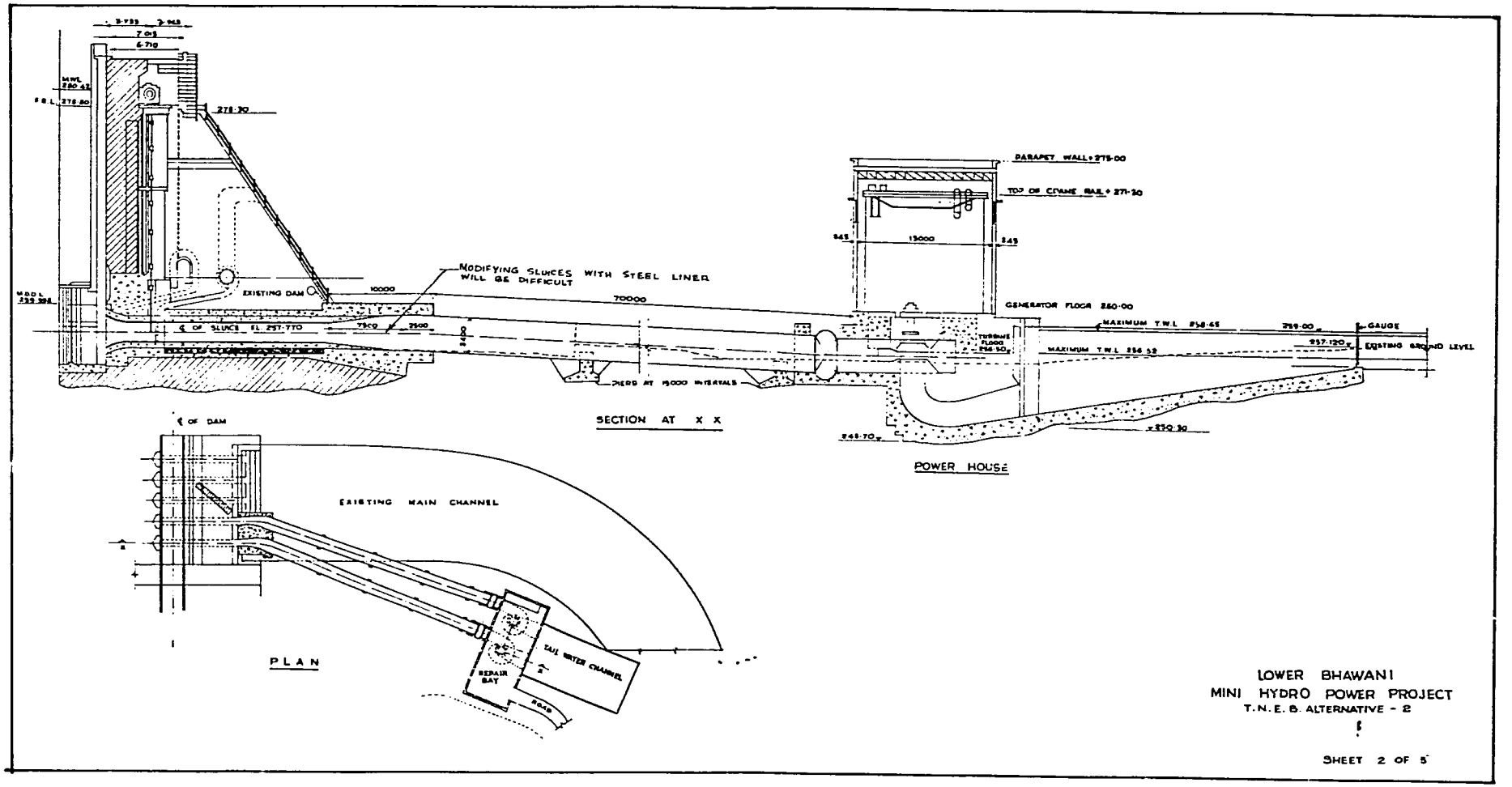


NOTE: THIS ALTERNATIVE MAY NOT BE FEASIBLE DUE TO STEEL ANCHOR BARS REQUIRED TO COUNTERACT PRESSURES FROM RESERVOIR.

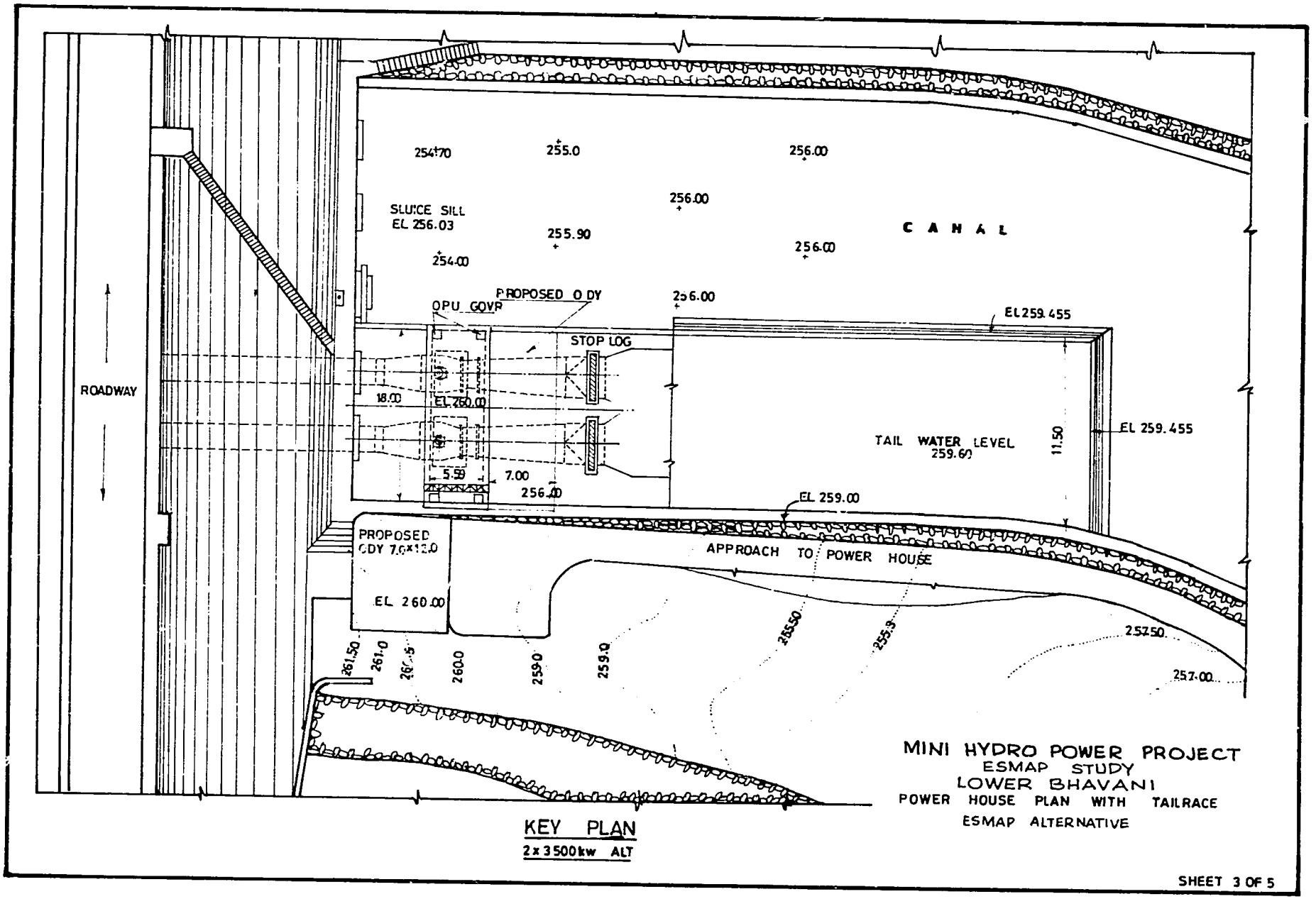
LOWER BHAWANI
MINI HYDRO POWER PROJECT
T N E B ALTERNATIVE - 1

SHEET 1 OF 5

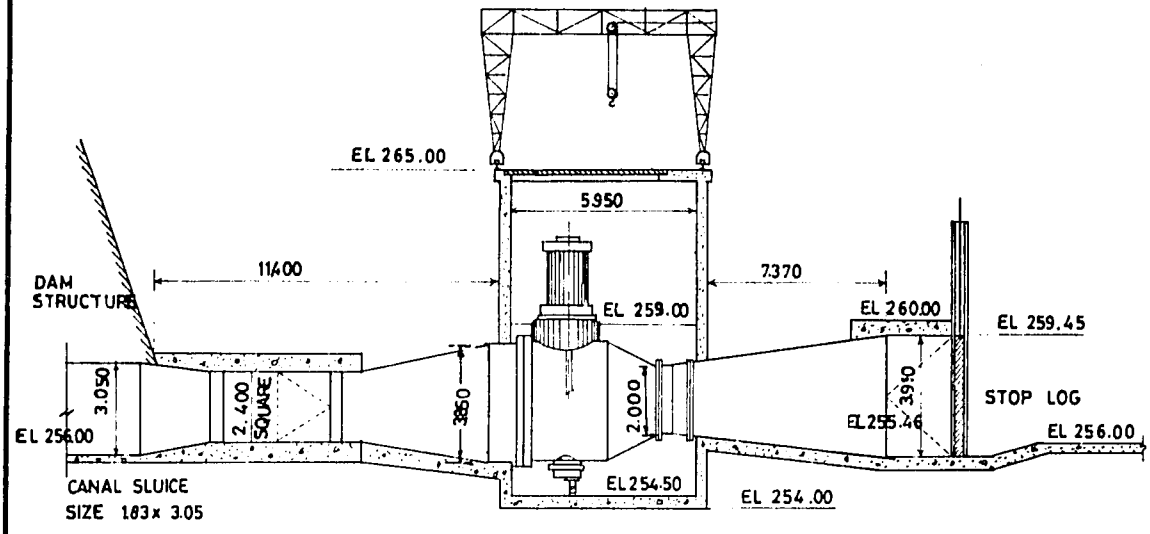
sads/w48595(76)



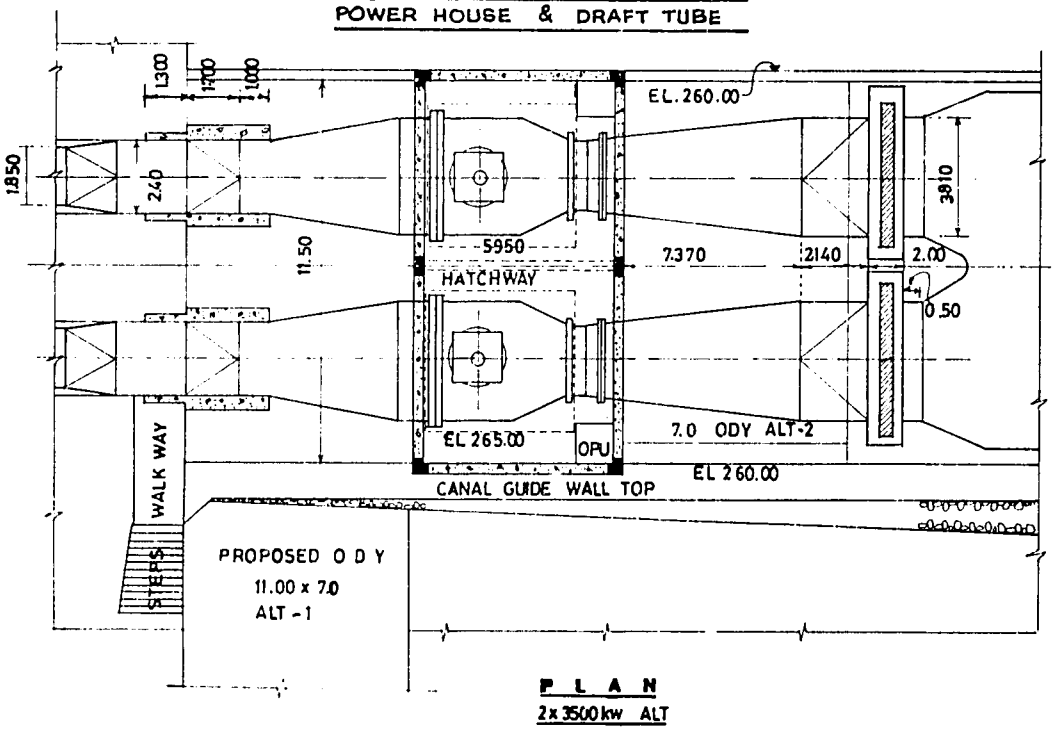
sade/w48505(77)



sads/w48595(78)

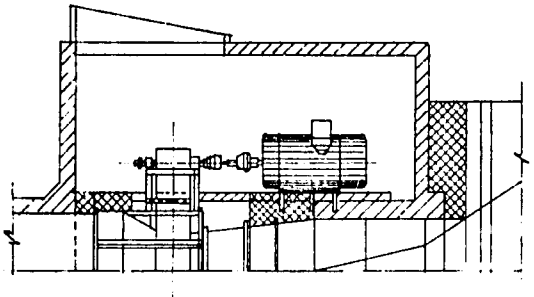


L- SECTION OF PENSTOCK
POWER HOUSE & DRAFT TUBE



PLAN
2x 3500 kw ALT

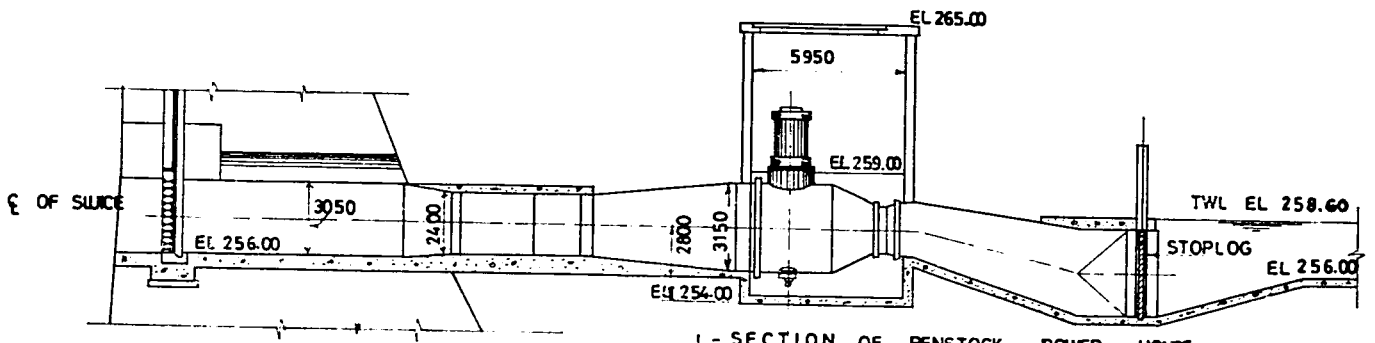
SUITABLE MODIFICATIONS SUCH AS RIM TYPE OR BELT DRIVE TO RIGHT ANGLE DRIVE MAY BE CONSIDERED WITH ASSOCIATED ADDITIONAL FLOOR SPACE IF NECESSARY LATER



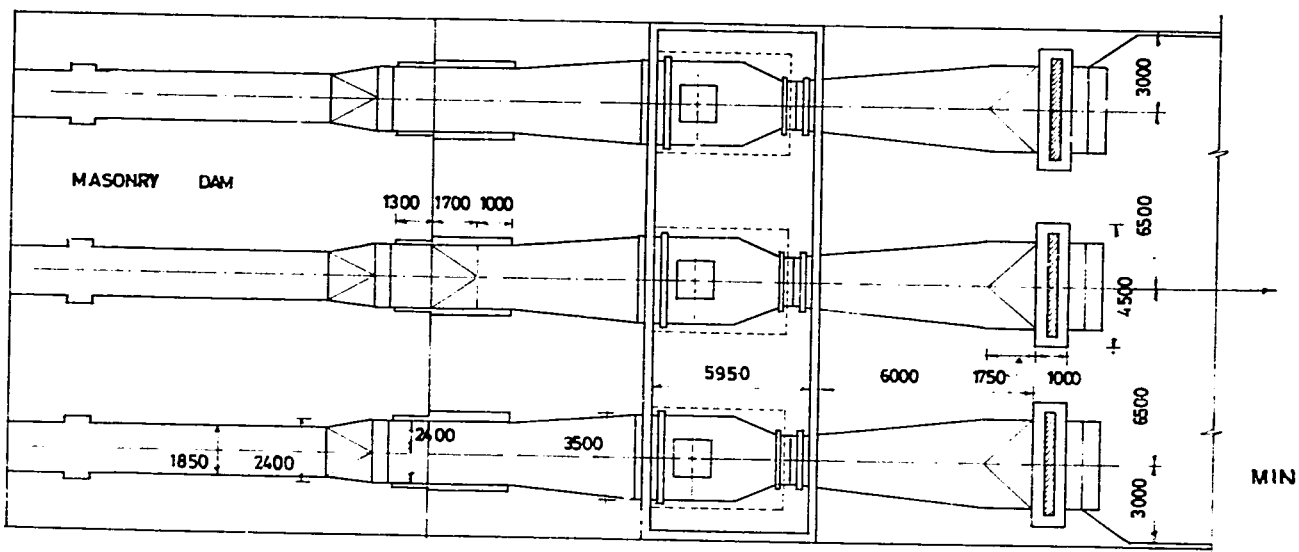
ALT ARRANGEMENT FOR GENERATOR
(BELT DRIVE)

MINI HYDRO POWER PROJECT
ESMAP STUDY
LOWER BHAVANI
POWER HOUSE
ESMAP ALTERNATIVE

SHEET 4 OF 5



L - SECTION OF PENSTOCK POWER HOUSE AND DRAFT TUBE

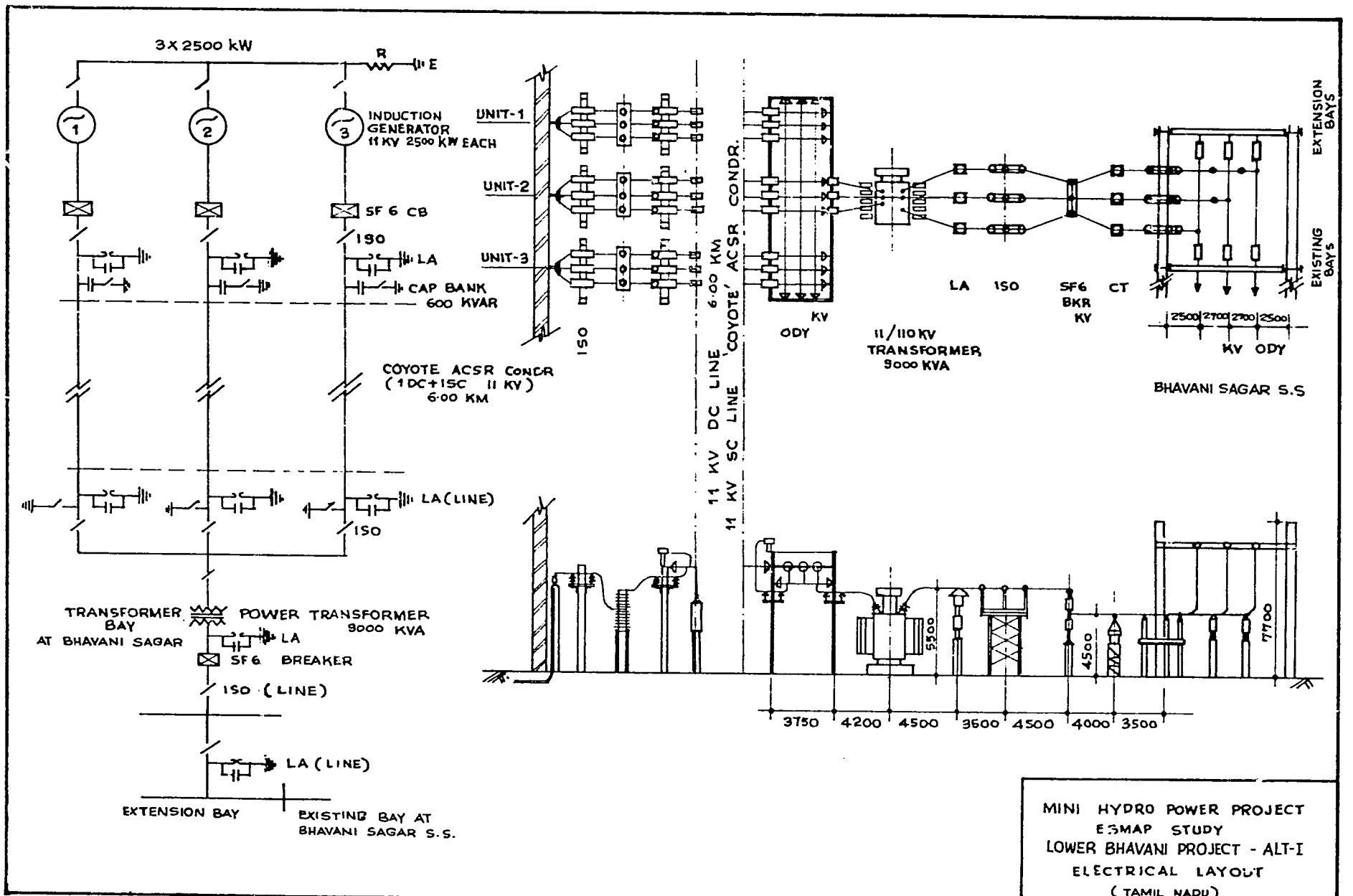


PLAN - POWER HOUSE
3x 2500kw ALT

MINI HYDRO POWER PROJECT
ESMAP STUDY
LOWER BHAVANI
POWER HOUSE
ESMAP ALTERNATIVE

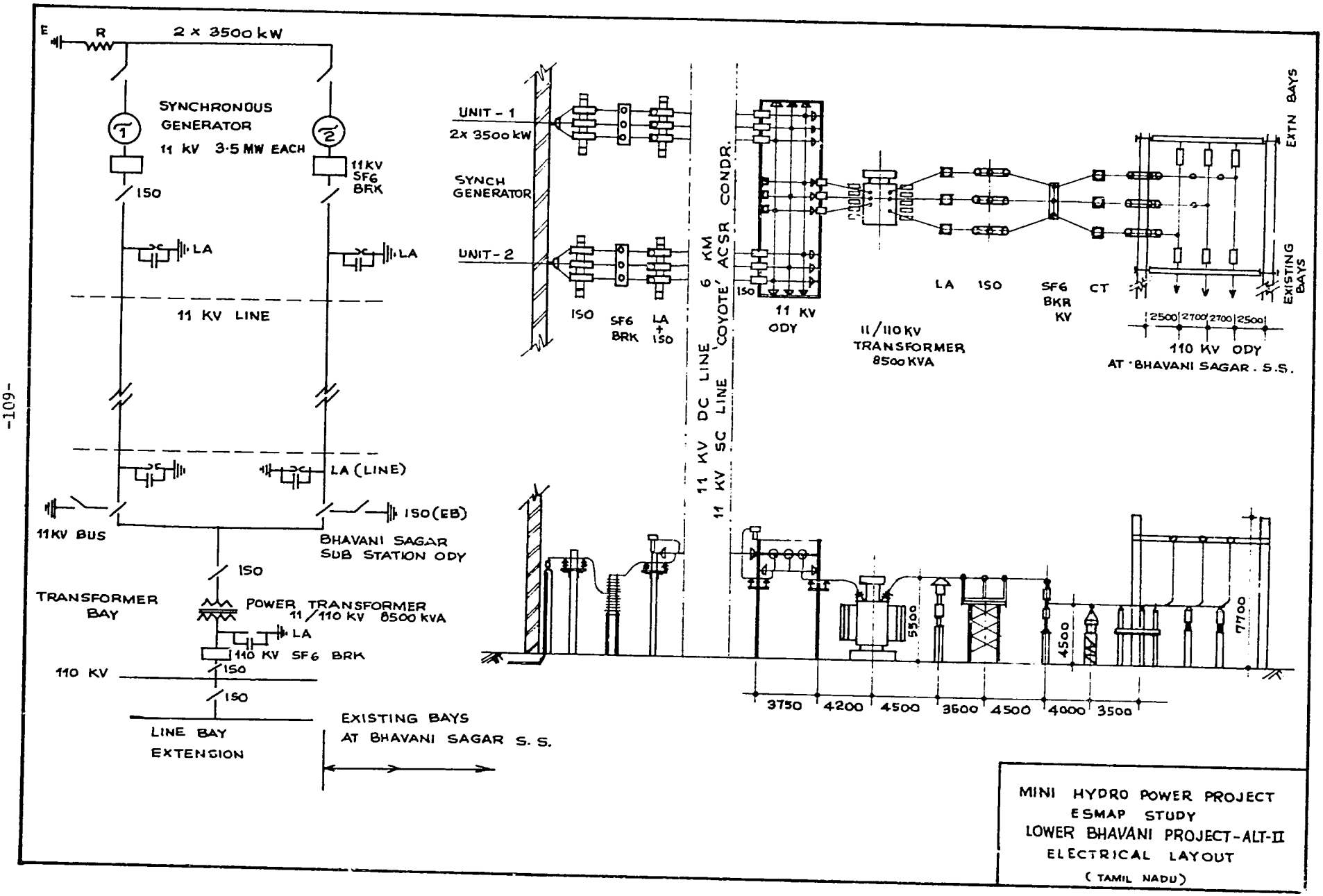
SHEET 5 OF 5

sads/w48595(80)



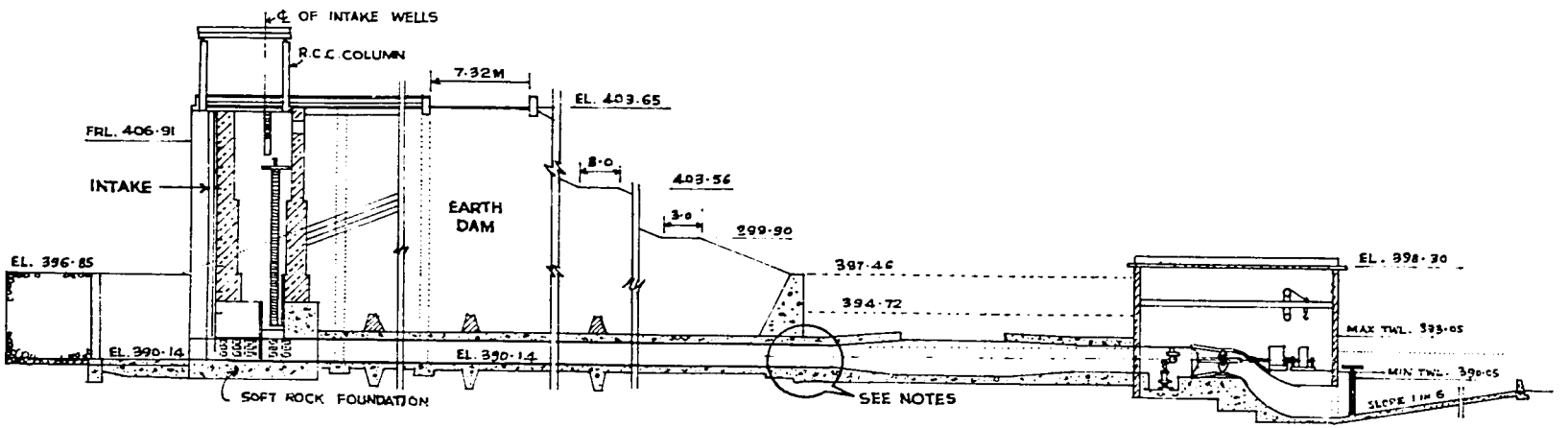
MINI HYDRO POWER PROJECT
ESMAP STUDY
LOWER BHAVANI PROJECT - ALT-I
ELECTRICAL LAYOUT
(TAMIL NADU)

sads/w48595(8/)

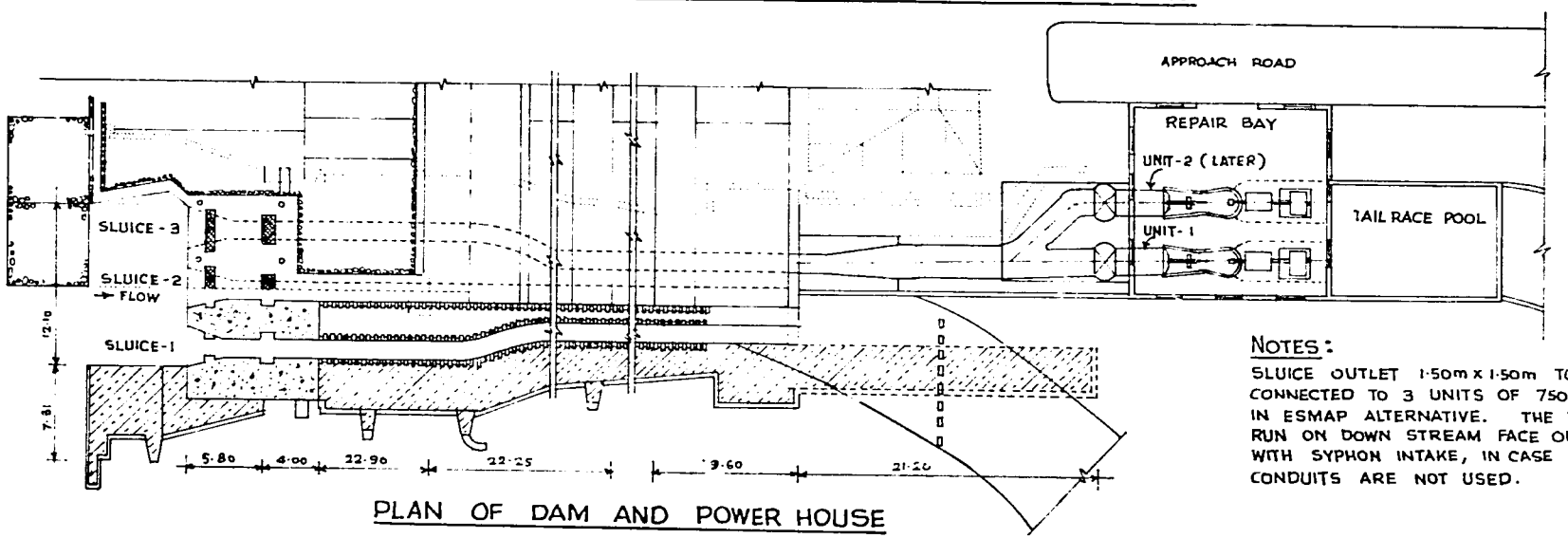


MINI HYDRO POWER PROJECT
ESMAP STUDY
LOWER BHAVANI PROJECT-ALT-II
ELECTRICAL LAYOUT
(TAMIL NADU)

sads/w48595(82)



L- SECTION OF INTAKE, CONDUIT AND POWER HOUSE



PLAN OF DAM AND POWER HOUSE

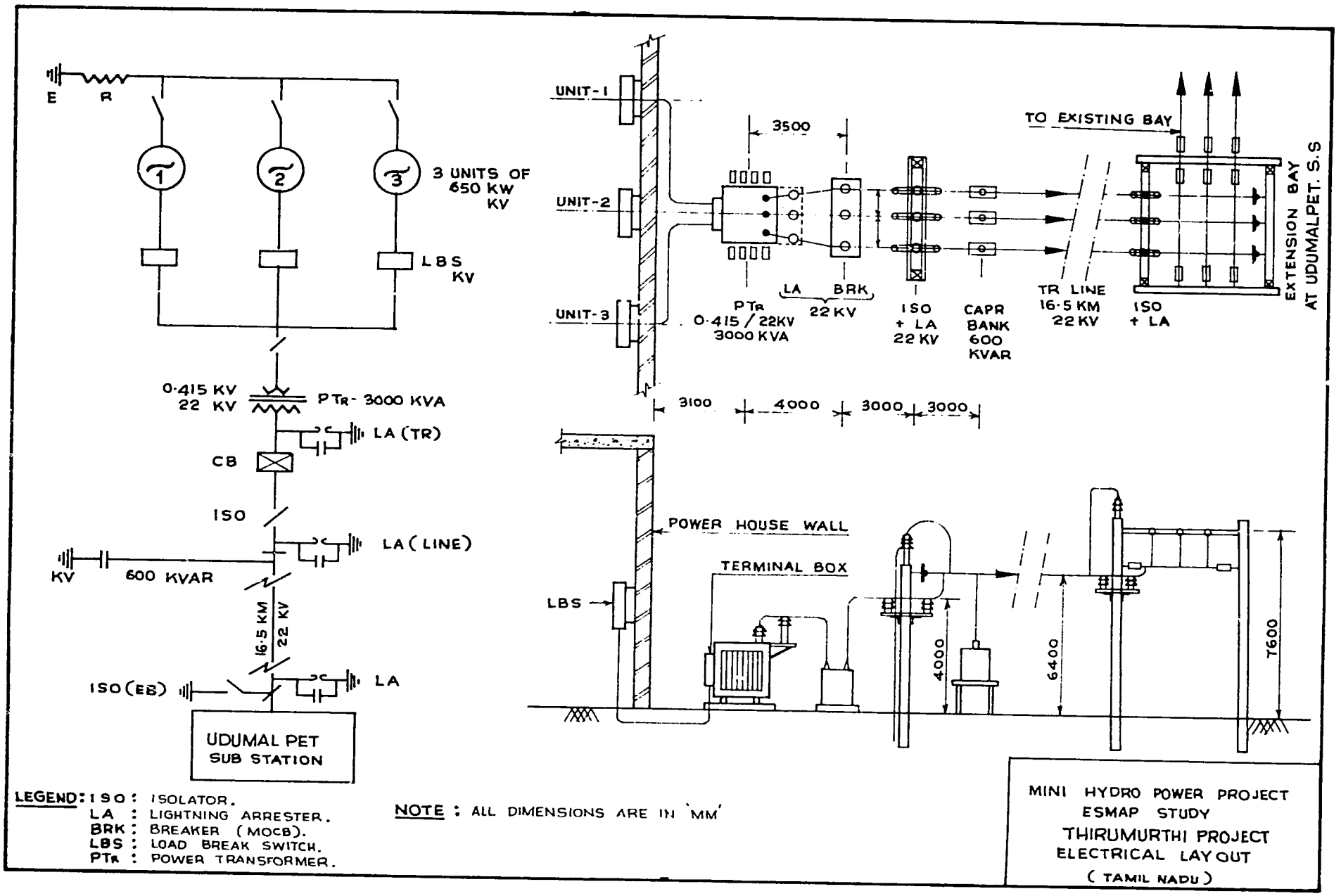
HALF PLAN AT TOP AND HALF THROUGH SLUICES

NOTES:

SLUICE OUTLET 1.50m x 1.50m TO BE CONNECTED TO 3 UNITS OF 750 kW TURBINES IN ESMAP ALTERNATIVE. THE PENSTOCK MAY RUN ON DOWN STREAM FACE OF EARTH DYKE WITH SYPHON INTAKE, IN CASE EXISTING CONDUITS ARE NOT USED.

MINI HYDRO POWER PROJECT.
ESMAP STUDY
THIRUMURTHI PROJECT OF TNEB
DAM & POWER HOUSE
TNEB PROPOSAL

sads/w48595(83)

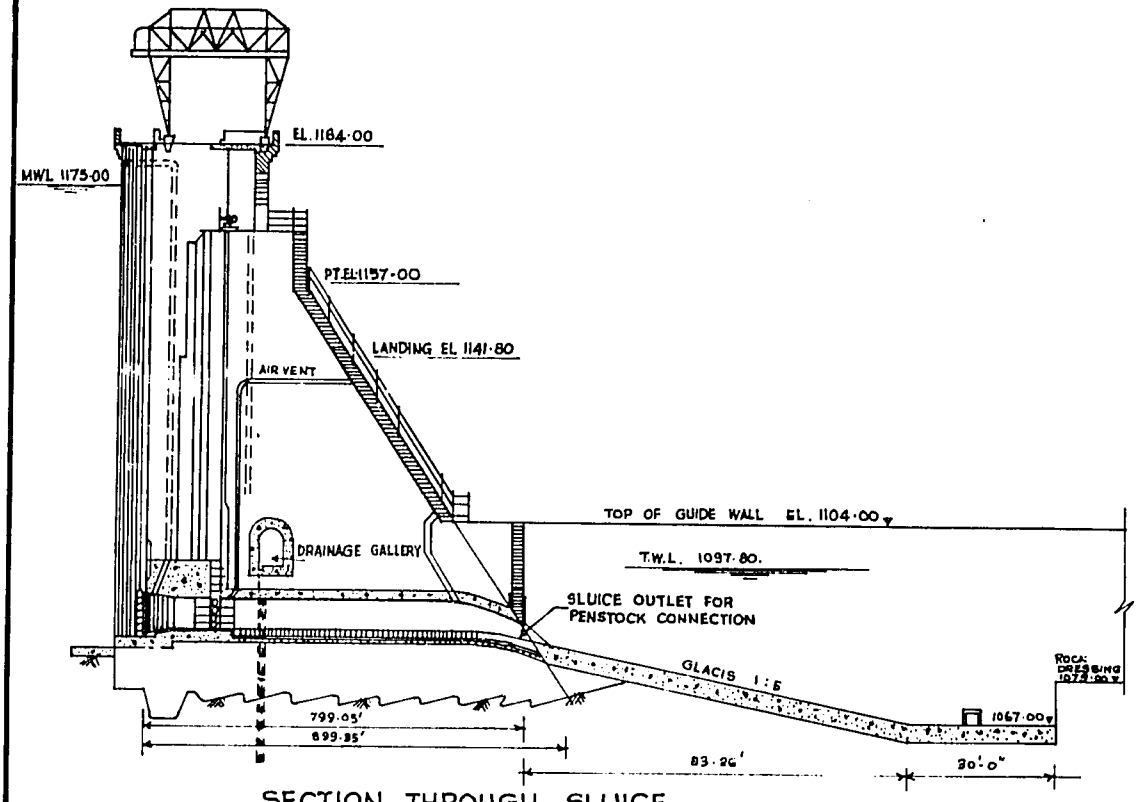


LEGEND: ISO : ISOLATOR.
LA : LIGHTNING ARRESTER.
BRK : BREAKER (MOCB).
LBS : LOAD BREAK SWITCH.
PTR : POWER TRANSFORMER.

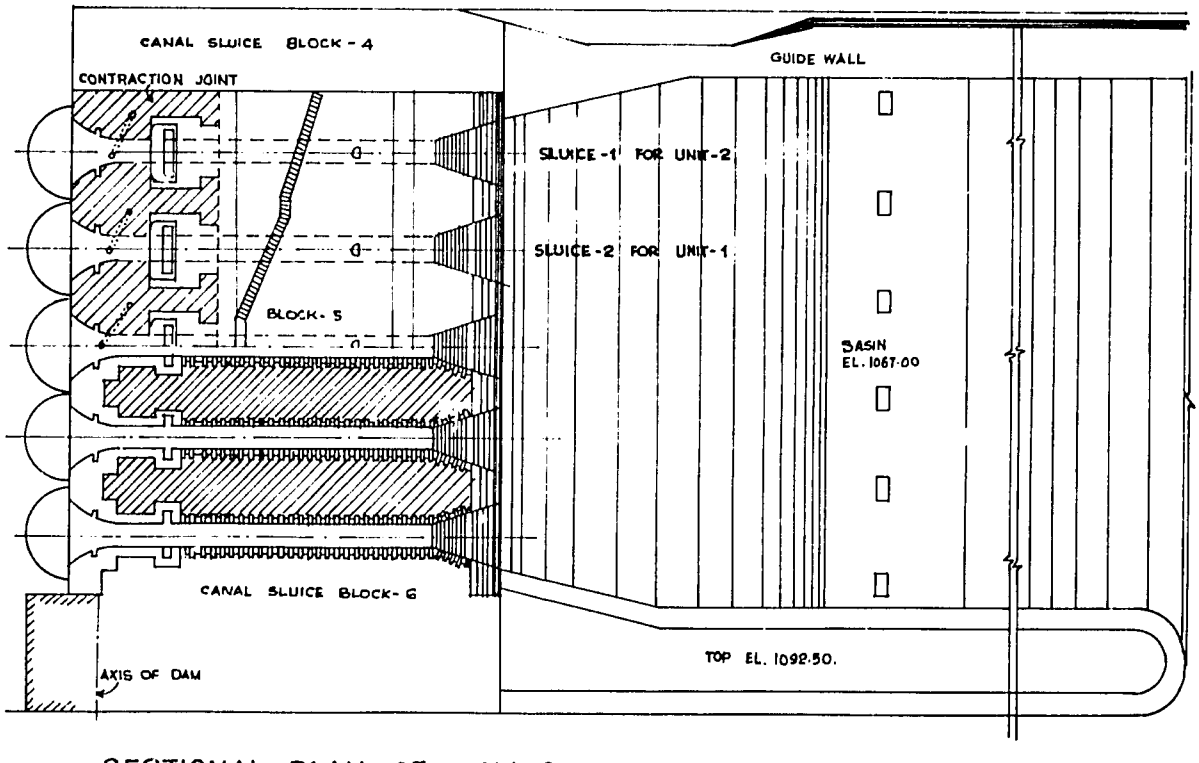
NOTE : ALL DIMENSIONS ARE IN 'MM'

MINI HYDRO POWER PROJECT
ESMAP STUDY
THIRUMURTHI PROJECT
ELECTRICAL LAYOUT
(TAMIL NADU)

sads/w48595(84)



SECTION THROUGH SLUICE



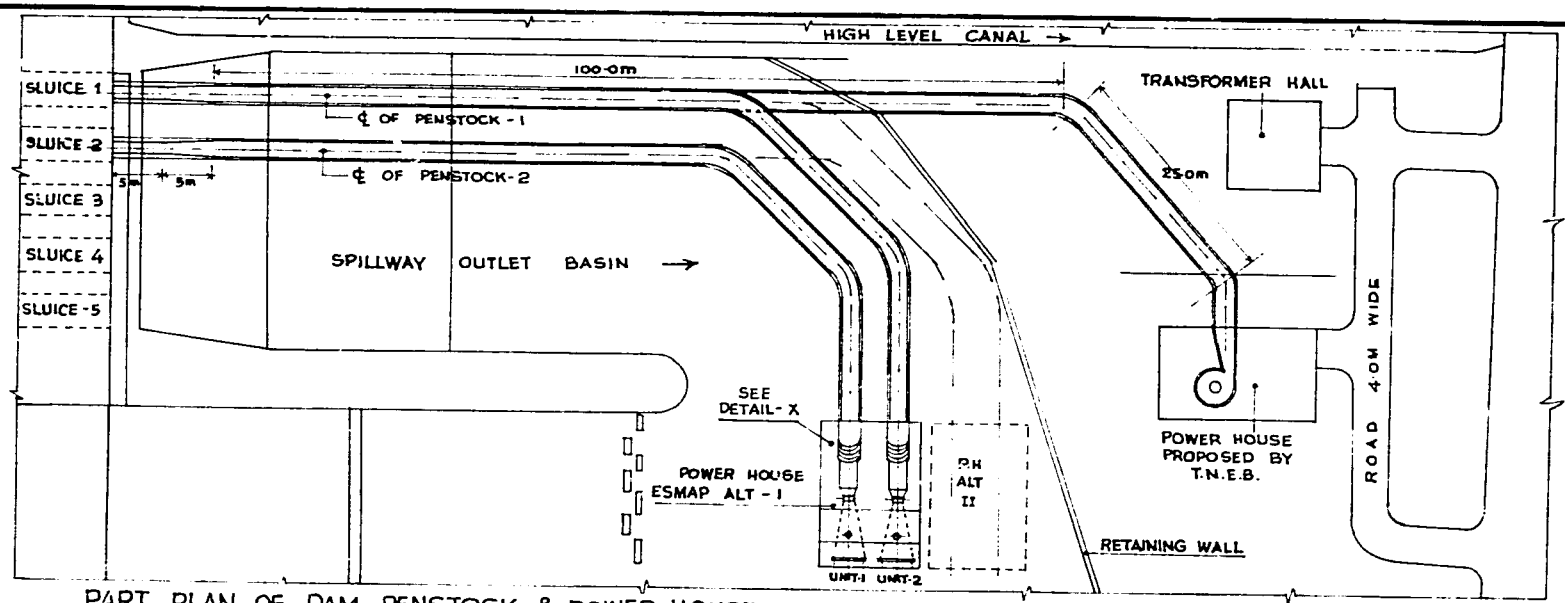
SECTIONAL PLAN OF DAM & RIVER SLUICES.

NOTES:
THIS DRAWING IS BASED ON DRG NO 1510A-17-E OF T.N.P.W.D.
SEE SHEET 2 OF 2 FOR POWER HOUSE ALTERNATIVES.

MINI HYDRO POWER PROJECT
ESMAP STUDY
AMARAVATHY
DAM WITH OUTLET DETAILS OF P. HOUSE
TNEB PROPOSAL

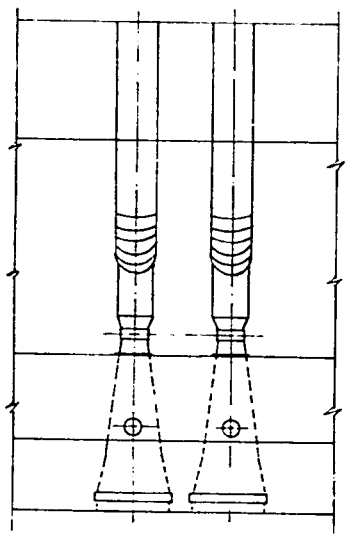
SHEET 1 OF 2

sads/w48595(87)

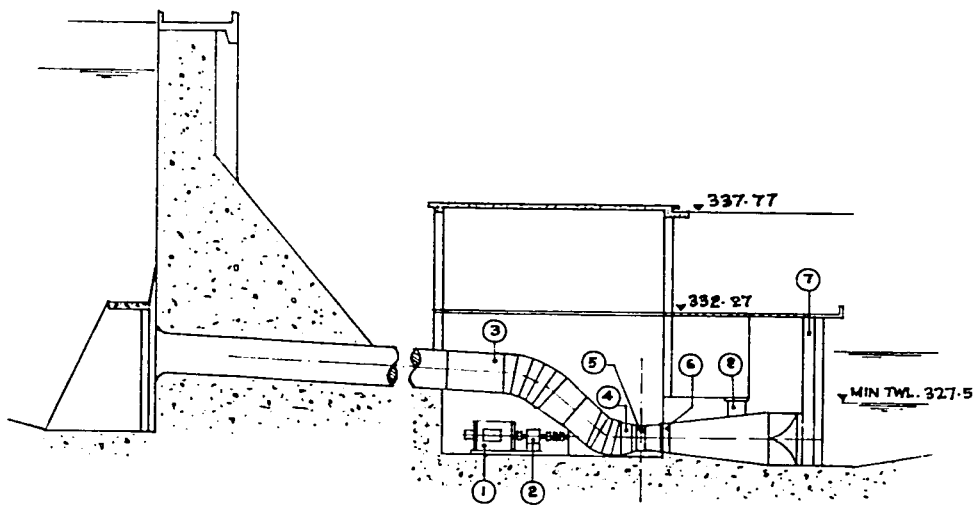


PART PLAN OF DAM, PENSTOCK & POWER HOUSE

① GENERATOR.
② SPEED INCREASER
③ PENSTOCK.
④ GUIDE VANE
⑤ RUNNER CASING.
⑥ DRAFT TUBE.
⑦ DRAFT TUBE GATE.
⑧ MAN HOLE.



DETAIL - X



CROSS SECTION OF DAM & POWER HOUSE
WITH TUBULAR TURBINE (UPSTREAM ELBOW)

STANDARDISED PARAMETERS:

RATED NET HEAD - 21·0M

RATED DISCHARGE -12·5m^3/SEC.

TURBINE SPEED -

TURBINE OUTPUT - 2000 kW.

NO OF UNITS - 2

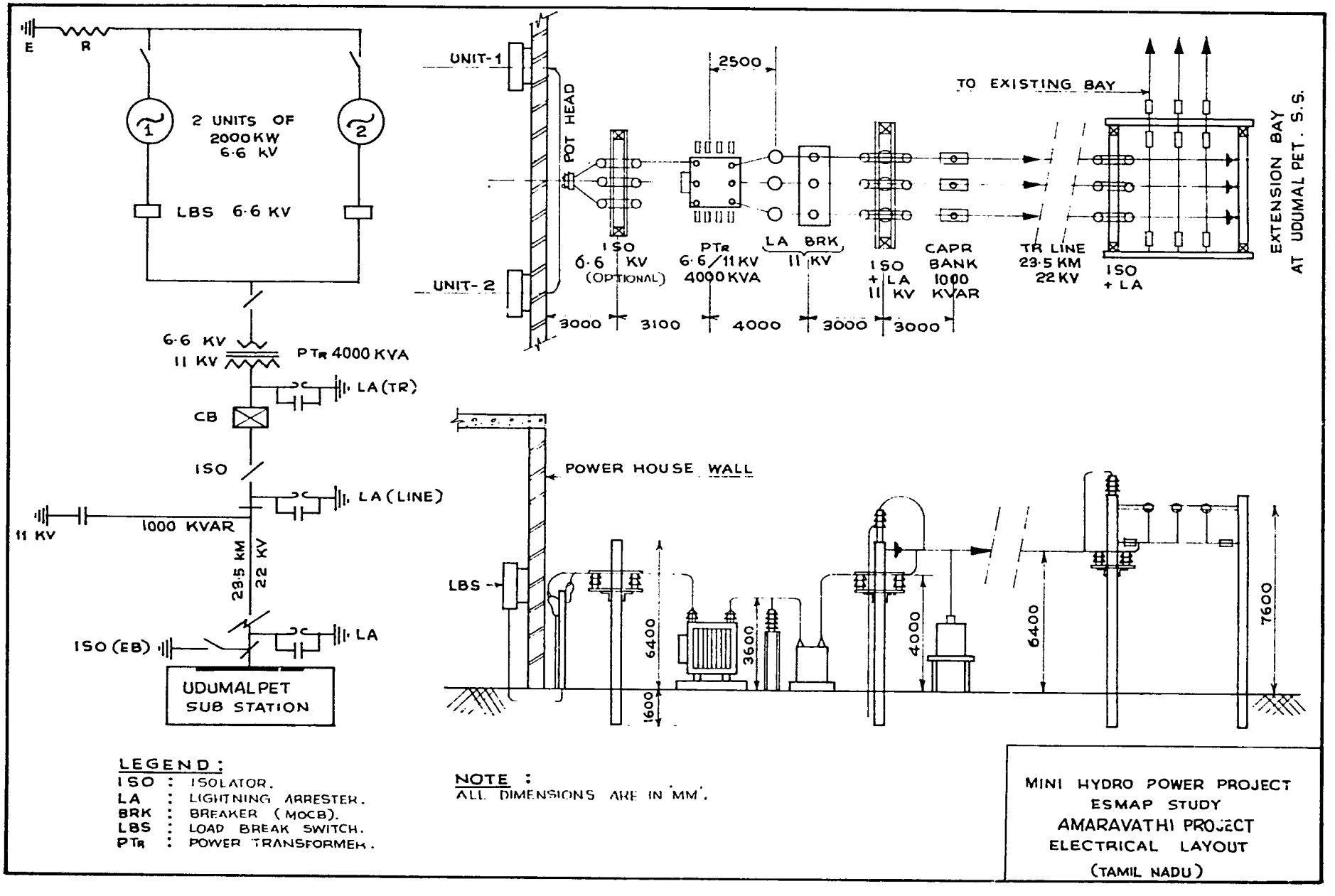
NOTES:

THIS DRAWING SHOWS ALTERNATIVE ARRANGEMENTS FOR PENSTOCK WITH POWER HOUSE.

MINI HYDRO POWER PROJECT
ESMAP STUDY
AMARAVATHY DAM
PENSTOCK AND POWER HOUSE
TNEB PROPOSAL & ESMAP ALTERNATIVE

SHEET 2 OF 2

sads/w48595(88)



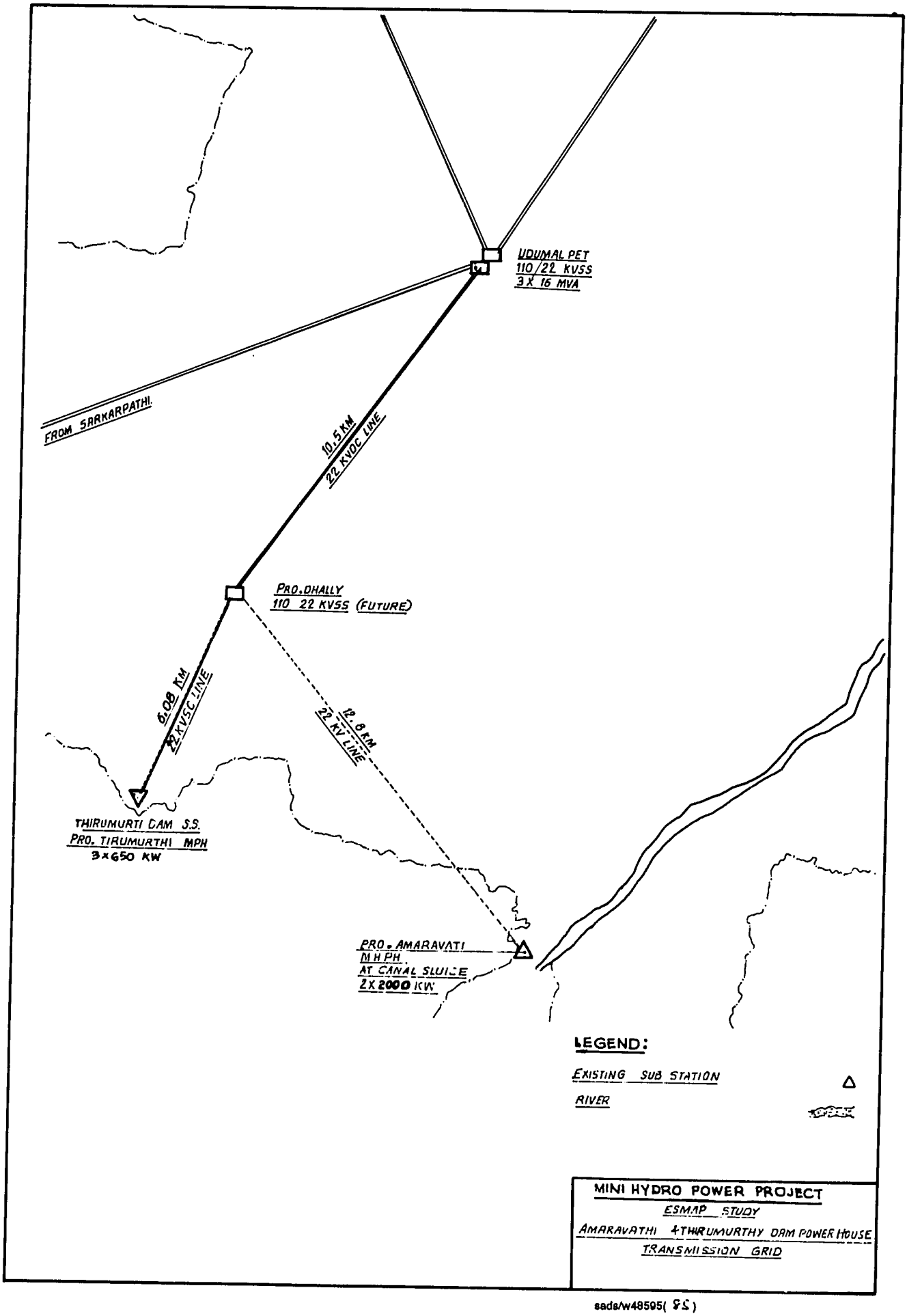
LEGEND:

ISO : ISOLATOR.
LA : LIGHTNING ARRESTER.
BRK : BREAKER (MOCB).
LBS : LOAD BREAK SWITCH.
PTR : POWER TRANSFORMER.

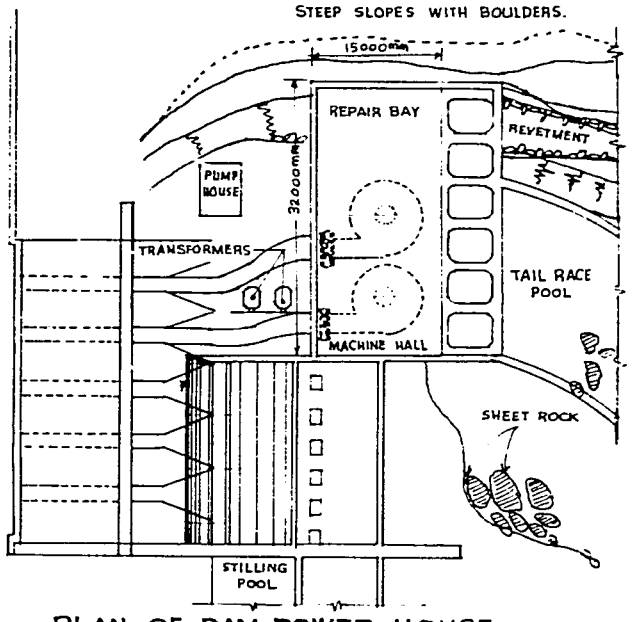
NOTE :
ALL DIMENSIONS ARE IN 'MM'.

MINI HYDRO POWER PROJECT
ESMAP STUDY
AMARAVATHI PROJECT
ELECTRICAL LAYOUT
(TAMIL NADU)

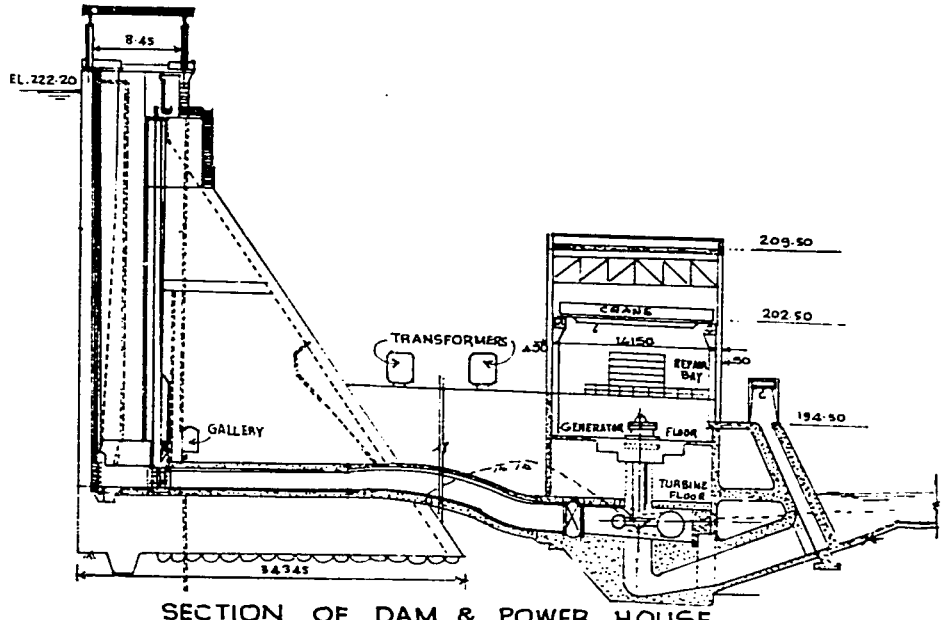
sads/w48595(86)



sads/w48595(85)

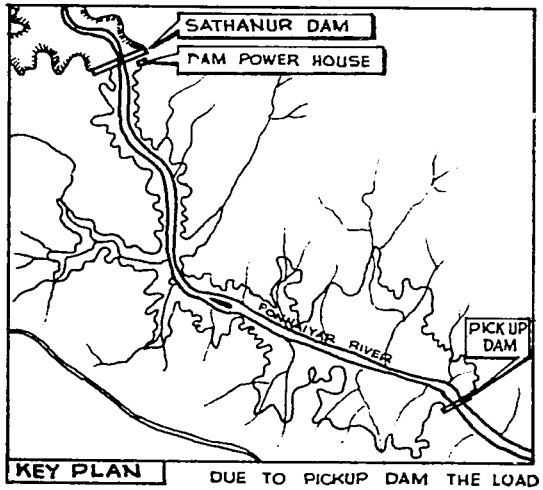


PLAN OF DAM POWER HOUSE TNEB PROPOSAL



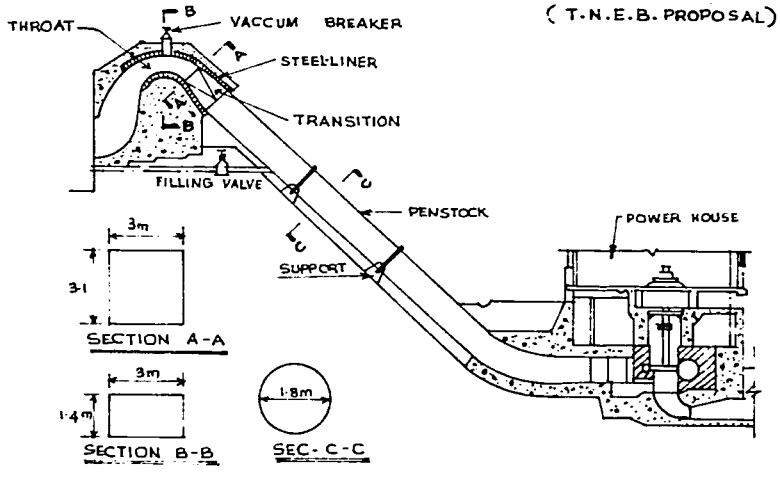
SECTION OF DAM & POWER HOUSE

(T.N.E.B. PROPOSAL)



KEY PLAN

DUE TO PICKUP DAM THE LOAD FACTOR OF SATHANUR P.S. CAN BE DECREASED & 2 UNITS OF 6MW EACH OR HIGHER CAPACITY CONSIDERED.



SECTION OF POWER HOUSE WITH SYPHON INTAKE

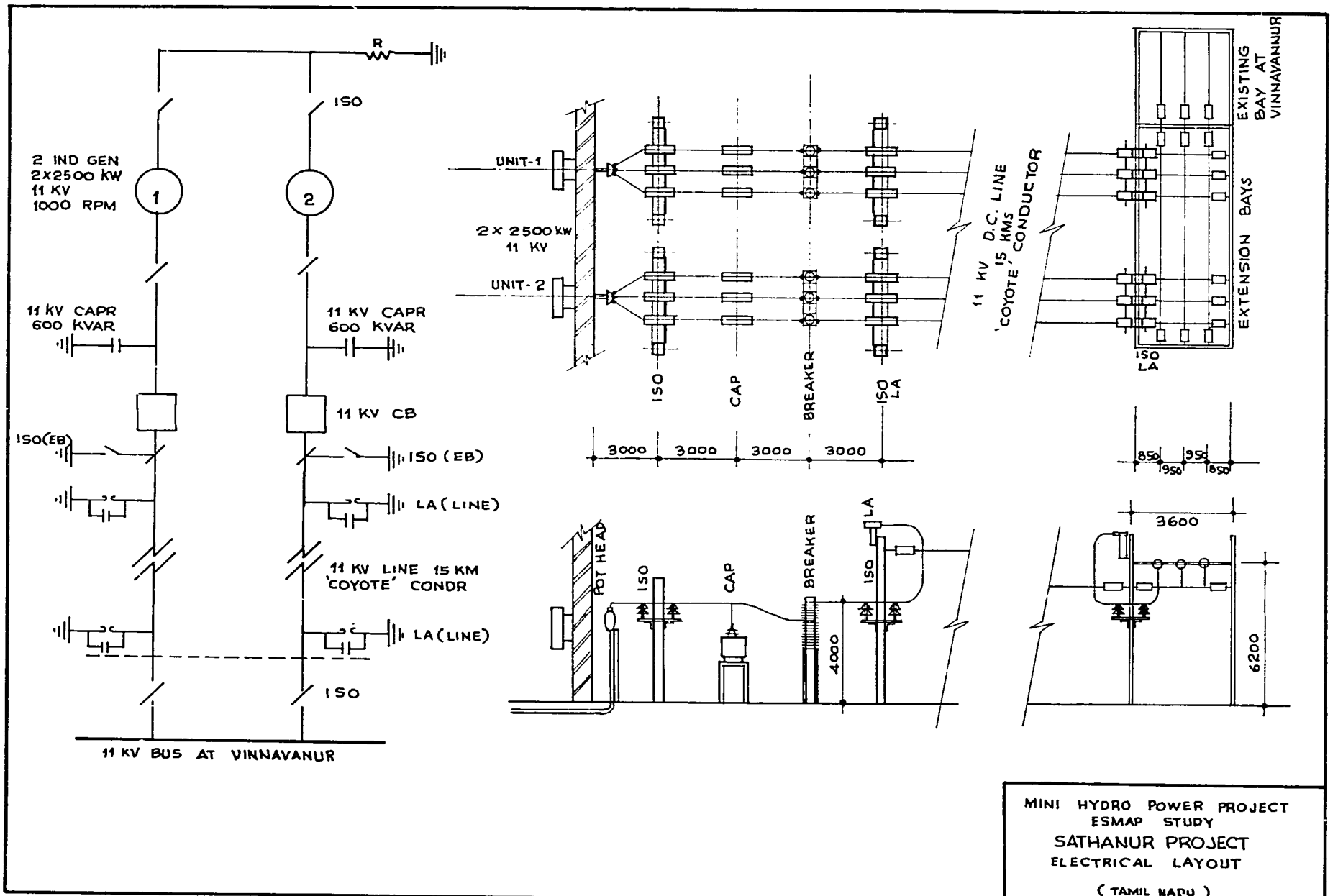
E.S.M.A.P. ALTERNATIVE

NOTES:

SATHANUR P.S. HAS TO ACCOMODATE ABOUT $30m^3$/SEC IN EACH OF THE SLUICES. AS PER FLOW DURATION CURVE $10m^3$/SEC IS AVAILABLE PER UNIT. THE SLUICES CAN HANDLE $10m^3$/SEC AS AN ALTERNATIVE AND IF DIVERSION IS RESTRICTED TO $10m^3$/SEC PER UNIT AND SLUICES ARE NOT AVAILABLE FOR POWER GENERATION, SYPHON INTAKE CAN BE PROVIDED.

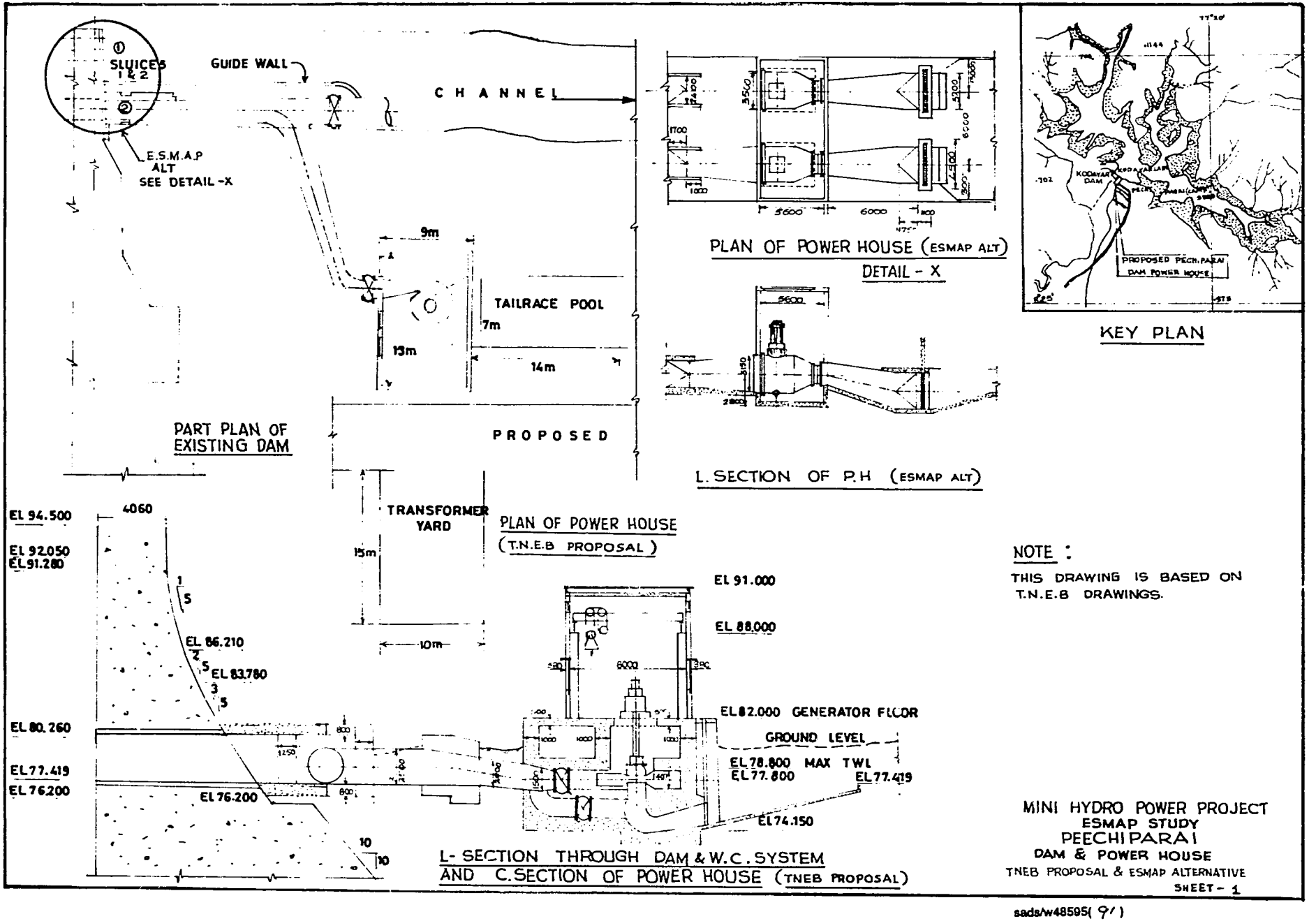
MINI HYDRO POWER PROJECT
ESMAP STUDY
SATHANUR DAM AND POWER HOUSE
TNEB PROPOSAL & ESMAP ALTERNATIVE

sads/w48595(89)

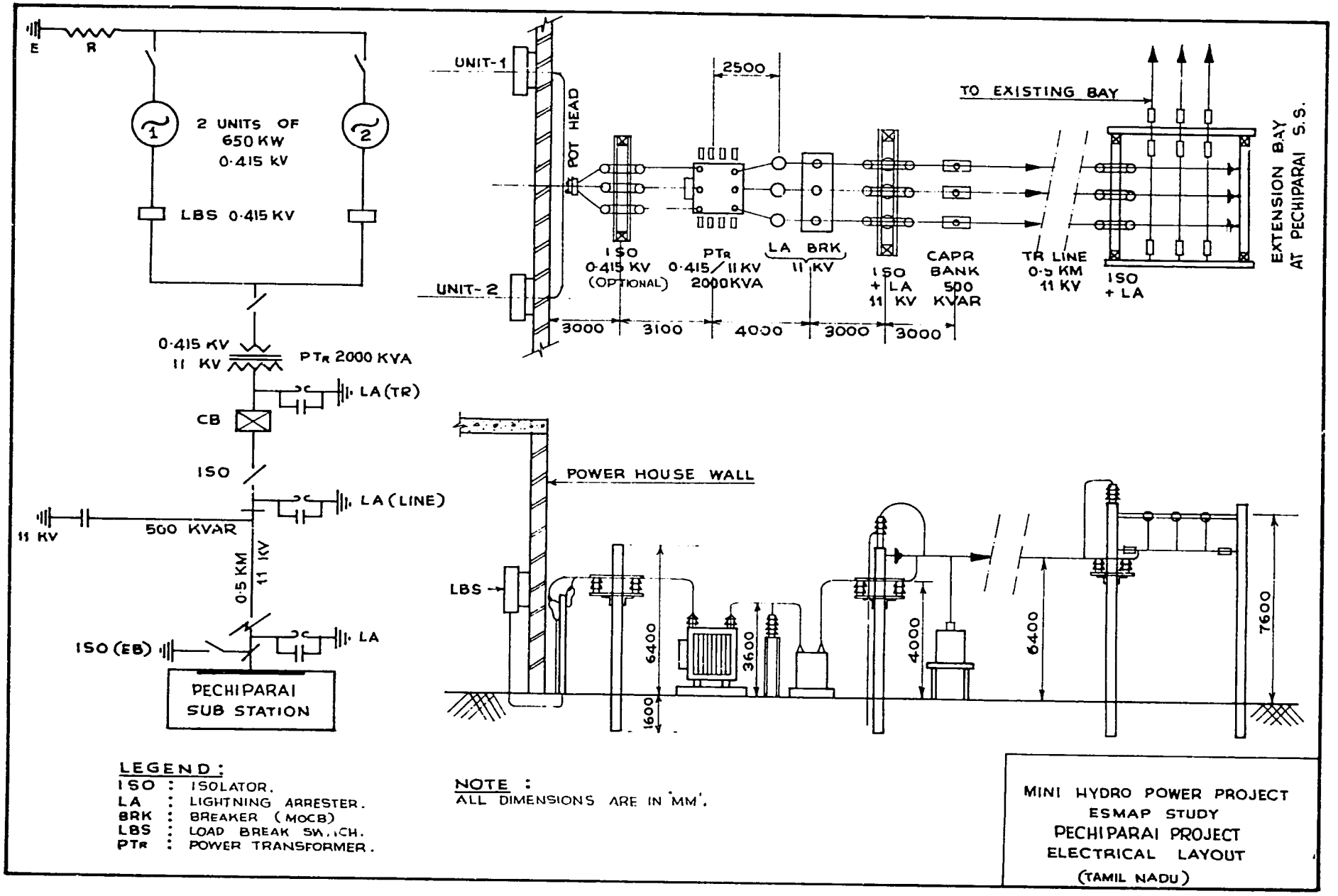


MINI HYDRO POWER PROJECT
ESMAP STUDY
SATHANUR PROJECT
ELECTRICAL LAYOUT
(TAMIL NADU)

sads/w48595(90)



sads/w48595(9/)



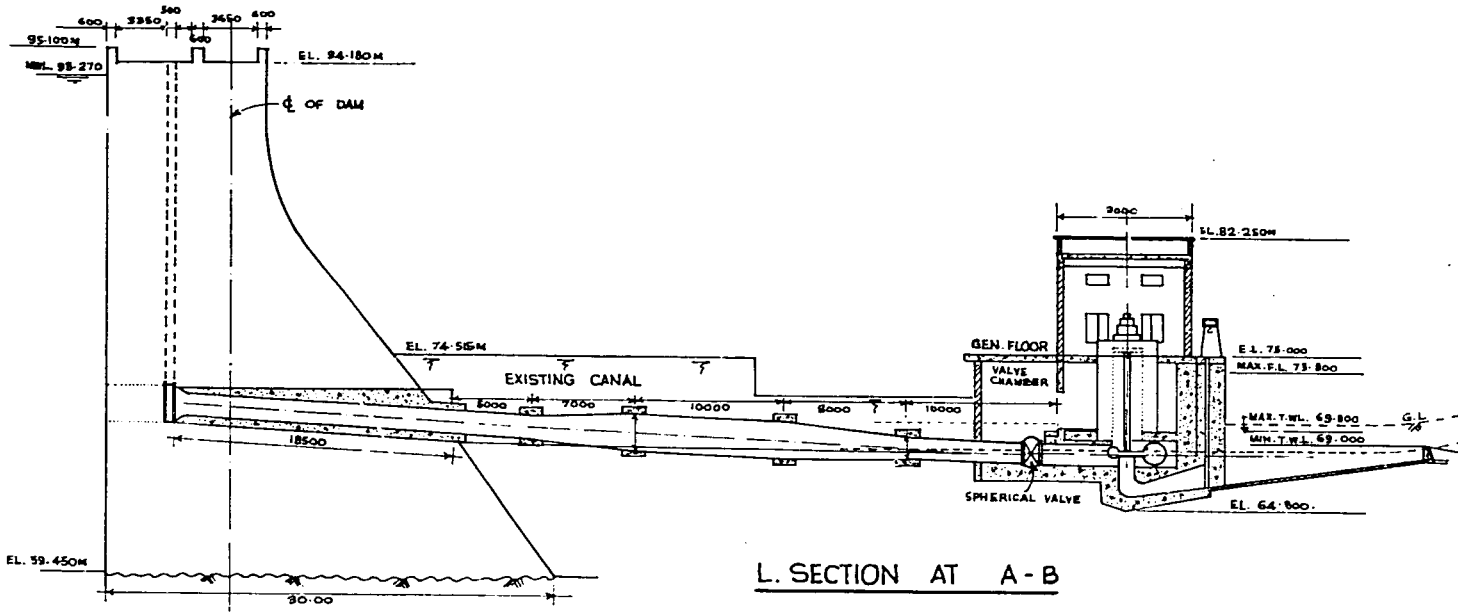
LEGEND :

ISO : ISOLATOR.
LA : LIGHTNING ARRESTER.
BRK : BREAKER (MOCB)
LBS : LOAD BREAK SWITCH.
PTR : POWER TRANSFORMER.

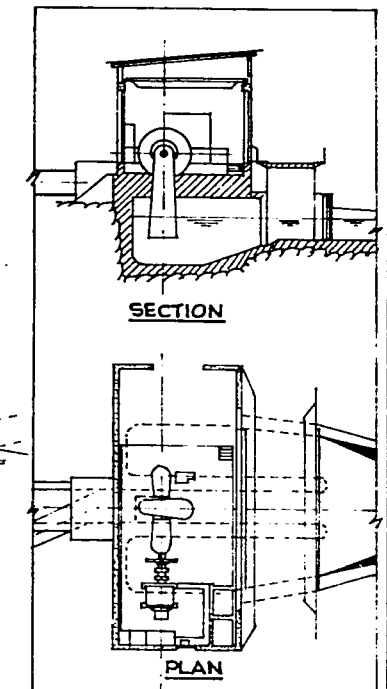
NOTE :
ALL DIMENSIONS ARE IN 'MM'.

MINI HYDRO POWER PROJECT
ESMAP STUDY
PECHIPARAI PROJECT
ELECTRICAL LAYOUT
(TAMIL NADU)

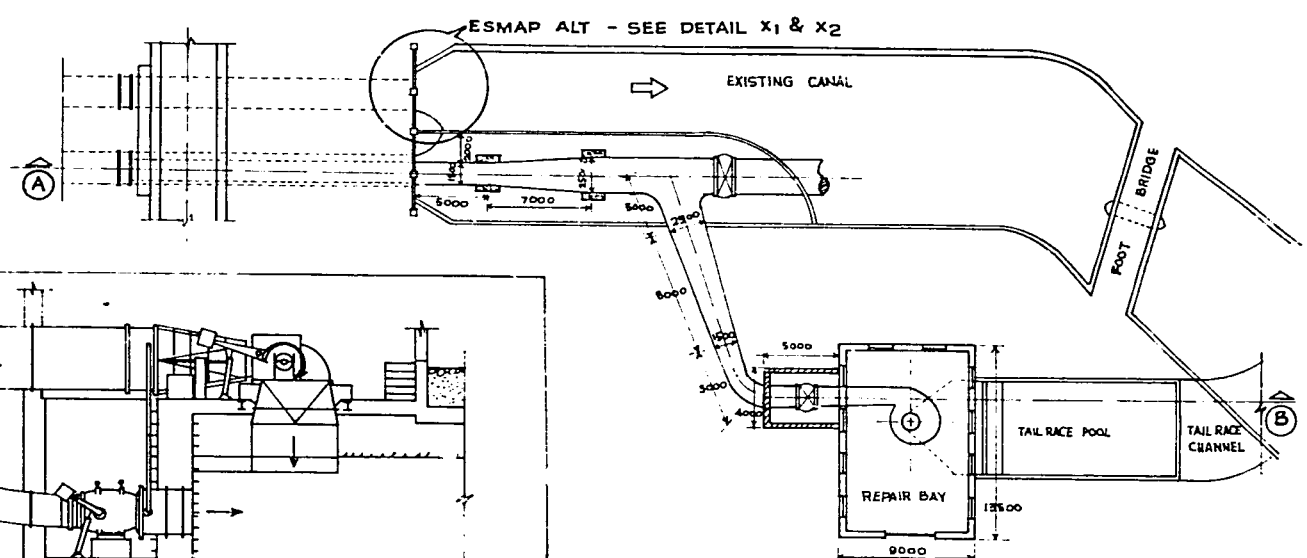
sads/w48595(92)



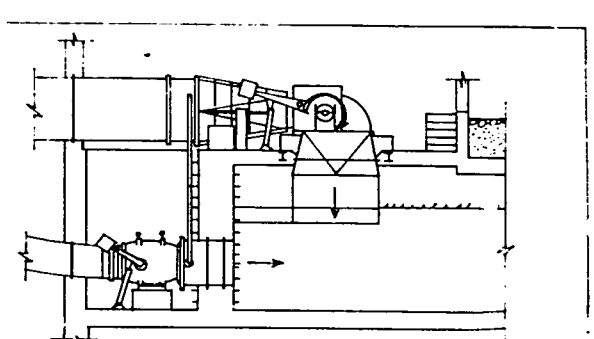
L. SECTION AT A-B



POWER HOUSE
(E.S.M.A.P ALT - 2)
DOUBLE FRANCIS
DETAIL - X2



PLAN OF DAM & POWER HOUSE
T.N.E.B PROPOSAL



CROSS FLOW TURBINE (E.S.M.A.P ALT-1)
DETAIL - X1

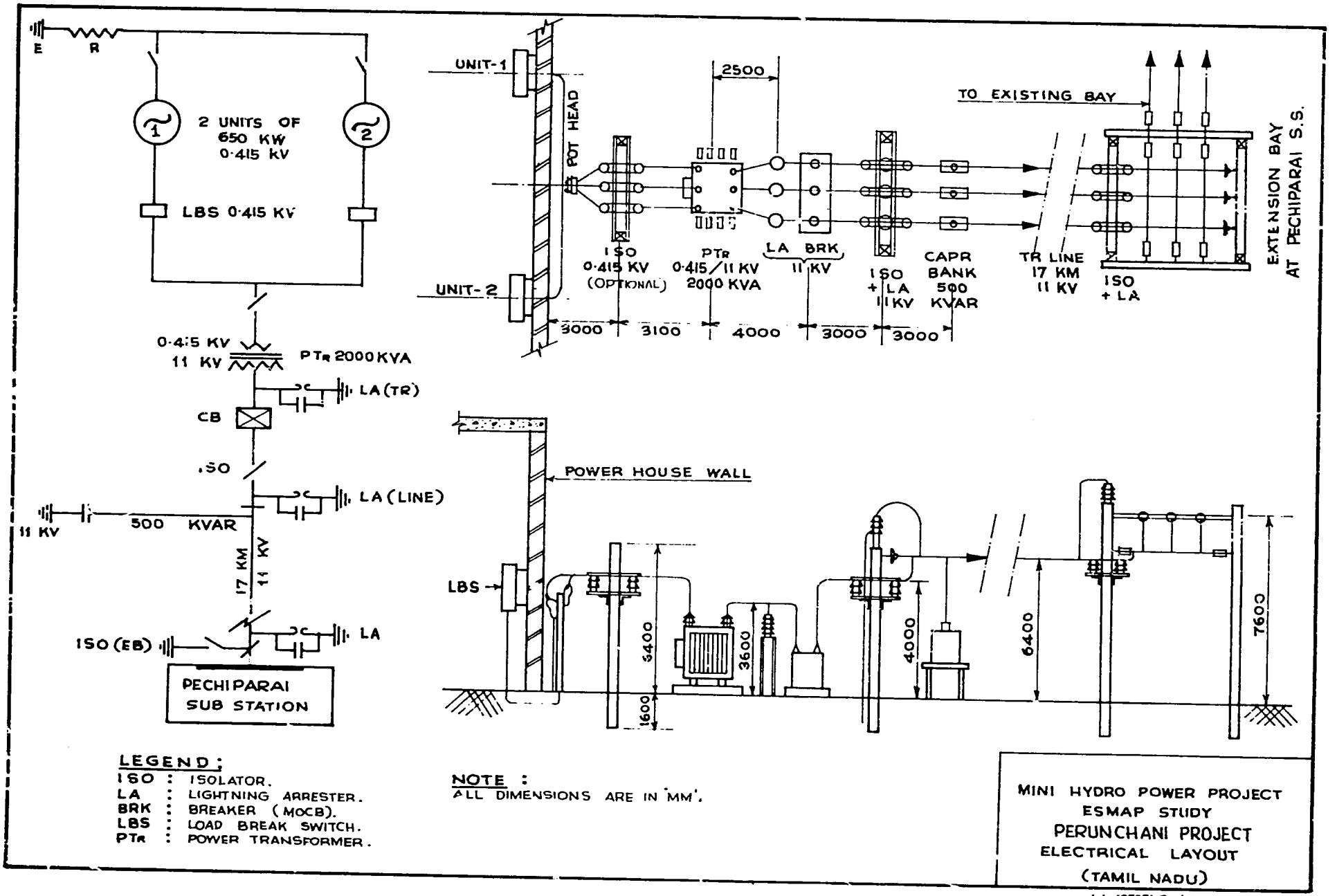
NOTES:

THIS DRAWING IS BASED ON TNEB DRG NO. NIL DATED 9-2-90.

POSSIBLE ESMAP ALTERNATIVES ARE DOUBLE FRANCIS HORIZONTAL SHAFT AND CROSS FLOW TURBINES.

MINI HYDRO POWER PROJECT
ESMAP STUDY
PERUNCHANI DAM & P.-HOUSE
TNEB PROPOSAL & ESMAP ALT-VES

sads/w48595(93)



LEGEND:

ISO : ISOLATOR.
LA : LIGHTNING ARRESTER.
BRK : BREAKER (MOCB).
LBS : LOAD BREAK SWITCH.
PTR : POWER TRANSFORMER.

NOTE :
ALL DIMENSIONS ARE IN 'MM'.

MINI HYDRO POWER PROJECT
ESMAP STUDY
PERUNCHANI PROJECT
ELECTRICAL LAYOUT
(TAMIL NADU)

sads/w48595(94)

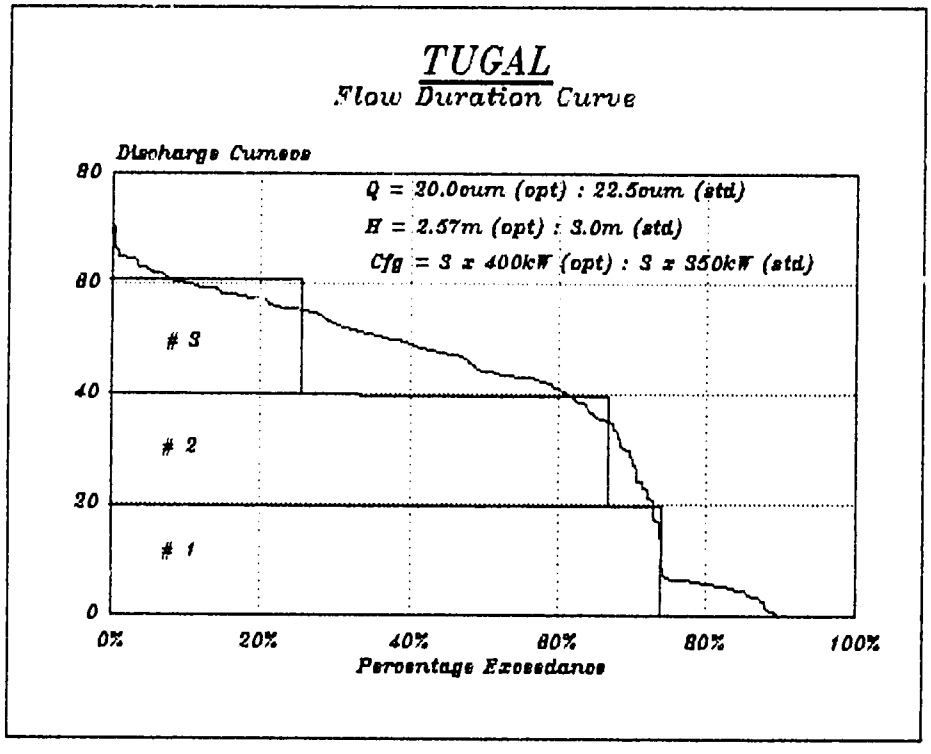
121A

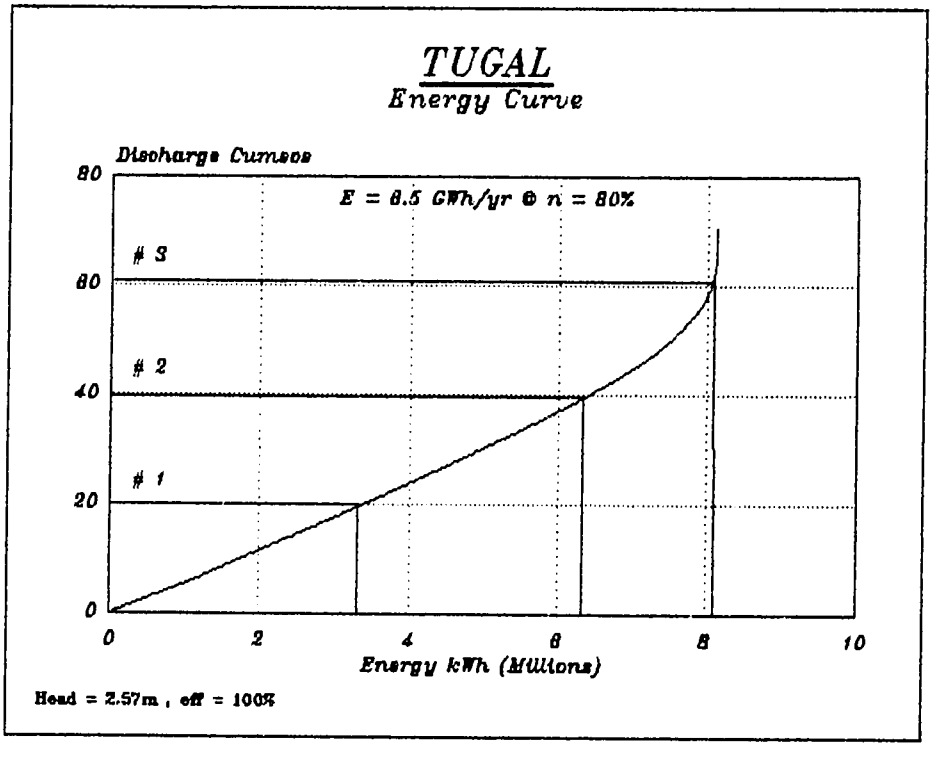
SECTION V - PUNJAB

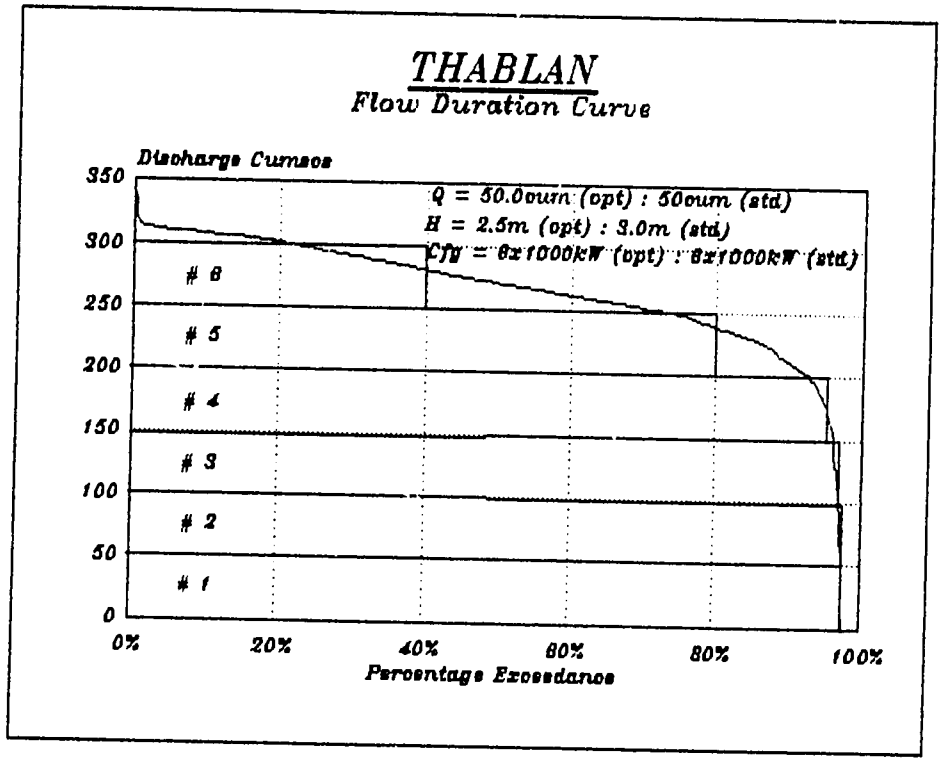
Channarthal Canal Crop
Thablan Canal Drop
Naranwal Canal Drop
Dalla Canal Drop
Tugal Canal Drop
Chupki Canal Drop
Dolowal Canal Drop
Babanpur Canal Drop
Kila Canal Drop
Salar Canal Drop
Chak Bai
Sidhana Canal Drop

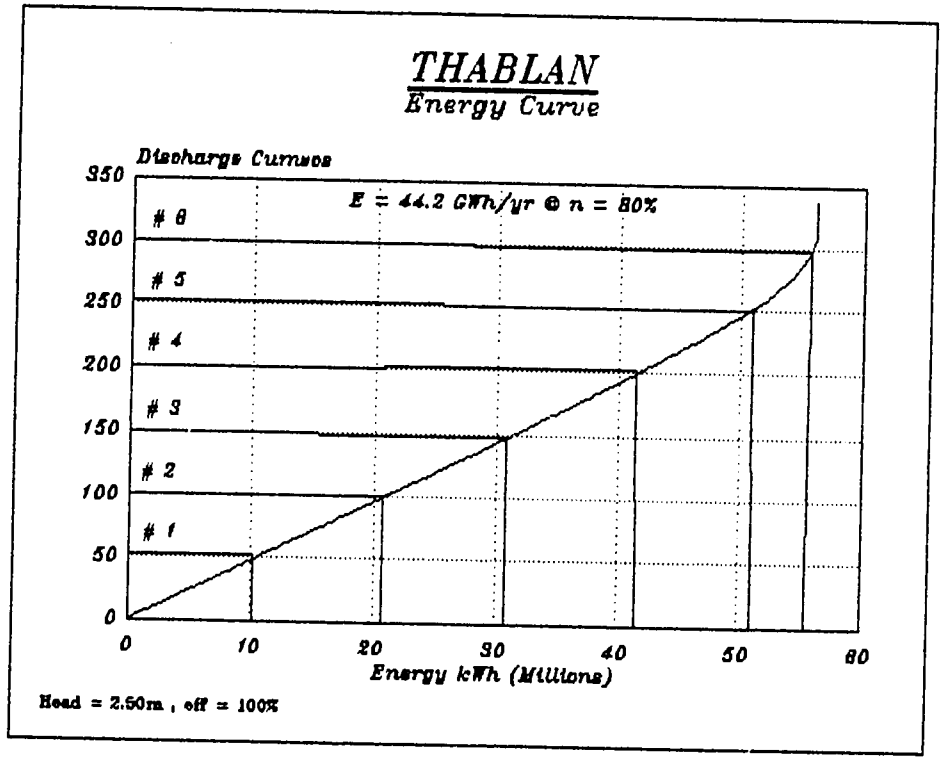
Contents:

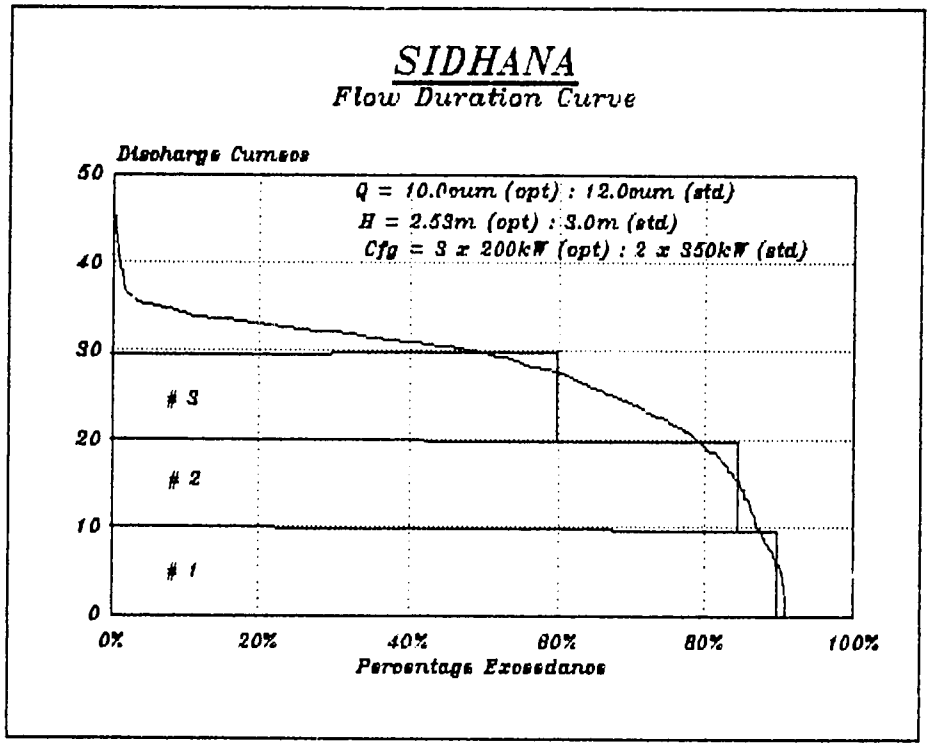
1. ***Design Graphs***
   (Flow duration curves, Energy curves)
2. ***Technical Drawings***
   (Layouts, Electrical Schemes, Grid-Tie Arrangements)

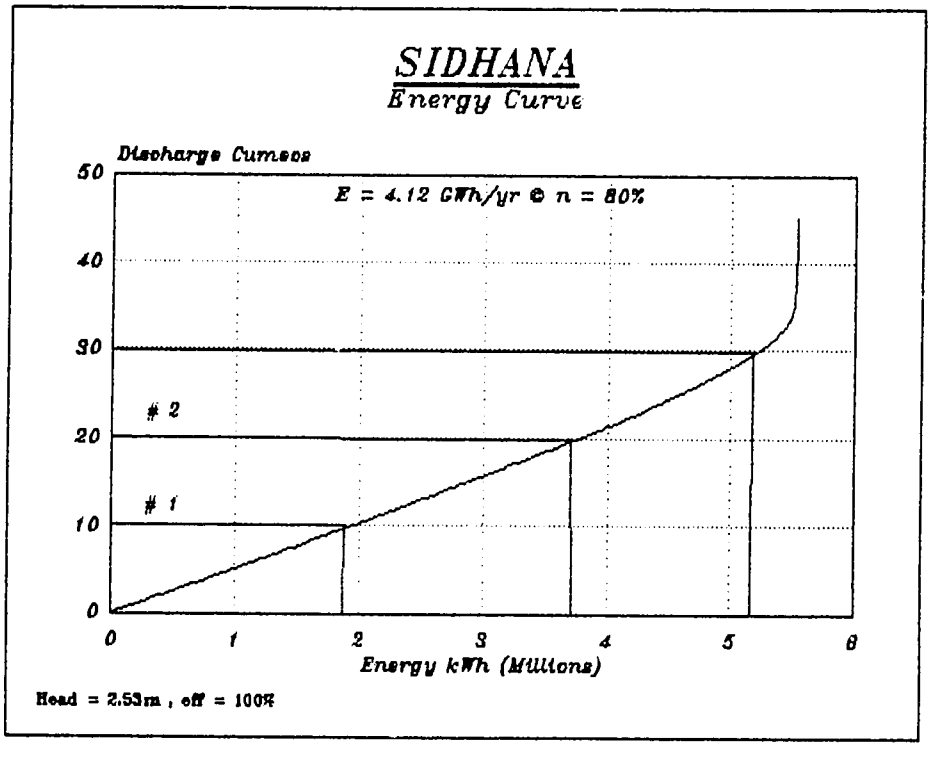

TUGAL
Flow Duration Curve
Discharge Cumecs
Q = 20.0cum (opt) : 22.5cum (std)
H = 2.57m (opt) : 3.0m (std)
Cfg = 3 x 400kW (opt) : 3 x 350kW (std)
# 3
# 2
# 1
80
60
40
20
0
0%
20%
40%
60%
80%
100%
Percentage Exceedance

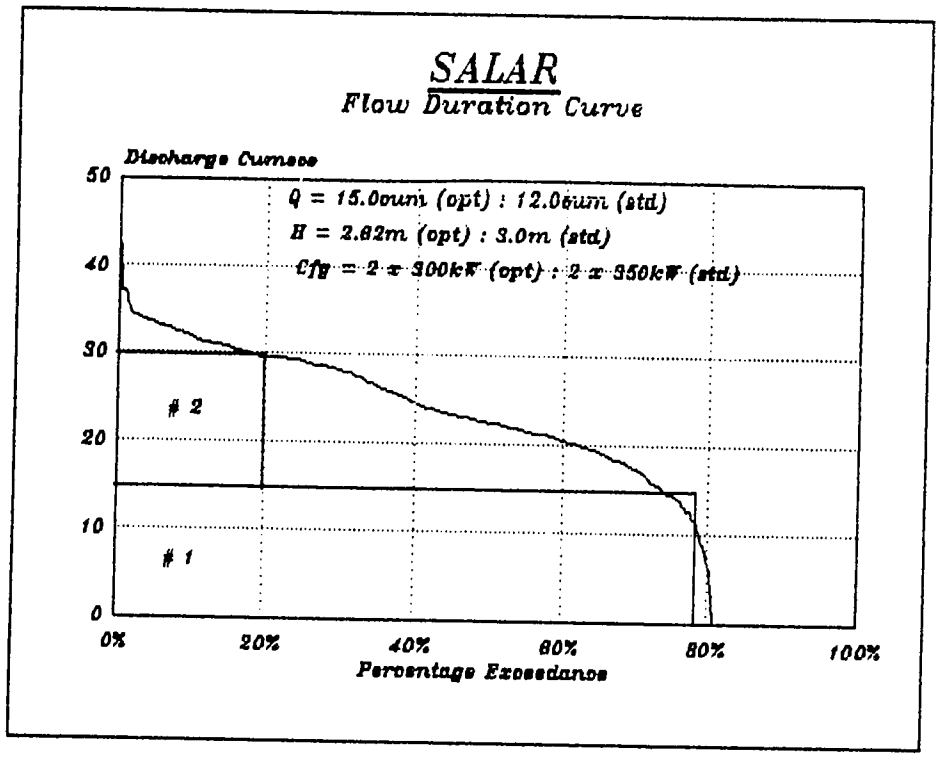

TUGAL
Energy Curve
Discharge Cumecs
E = 8.5 GWh/yr @ n = 80%
# 3
# 2
# 1
80
60
40
20
0
0
2
4
6
8
10
Energy kWh (Millions)
Head = 2.57m , eff = 100%

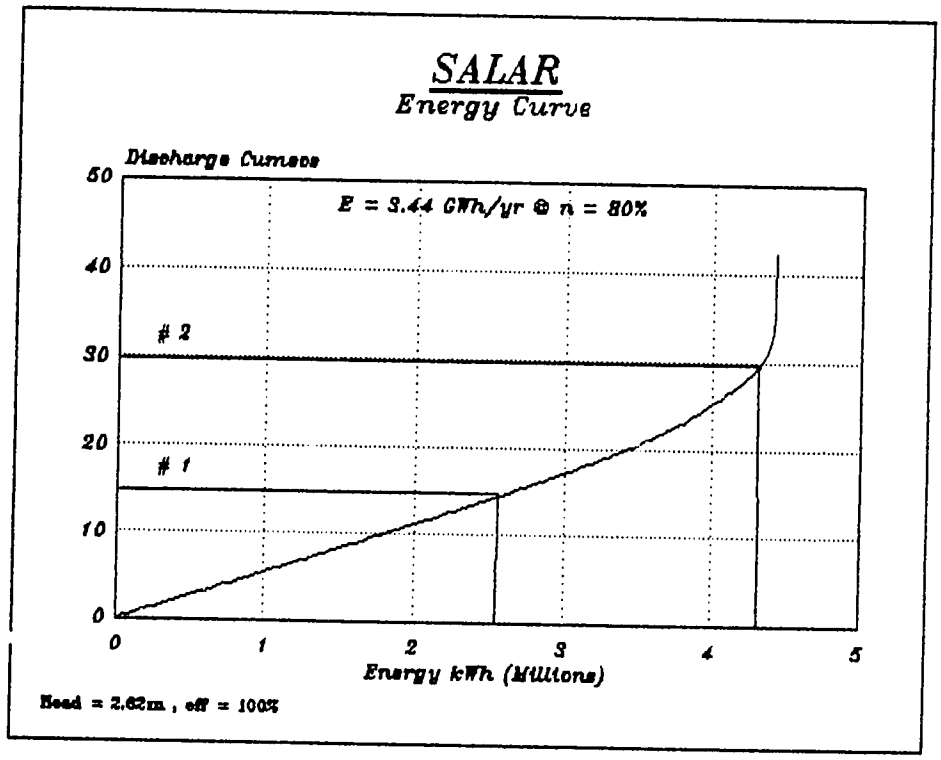

THABLAN
Flow Duration Curve
Discharge Cumecs
Q = 50.0cum (opt) : 50cum (std)
H = 2.5m (opt) : 3.0m (std)
Cfg = 8x1000kW (opt) : 8x1000kW (std)
# 8
# 5
# 4
# 3
# 2
# 1
350
300
250
200
150
100
50
0
0%
20%
40%
60%
80%
100%
Percentage Exceedance

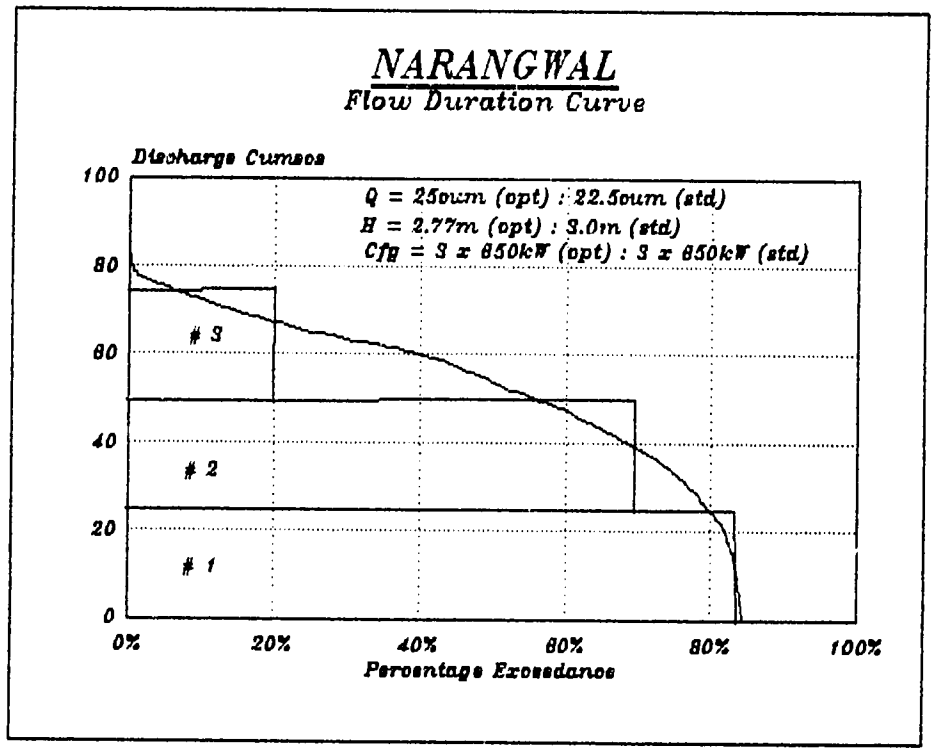

THABLAN
Energy Curve
Discharge Cumecs
E = 44.2 GWh/yr @ n = 80%
# 8
# 5
# 4
# 3
# 2
# 1
350
300
250
200
150
100
50
0
0
10
20
30
40
50
60
Energy kWh (Millions)
Head = 2.50m , eff = 100%

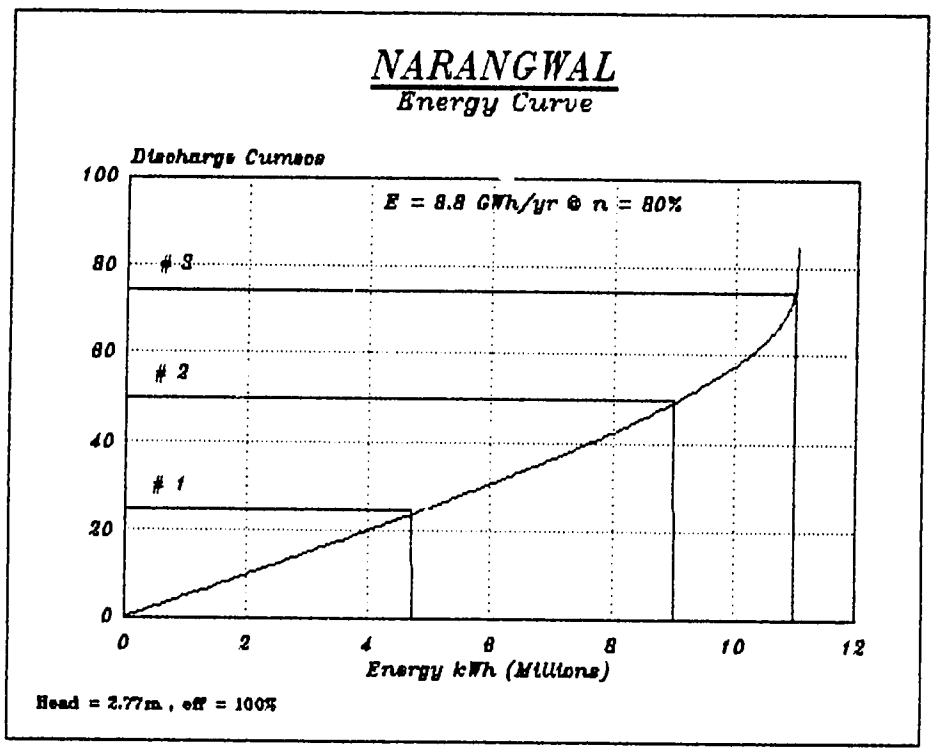

SIDHANA
Flow Duration Curve
Discharge Cumecs
Q = 10.0cum (opt) : 12.0cum (std)
H = 2.53m (opt) : 3.0m (std)
Cfg = 3 x 200kW (opt) : 2 x 350kW (std)
# 3
# 2
# 1
0
10
20
30
40
50
0%
20%
40%
60%
80%
100%
Percentage Exceedance

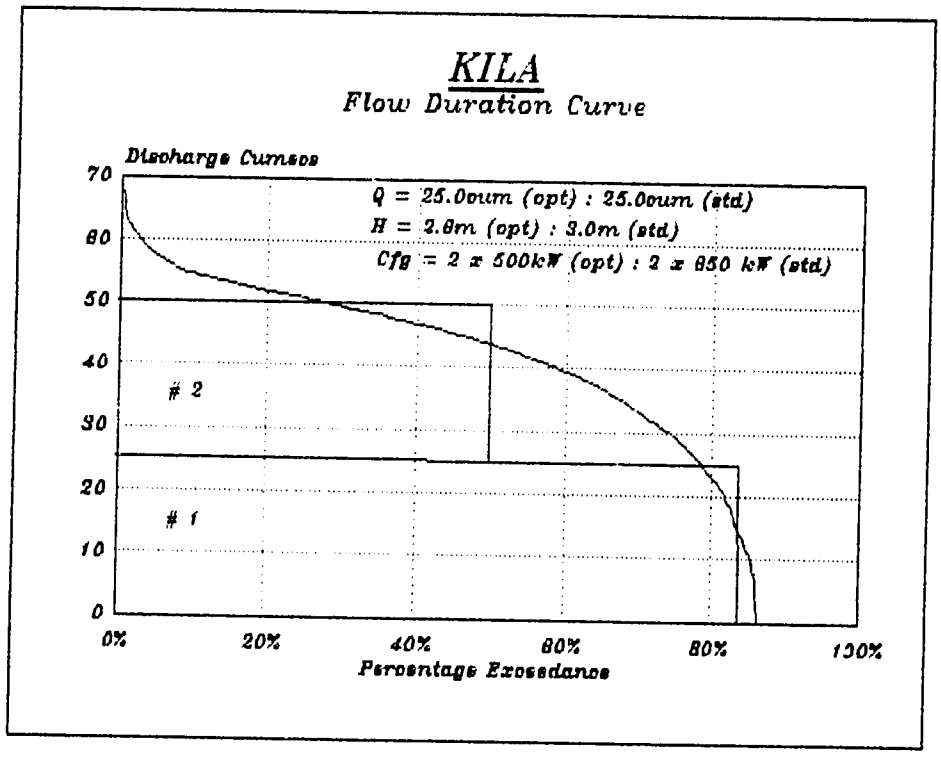

SIDHANA
Energy Curve
Discharge Cumecs
E = 4.12 GWh/yr @ n = 80%
# 2
# 1
0
10
20
30
40
50
0
1
2
3
4
5
6
Energy kWh (Millions)
Head = 2.53m , eff = 100%

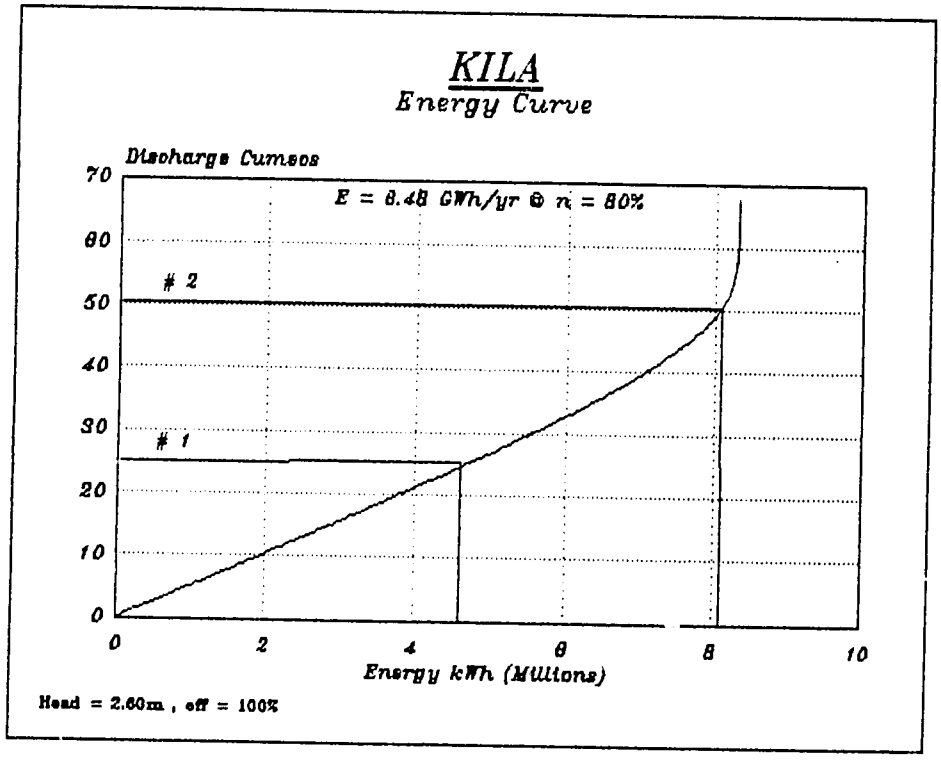

SALAR
Flow Duration Curve
Discharge Cumecs
Q = 15.0cum (opt) : 12.0cum (std)
H = 2.82m (opt) : 3.0m (std)
Cfg = 2 x 300kW (opt) : 2 x 350kW (std)
# 2
# 1
50
40
30
20
10
0
0%
20%
40%
60%
80%
100%
Percentage Exceedance

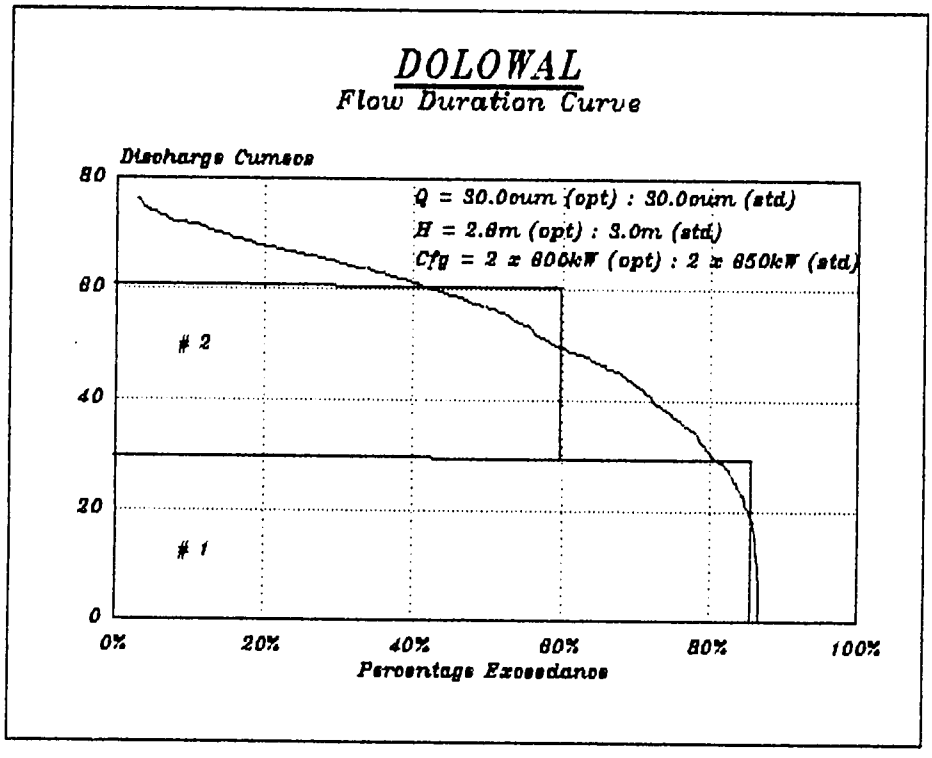

SALAR
Energy Curve
Discharge Cumecs
E = 3.44 GWh/yr @ n = 80%
# 2
# 1
50
40
30
20
10
0
0
1
2
3
4
5
Energy kWh (Millions)
Head = 2.82m , eff = 100%

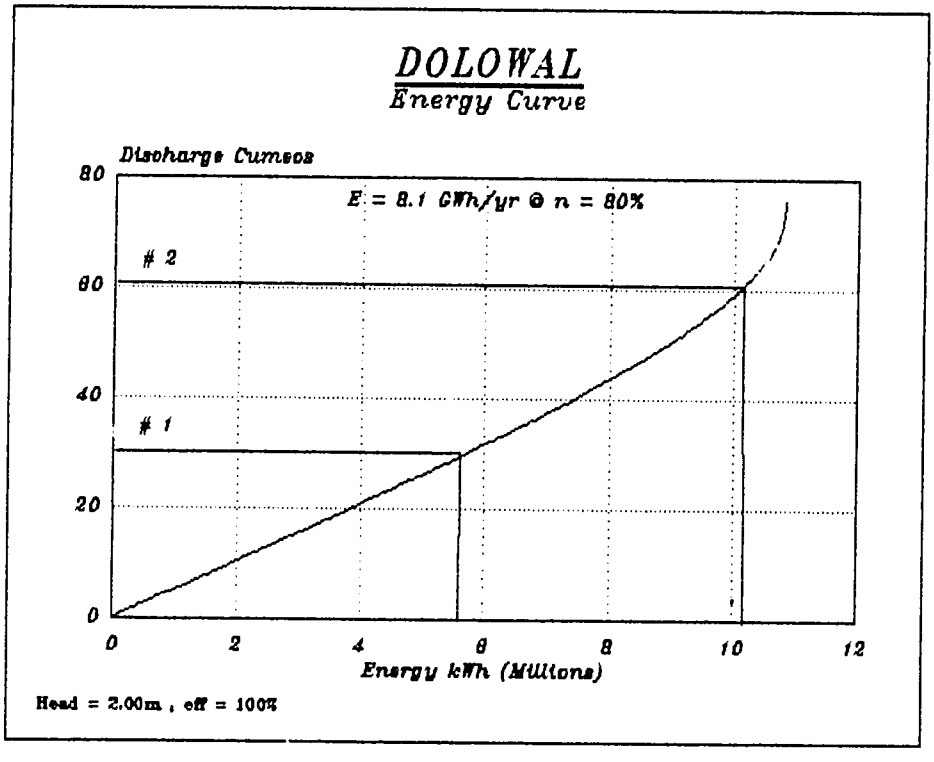

NARANGWAL
Flow Duration Curve
Discharge Cumecs
Q = 25cum (opt) : 22.5cum (std)
H = 2.77m (opt) : 3.0m (std)
Cfg = 3 x 850kW (opt) : 3 x 850kW (std)
# 3
# 2
# 1
100
80
60
40
20
0
0%
20%
40%
60%
80%
100%
Percentage Exceedance

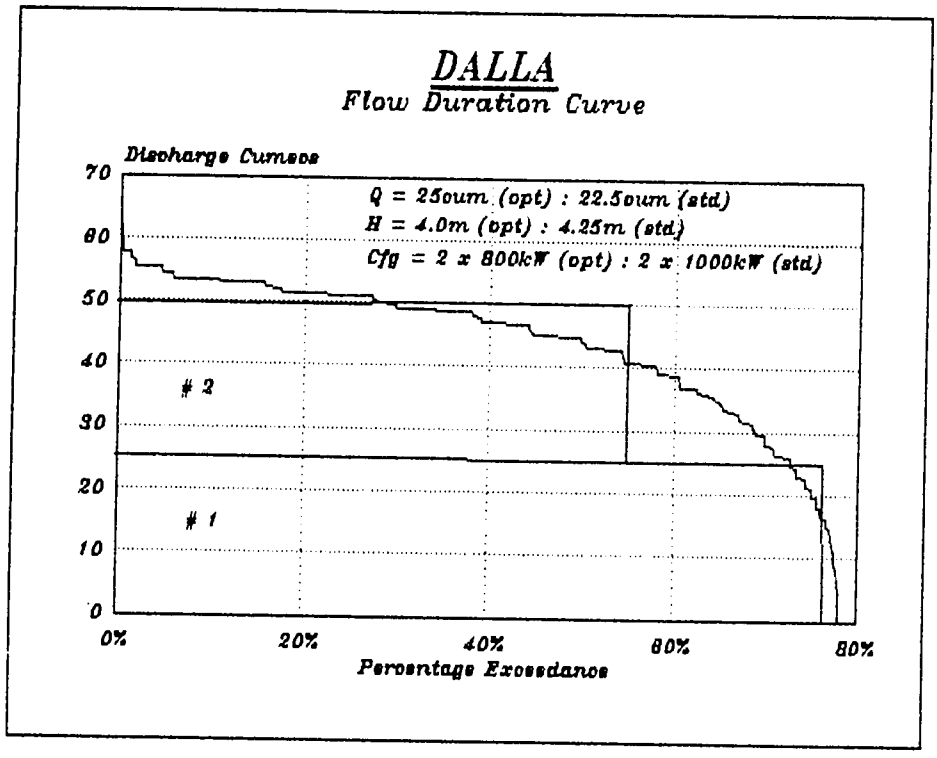

NARANGWAL
Energy Curve
Discharge Cumecs
E = 8.8 GWh/yr @ n = 80%
# 3
# 2
# 1
100
80
60
40
20
0
0
2
4
6
8
10
12
Energy kWh (Millions)
Head = 2.77m , eff = 100%

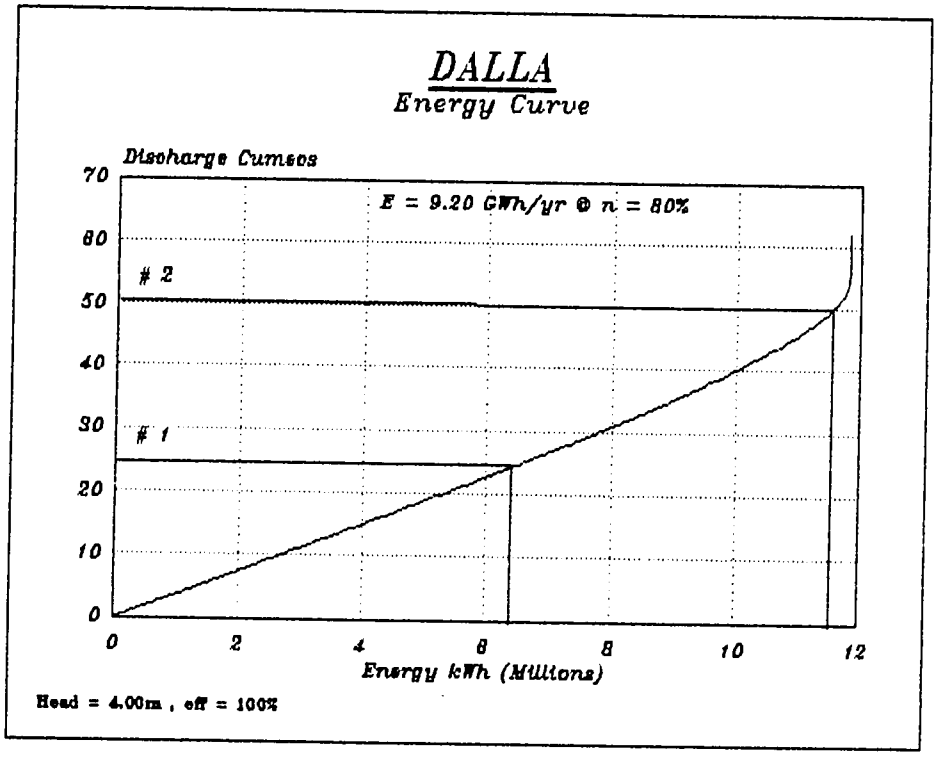

KILA
Flow Duration Curve
Discharge Cumecs
Q = 25.0cum (opt) : 25.0cum (std)
H = 2.8m (opt) : 3.0m (std)
Cfg = 2 x 500kW (opt) : 2 x 850 kW (std)
# 2
# 1
70
60
50
40
30
20
10
0
0%
20%
40%
60%
80%
100%
Percentage Exceedance

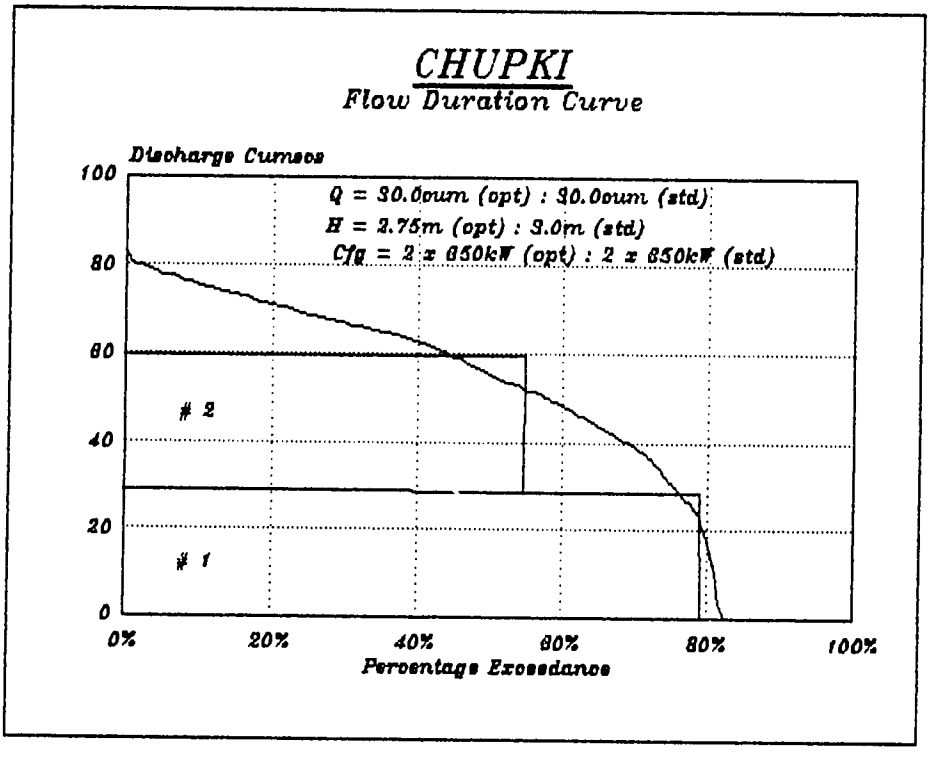

KILA
Energy Curve
Discharge Cumecs
E = 8.48 GWh/yr @ η = 80%
# 2
# 1
70
60
50
40
30
20
10
0
0
2
4
6
8
10
Energy kWh (Millions)
Head = 2.60m , eff = 100%

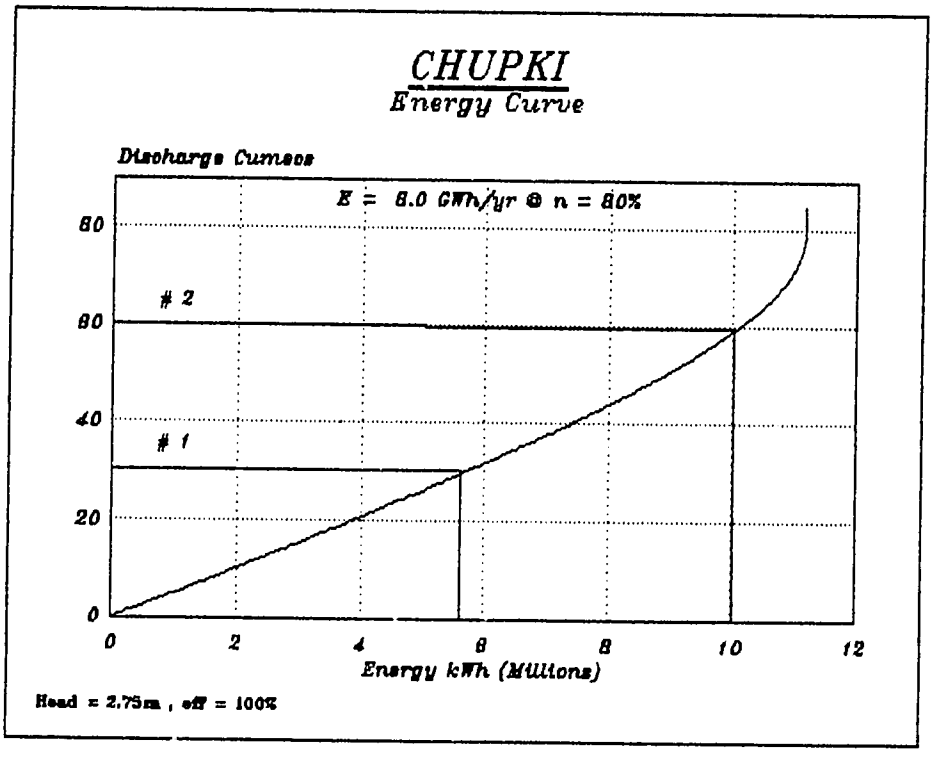

DOLOWAL
Flow Duration Curve
Discharge Cumecs
Q = 30.0cum (opt) : 30.0cum (std)
H = 2.8m (opt) : 3.0m (std)
Cfg = 2 x 800kW (opt) : 2 x 850kW (std)
# 2
# 1
80
60
40
20
0
0%
20%
40%
60%
80%
100%
Percentage Exceedance

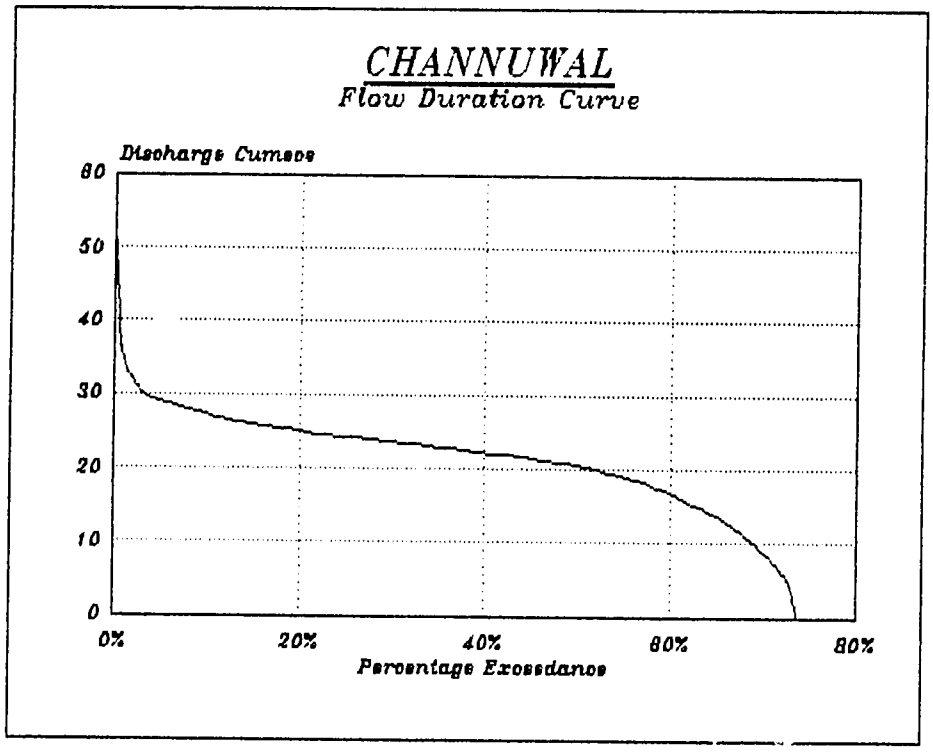

DOLOWAL
Energy Curve
Discharge Cumecs
E = 8.1 GWh/yr @ n = 80%
# 2
# 1
80
60
40
20
0
0
2
4
6
8
10
12
Energy kWh (Millions)
Head = 2.00m , eff = 100%

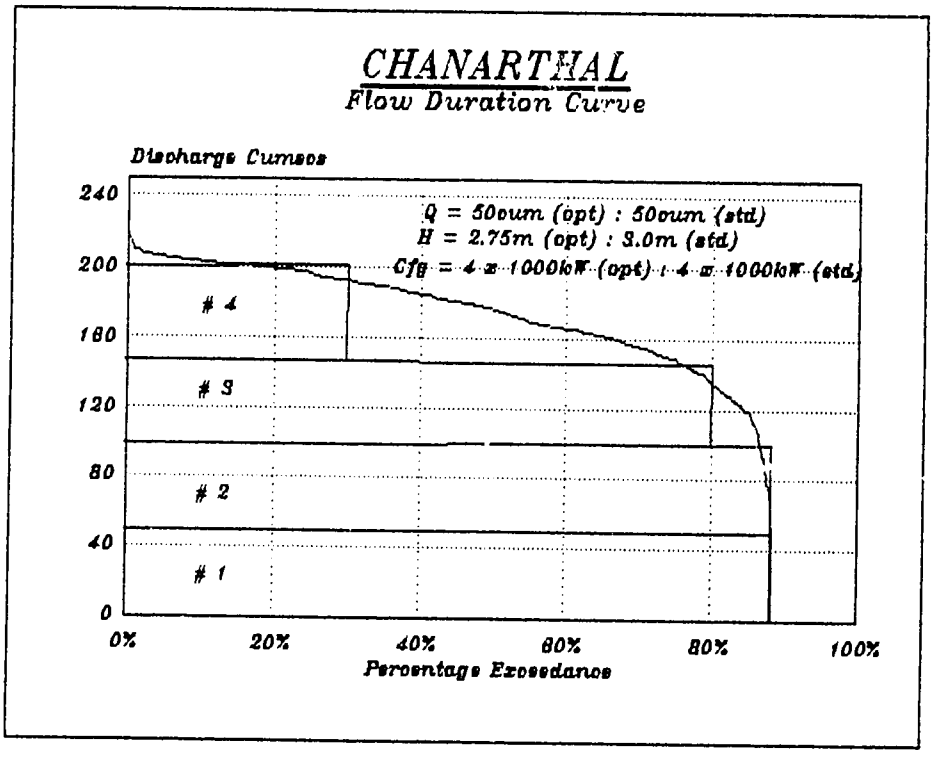

DALLA
Flow Duration Curve
Discharge Cumecs
Q = 25cum (opt) : 22.5cum (std)
H = 4.0m (opt) : 4.25m (std)
Cfg = 2 x 800kW (opt) : 2 x 1000kW (std)
# 2
# 1
70
60
50
40
30
20
10
0
0%
20%
40%
60%
80%
Percentage Exceedance

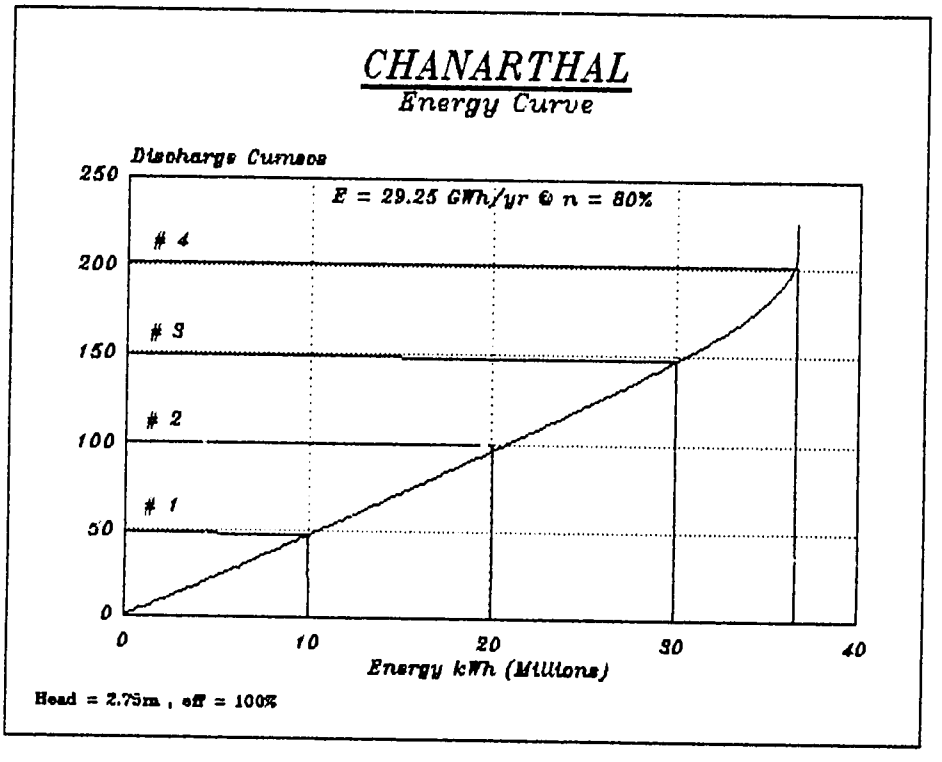

DALLA
Energy Curve
Discharge Cumecs
E = 9.20 GWh/yr @ n = 80%
# 2
# 1
70
60
50
40
30
20
10
0
0
2
4
6
8
10
12
Energy kWh (Millions)
Head = 4.00m , eff = 100%

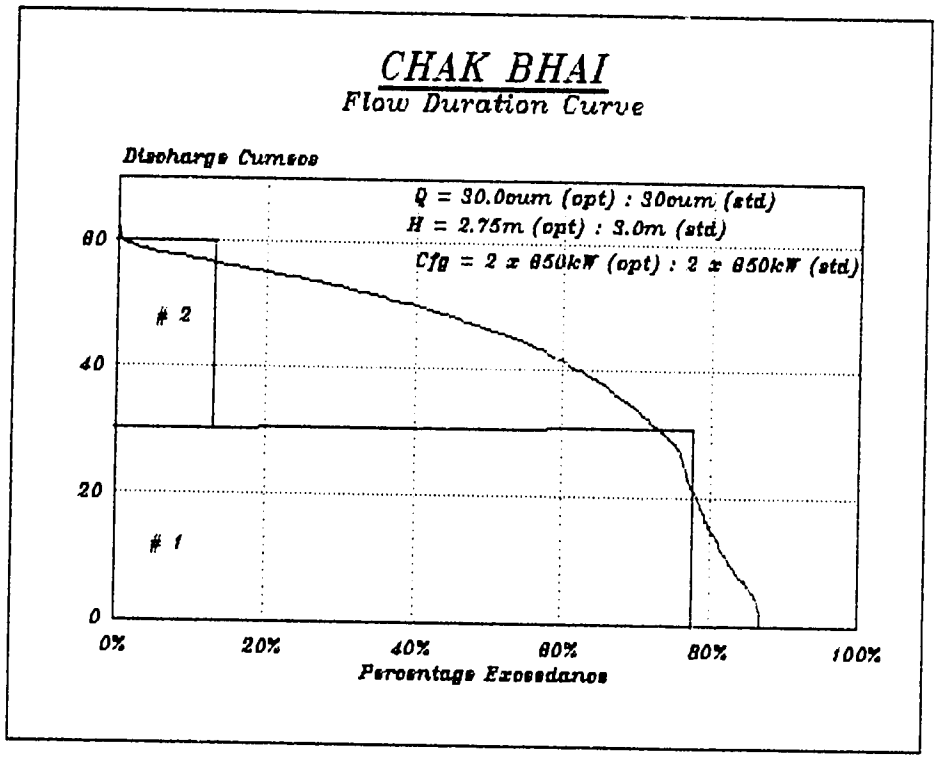

CHUPKI
Flow Duration Curve
Discharge Cumecs
Q = 30.0cum (opt) : 30.0cum (std)
H = 2.75m (opt) : 3.0m (std)
Cfg = 2 x 650kW (opt) : 2 x 650kW (std)
# 2
# 1
100
80
60
40
20
0
0%
20%
40%
60%
80%
100%
Percentage Exceedance

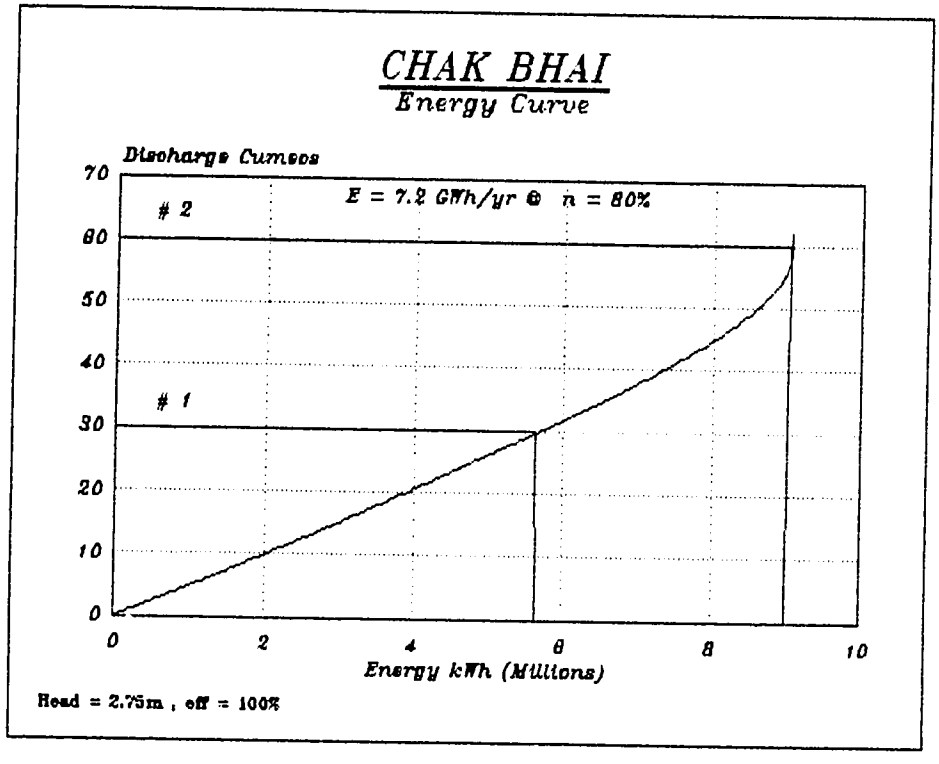

CHUPKI
Energy Curve
Discharge Cumecs
E = 8.0 GWh/yr @ n = 80%
# 2
# 1
80
60
40
20
0
0
2
4
6
8
10
12
Energy kWh (Millions)
Head = 2.75m , eff = 100%

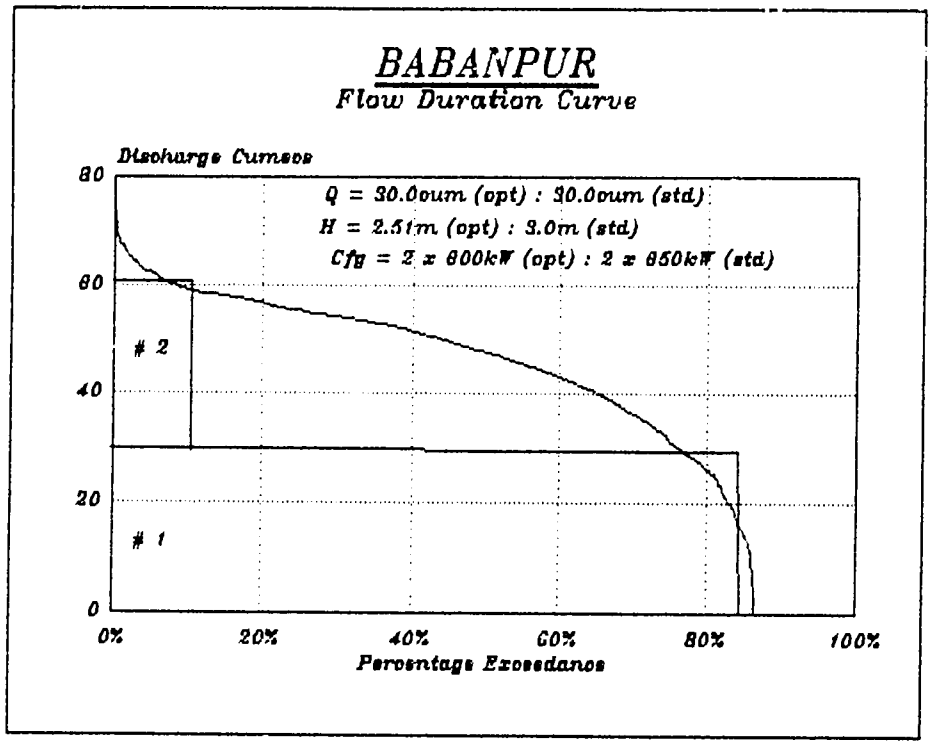

CHANNUWAL
Flow Duration Curve
Discharge Cumecs
60
50
40
30
20
10
0
0%
20%
40%
60%
80%
Percentage Exceedance

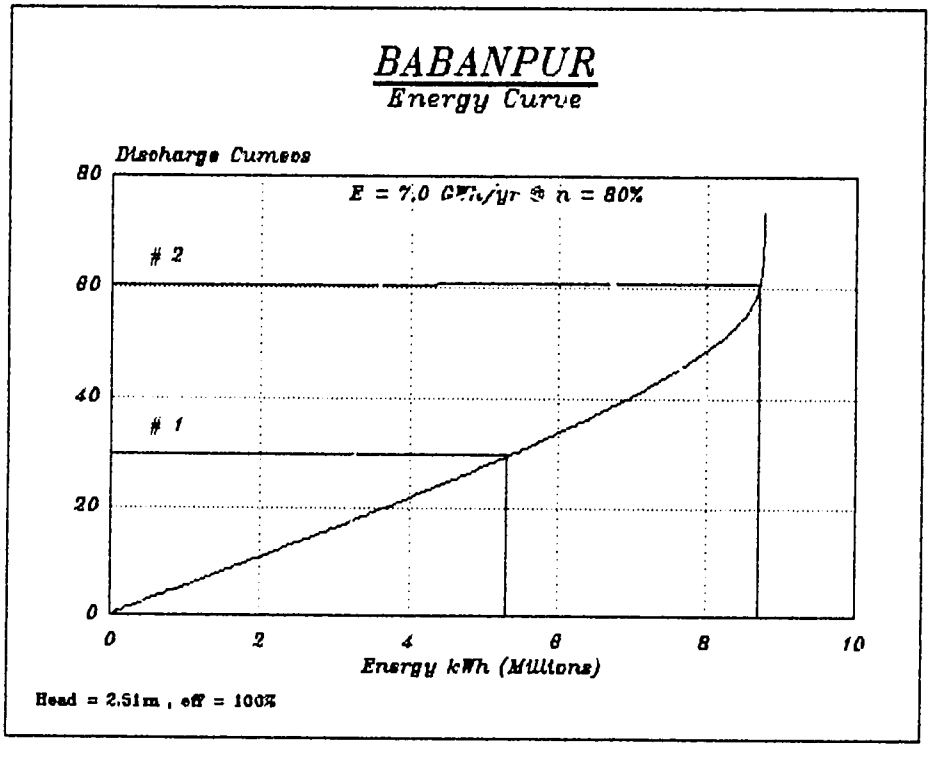

CHANARTHAL
Flow Duration Curve
Discharge Cumecs
Q = 500um (opt) : 500um (std)
H = 2.75m (opt) : 3.0m (std)
Cfg = 4 x 1000kW (opt) : 4 x 1000kW (std)
# 4
# 3
# 2
# 1
240
200
160
120
80
40
0
0%
20%
40%
60%
80%
100%
Percentage Exceedance

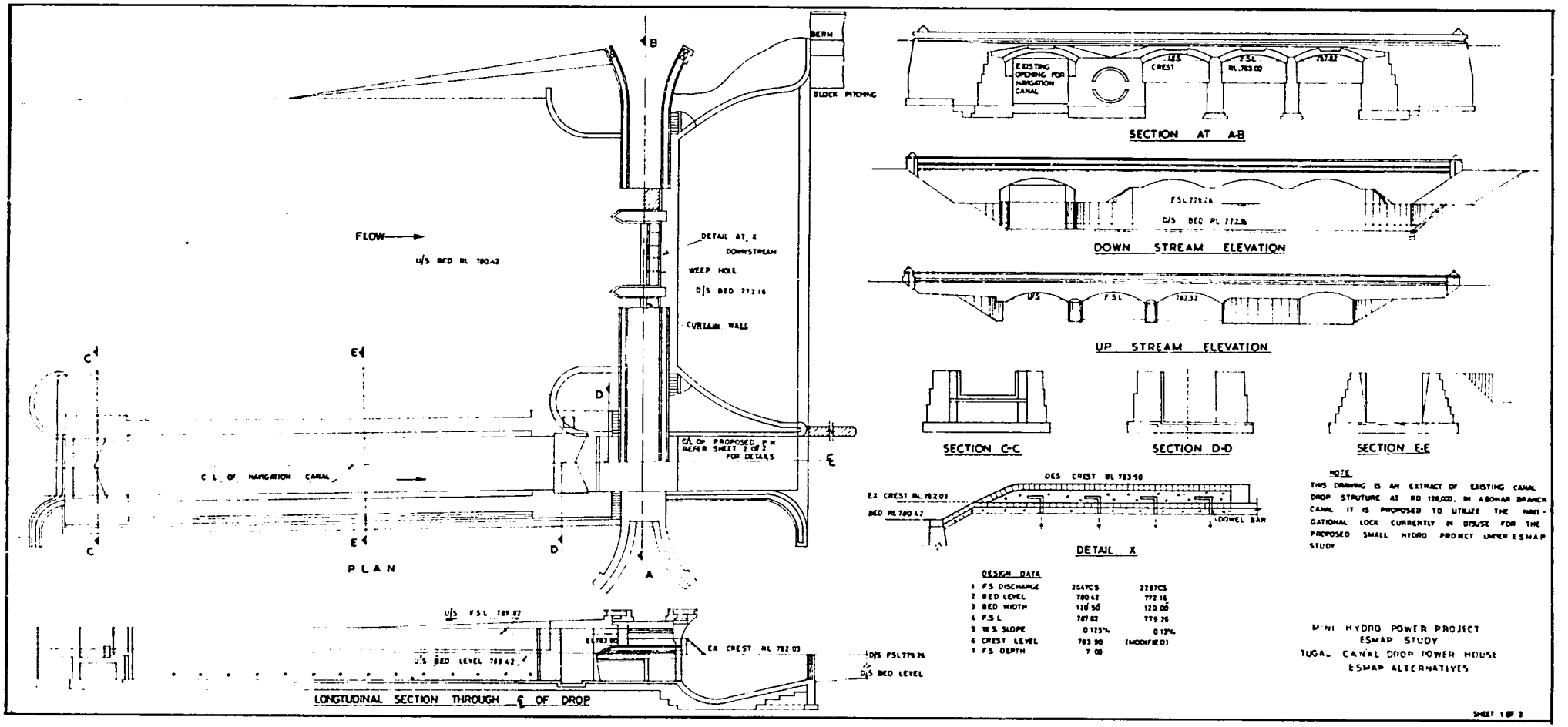

CHANARTHAL
Energy Curve
Discharge Cumecs
E = 29.25 GWh/yr @ n = 80%
# 4
# 3
# 2
# 1
250
200
150
100
50
0
0
10
20
30
40
Energy kWh (Millions)
Head = 2.75m , eff = 100%


CHAK BHAI
Flow Duration Curve
Discharge Cumecs
Q = 30.0cum (opt) : 30cum (std)
H = 2.75m (opt) : 3.0m (std)
Cfg = 2 x 850kW (opt) : 2 x 850kW (std)
# 2
# 1
60
40
20
0
0%
20%
40%
60%
80%
100%
Percentage Exceedance

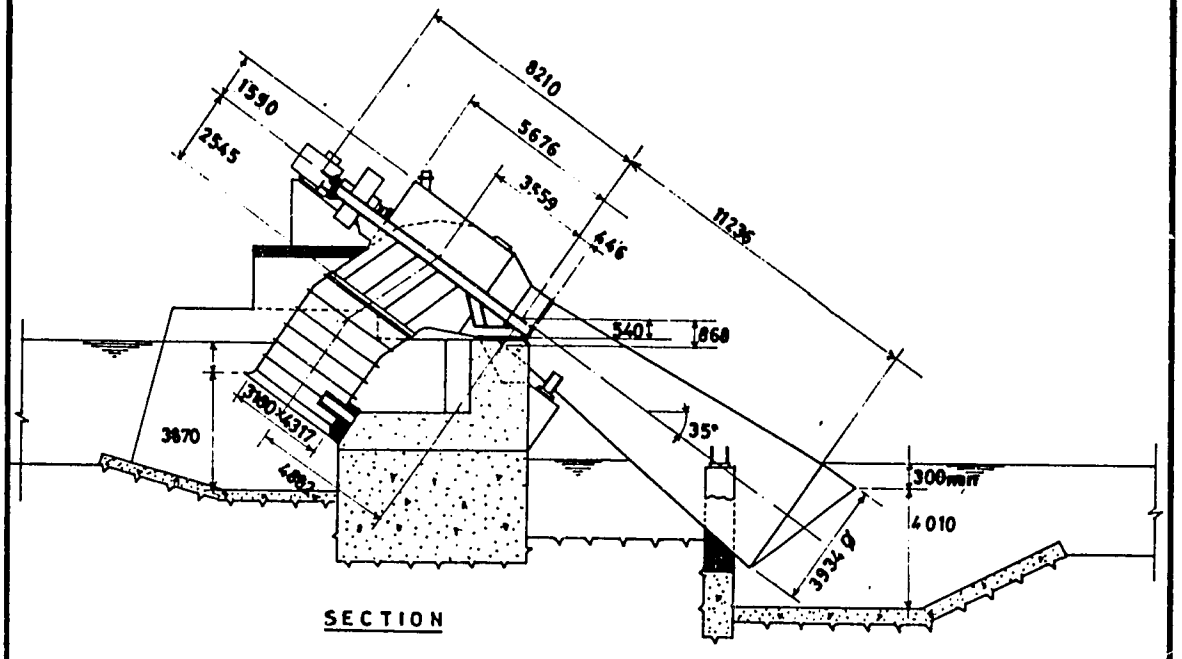

CHAK BHAI
Energy Curve
Discharge Cumecs
E = 7.2 GWh/yr @ n = 80%
# 2
# 1
70
60
50
40
30
20
10
0
0
2
4
6
8
10
Energy kWh (Millions)
Head = 2.75m , eff = 100%


BABANPUR
Flow Duration Curve
Discharge Cumecs
Q = 30.0cum (opt) : 30.0cum (std)
H = 2.51m (opt) : 3.0m (std)
Cfg = 2 x 800kW (opt) : 2 x 850kW (std)
# 2
# 1
80
60
40
20
0
0%
20%
40%
60%
80%
100%
Percentage Exceedance

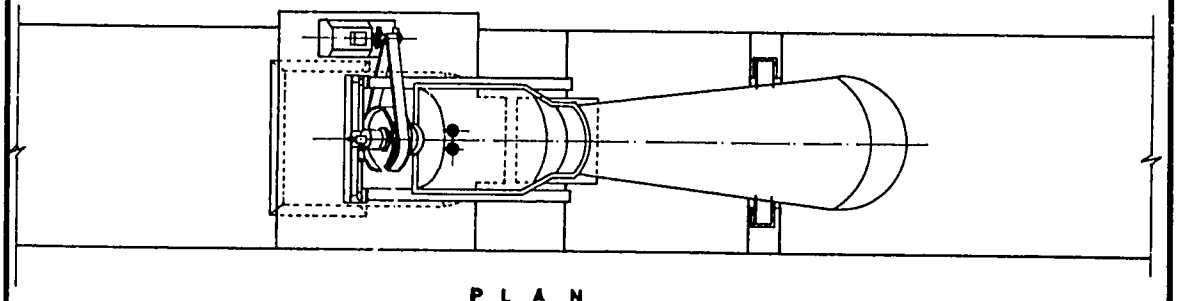

BABANPUR
Energy Curve
Discharge Cumecs
E = 7.0 GWh/yr @ n = 80%
# 2
# 1
80
60
40
20
0
0
2
4
6
8
10
Energy kWh (Millions)
Head = 2.51m , eff = 100%



eads/w48595(101)



SECTION



PLAN

NOTES

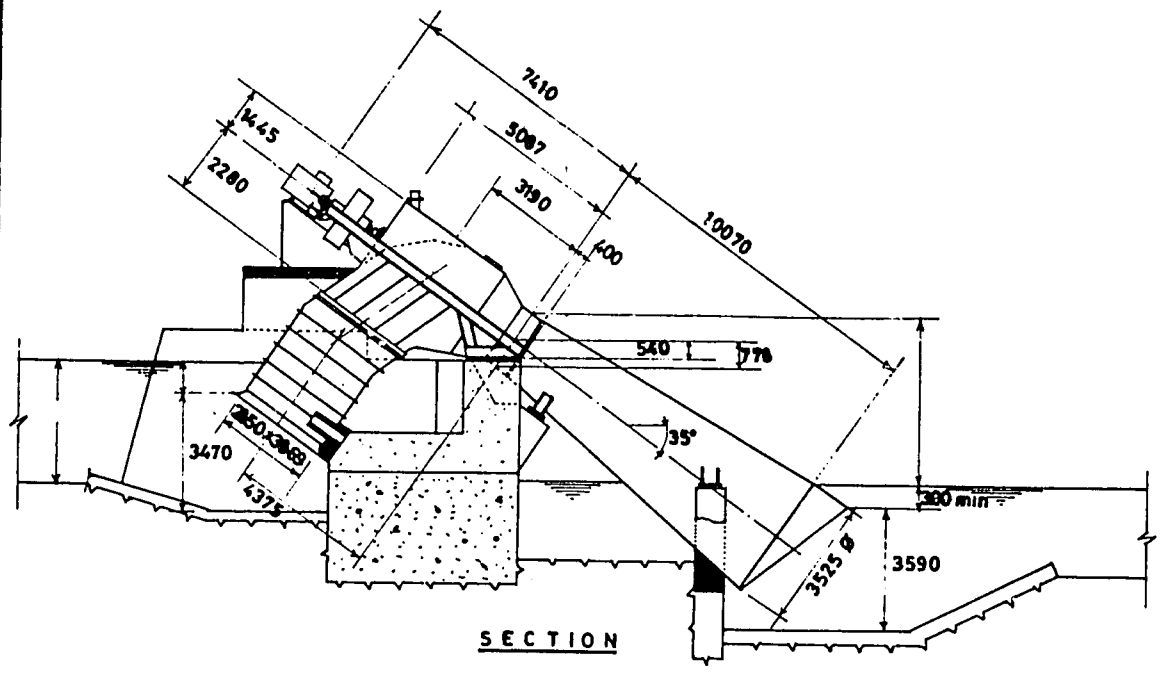
PACKAGE TYPE UNIT TO BE INCORPORATED IN NAVIGATION CANAL OF TUGAL DROP STRUCTURE.

1 UNIT ALTERNATIVE

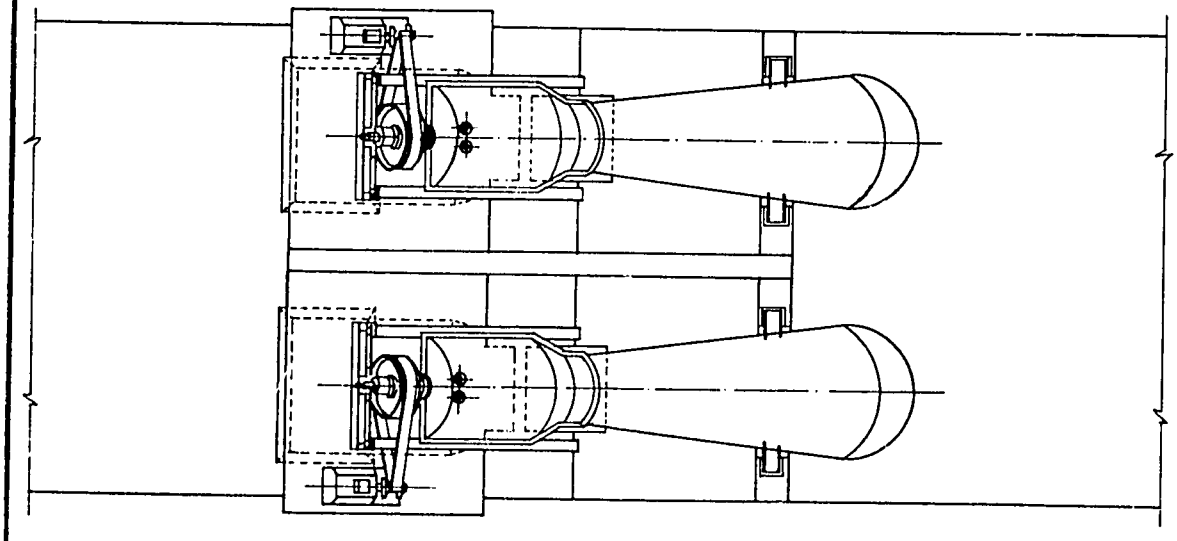
TUGAL CANAL DROP
MINI HYDRO POWER PROJECT

SHEET 2 OF 3

sads/w48595(/62)



SECTION



PLAN

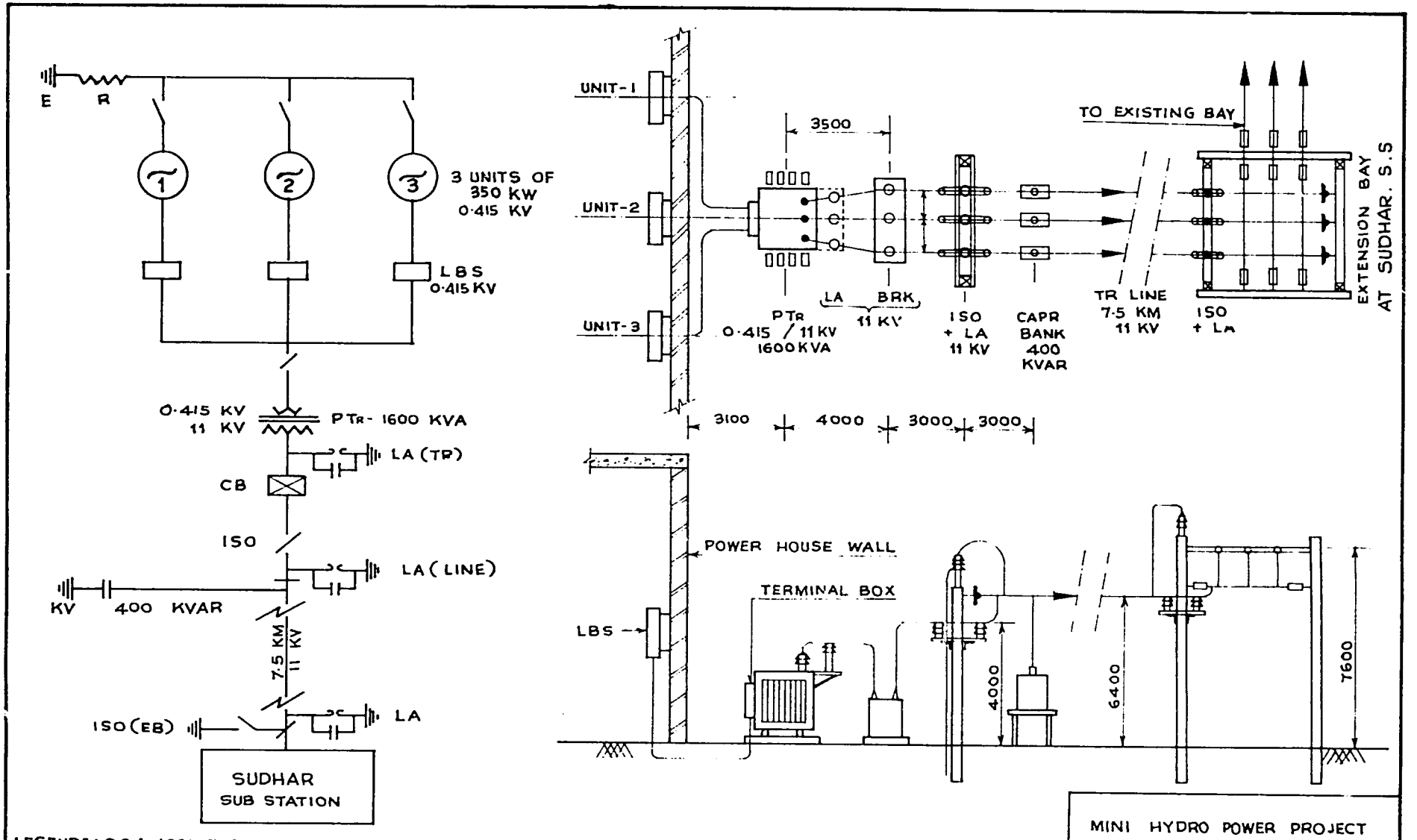
NOTES

PACKAGE TYPE UNIT TO BE INCORPORATED IN NAVIGATION CANAL OF TUGAL DROP STRUCTURE.
2 UNITS ALTERNATIVE.

TUGAL CANAL DROP
MINI HYDRO POWER PROJECT

SHEET 3 OF 3

sads/w48595(/03)

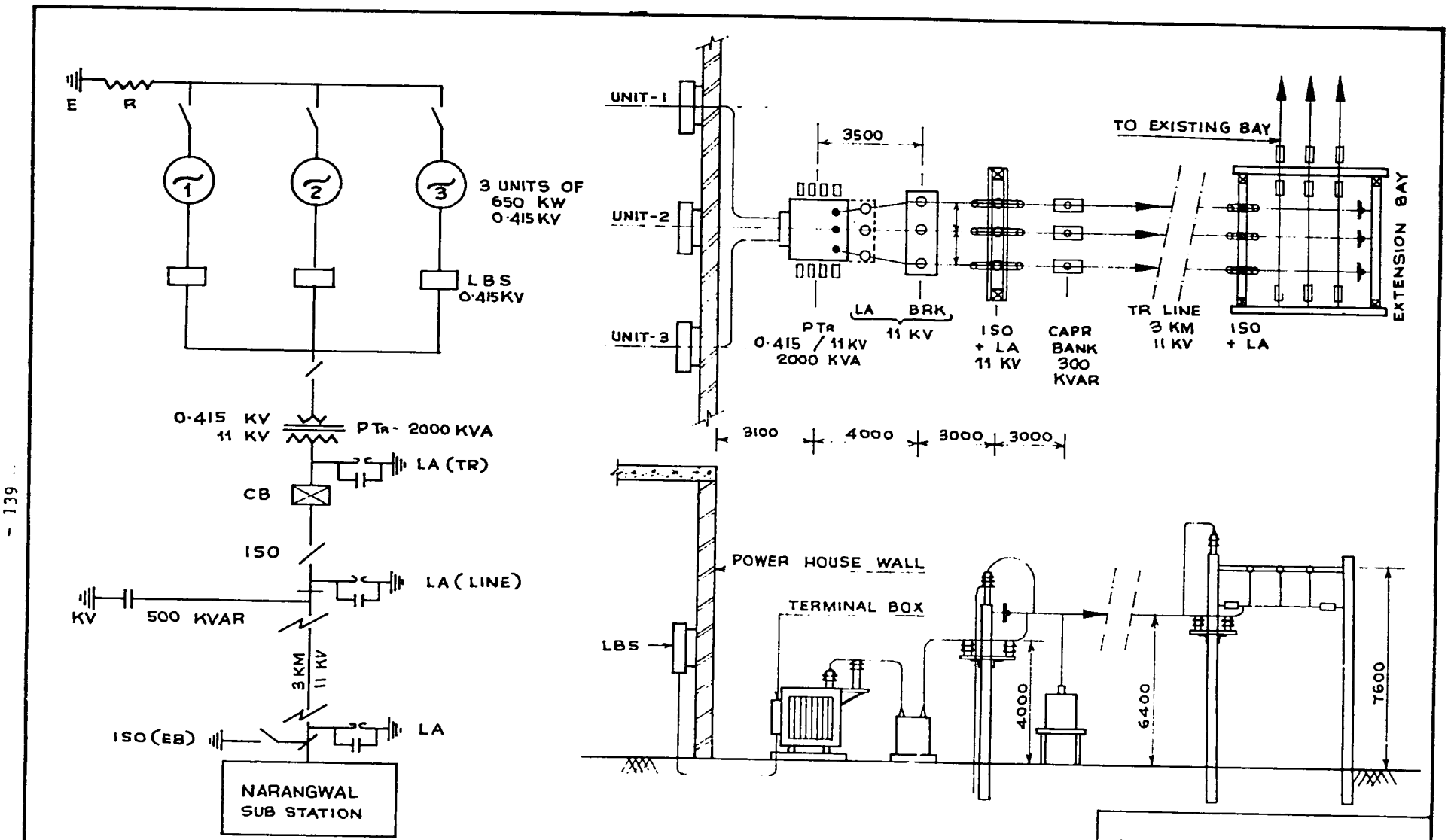


LEGEND: ISO : ISOLATOR.
LA : LIGHTNING ARRESTER.
BRK : BREAKER (MOCB).
LBS : LOAD BREAK SWITCH.
PTR : POWER TRANSFORMER.

NOTE : ALL DIMENSIONS ARE IN 'MM'

MINI HYDRO POWER PROJECT
ESMAP STUDY
TUGAL PROJECT
ELECTRICAL LAYOUT
(PUNJAB)

sads/w48595(67)

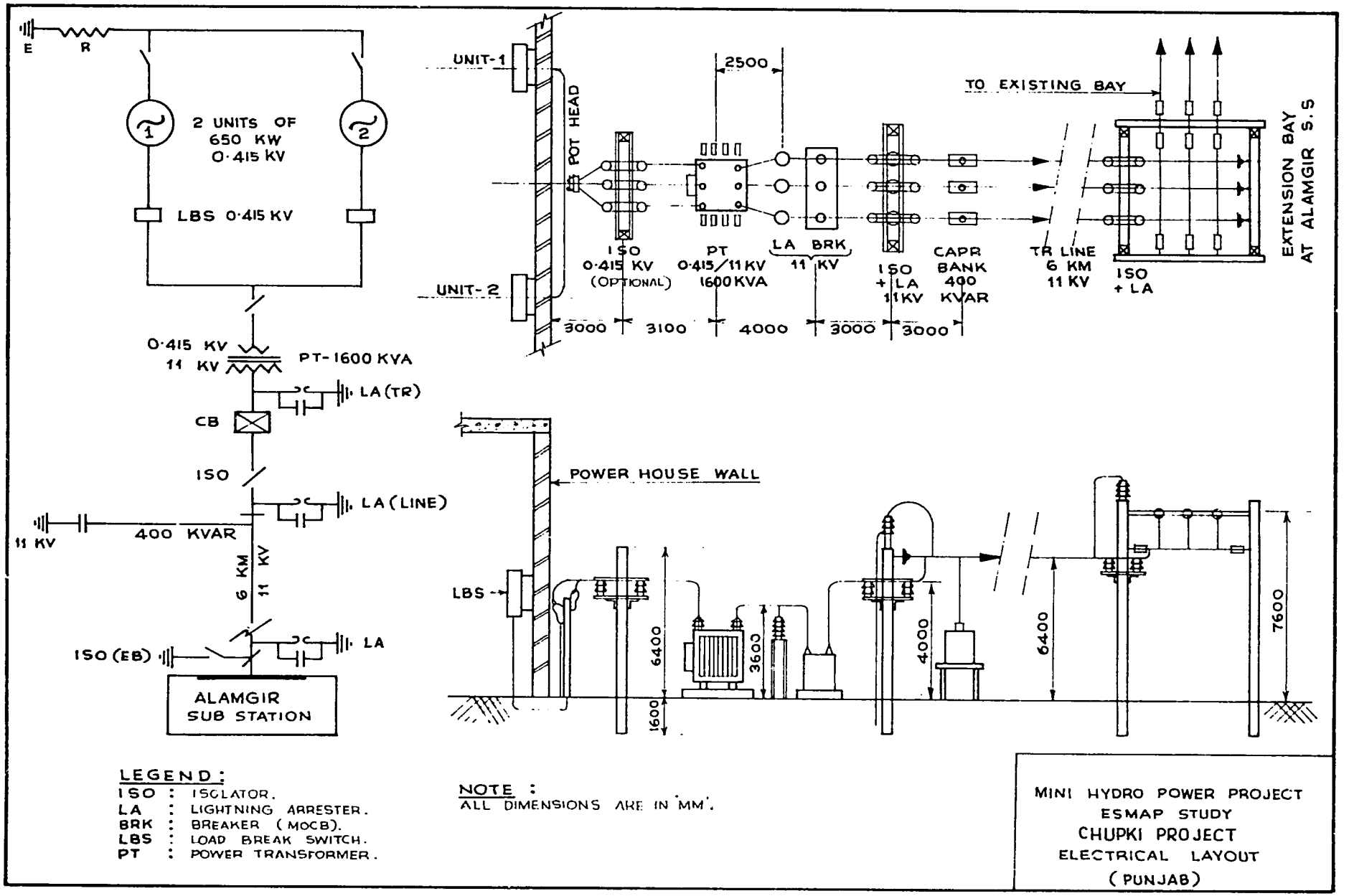


LEGEND: ISO : ISOLATOR.
LA : LIGHTNING ARRESTER.
BRK : BREAKER (MOCB).
LBS : LOAD BREAK SWITCH.
PTR : POWER TRANSFORMER.

NOTE : ALL DIMENSIONS ARE IN 'MM'

MINI HYDRO POWER PROJECT
ESMAP STUDY
NARANGWAL PROJECT
ELECTRICAL LAYOUT
(PUNJAB)

sada/w48595(65)



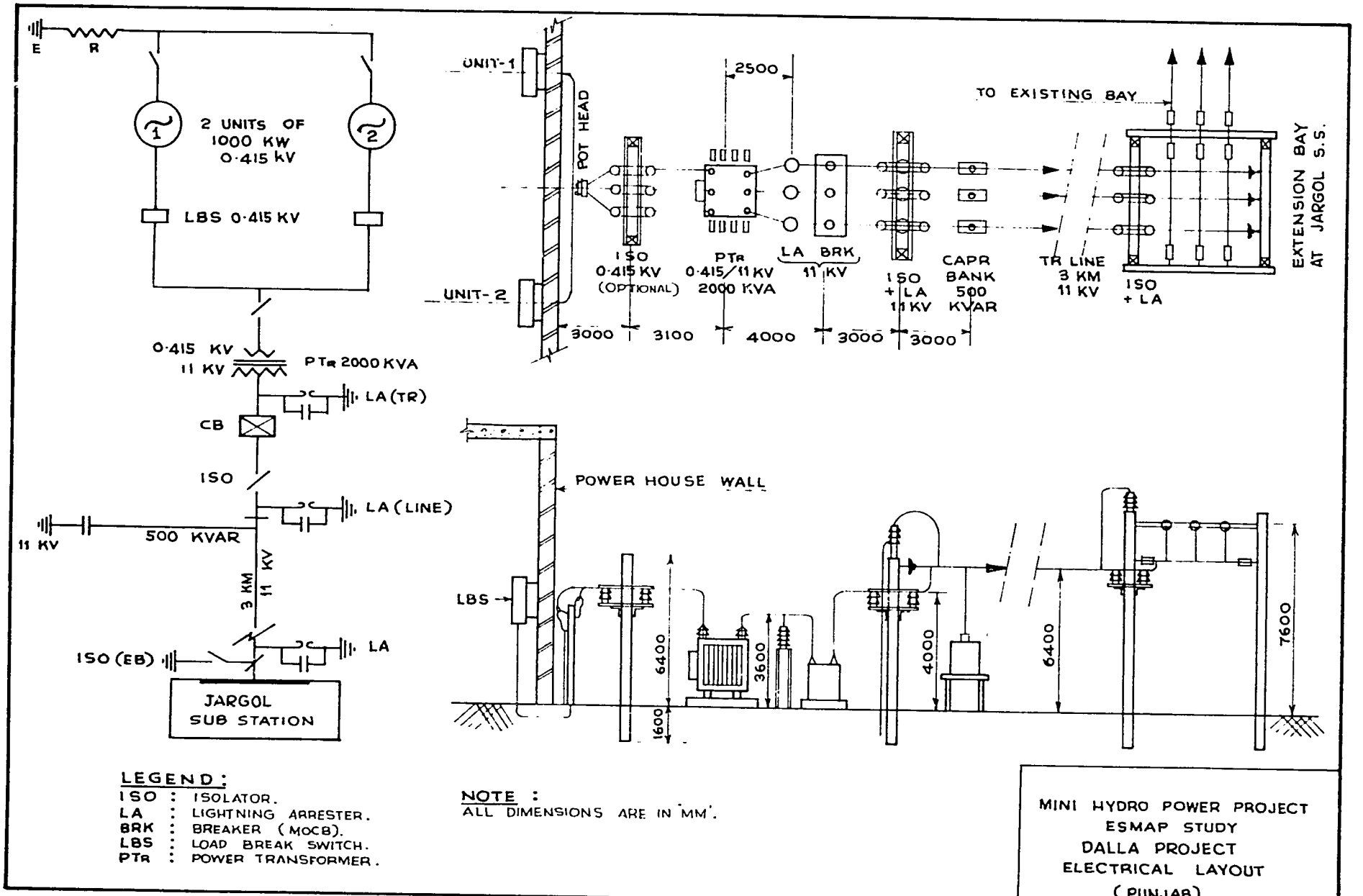
LEGEND:

ISO : ISOLATOR.
LA : LIGHTNING ARRESTER.
BRK : BREAKER (MOCB).
LBS : LOAD BREAK SWITCH.
PT : POWER TRANSFORMER.

NOTE :
ALL DIMENSIONS ARE IN 'MM'.

MINI HYDRO POWER PROJECT
ESMAP STUDY
CHUPKI PROJECT
ELECTRICAL LAYOUT
(PUNJAB)

sads/w48595(68)



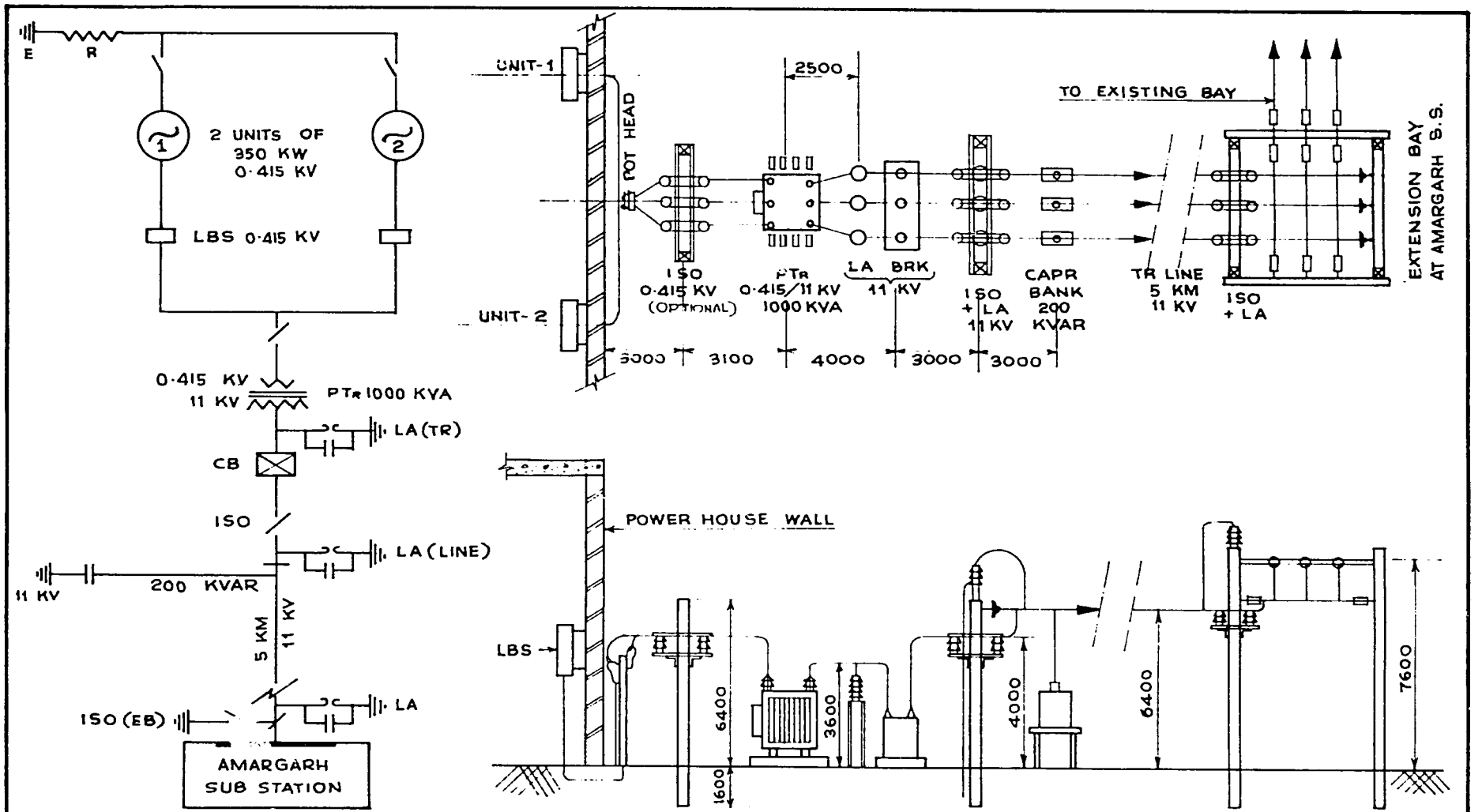
LEGEND:

ISO : ISOLATOR.
LA : LIGHTNING ARRESTER.
BRK : BREAKER (MOCB).
LBS : LOAD BREAK SWITCH.
PTR : POWER TRANSFORMER.

NOTE :
ALL DIMENSIONS ARE IN 'MM'.

MINI HYDRO POWER PROJECT
ESMAP STUDY
DALLA PROJECT
ELECTRICAL LAYOUT
(PUNJAB)

sads/w48595(66)



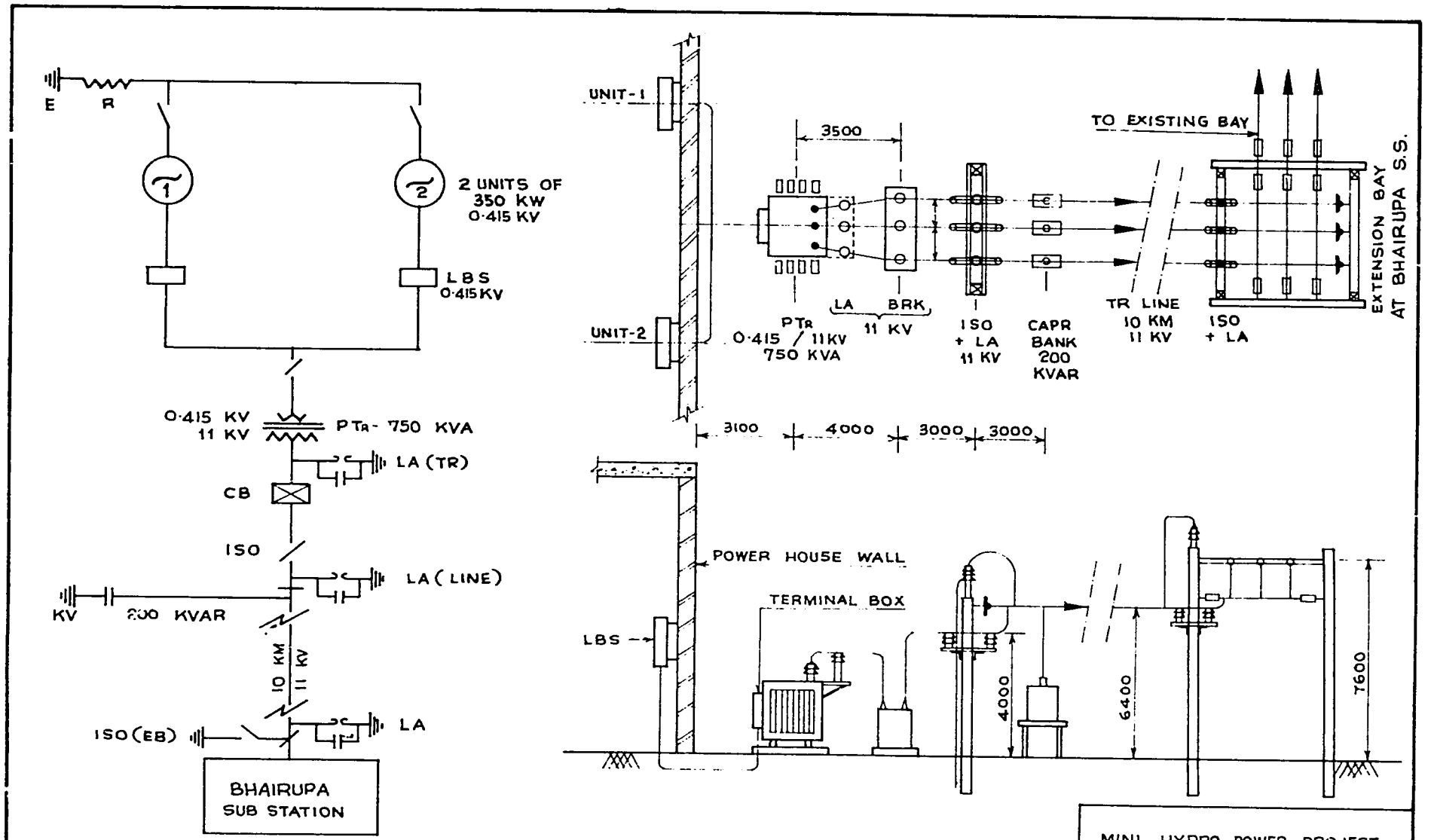
LEGEND :

ISO : ISOLATOR.
LA : LIGHTNING ARRESTER.
BRK : BREAKER (MOCB).
LBS : LOAD BREAK SWITCH.
PTr : POWER TRANSFORMER.

NOTE :
ALL DIMENSIONS ARE IN 'MM'.

MINI HYDRO POWER PROJECT
ESMAP STUDY
SALAR PROJECT
ELECTRICAL LAYOUT
(PUNJAB)

sads/w48595( )

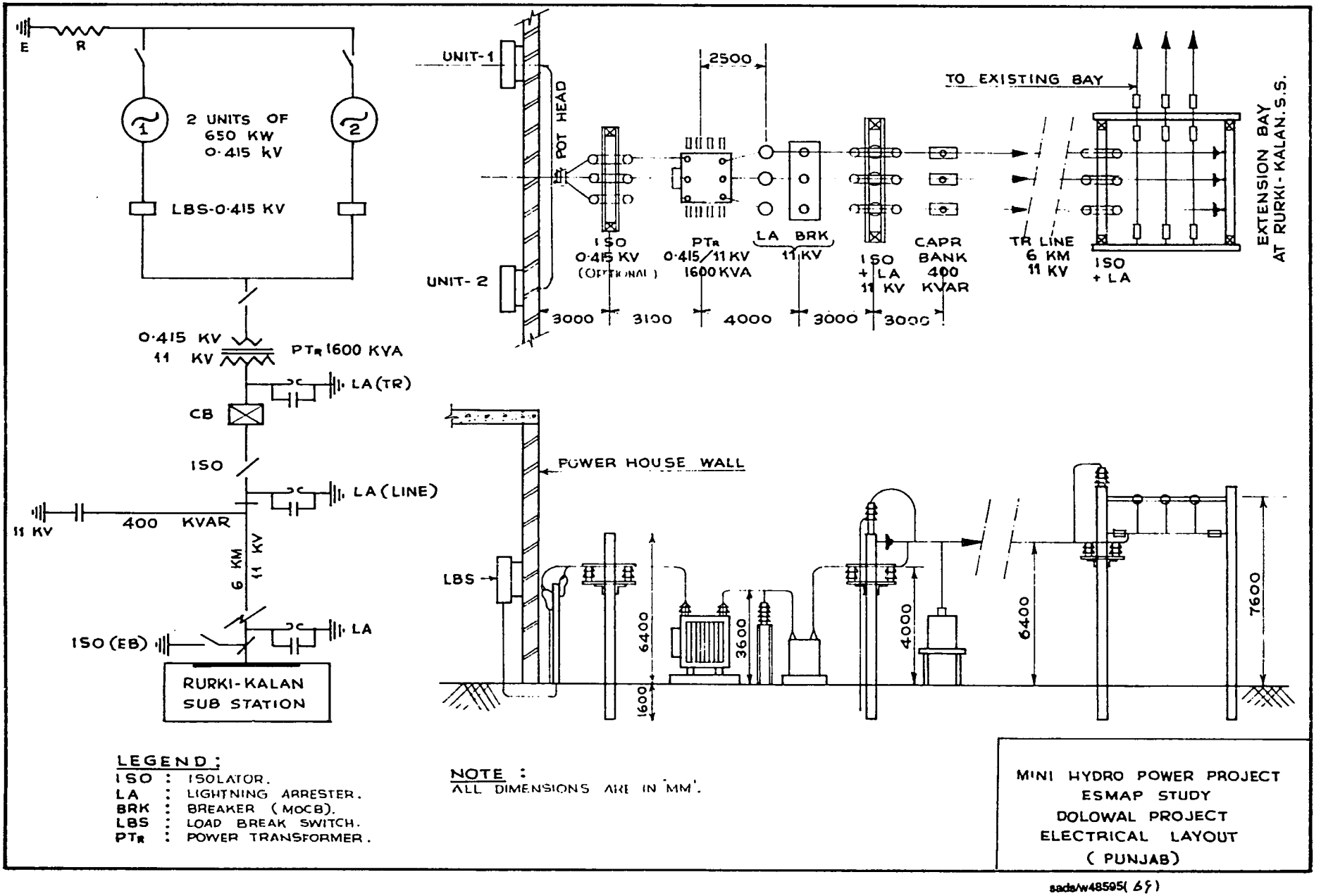


LEGEND: ISO : ISOLATOR.
LA : LIGHTNING ARRESTER.
BRK : BREAKER (MOCB).
LBS : LOAD BREAK SWITCH.
PTR : POWER TRANSFORMER.

NOTE : ALL DIMENSIONS ARE IN 'MM'

MINI HYDRO POWER PROJECT
ESMAP STUDY
SIDHANA PROJECT
ELECTRICAL LAYOUT
(PUNJAB)

sads/w48595(74)



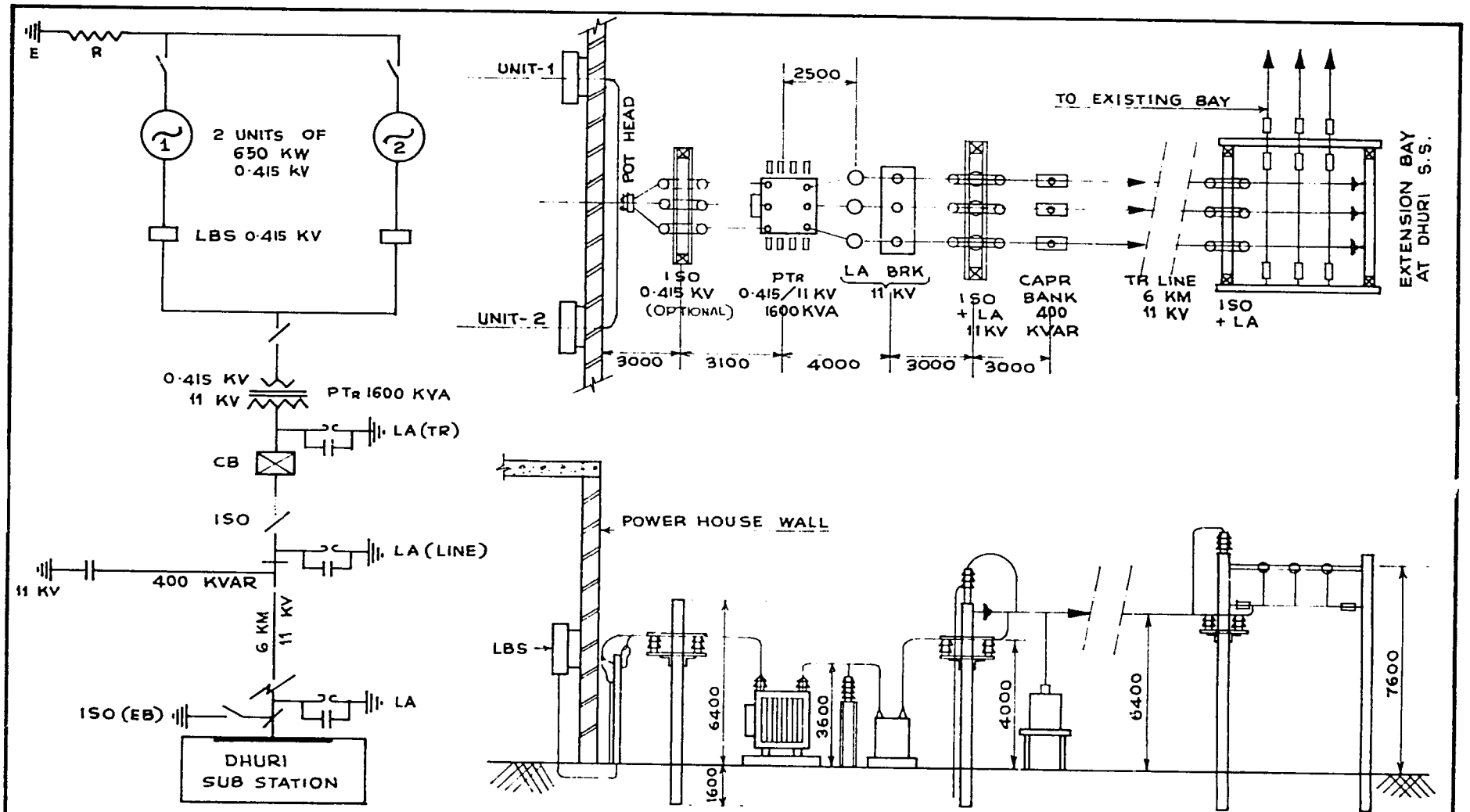
LEGEND :

ISO : ISOLATOR.
LA : LIGHTNING ARRESTER.
BRK : BREAKER (MOCB).
LBS : LOAD BREAK SWITCH.
PTR : POWER TRANSFORMER.

NOTE :
ALL DIMENSIONS ARE IN 'MM'.

MINI HYDRO POWER PROJECT
ESMAP STUDY
DOLOWAL PROJECT
ELECTRICAL LAYOUT
(PUNJAB)

sads/w48595(69)



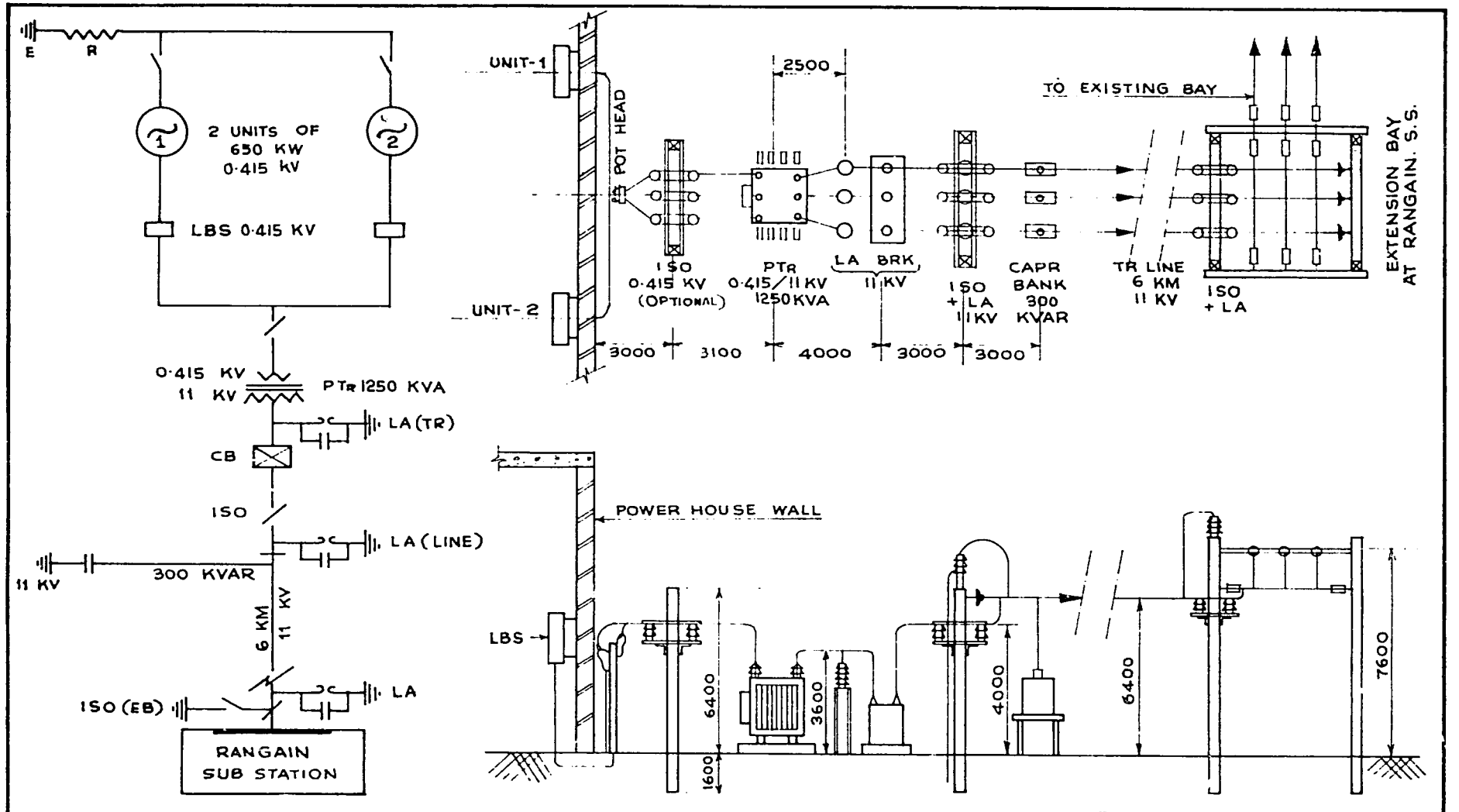
LEGEND:

ISO : ISOLATOR.
LA : LIGHTNING ARRESTER.
BRK : BREAKER (MOCB).
LBS : LOAD BREAK SWITCH.
PTR : POWER TRANSFORMER.

NOTE :
ALL DIMENSIONS ARE IN 'MM'.

MINI HYDRO POWER PROJECT
ESMAP STUDY
BABANPUR PROJECT
ELECTRICAL LAYOUT
(PUNJAB)

ssds/w48595(70)



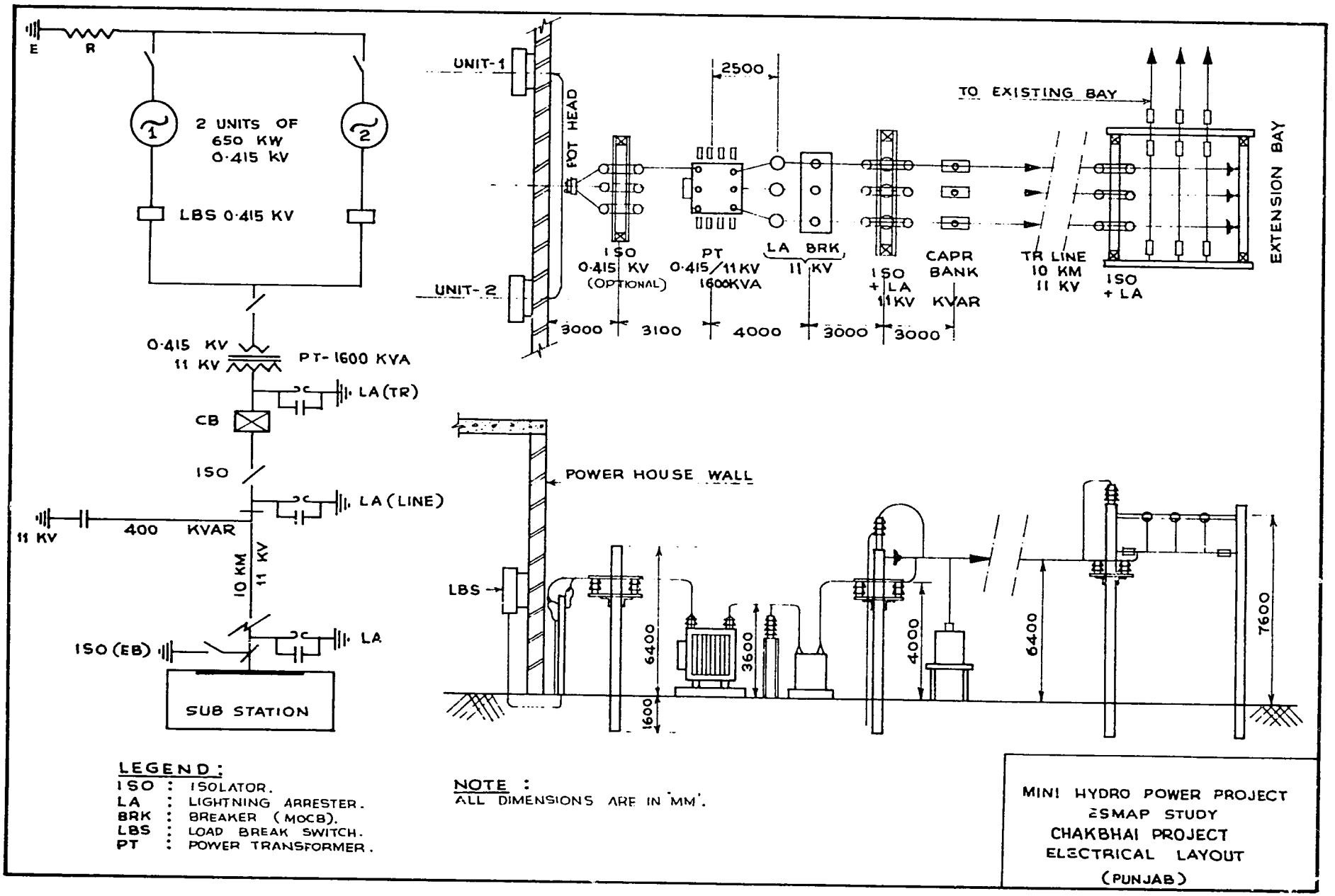
LEGEND:

ISO : ISOLATOR.
LA : LIGHTNING ARRESTER
BRK : BREAKER (MOCB).
LBS : LOAD BREAK SWITCH.
PTR : POWER TRANSFORMER.

NOTE :
ALL DIMENSIONS ARE IN 'MM'.

MINI HYDRO POWER PROJECT
ESMAP STUDY
KILA PROJECT
ELECTRICAL LAYOUT
(PUNJAB)

sad:w48595(74)



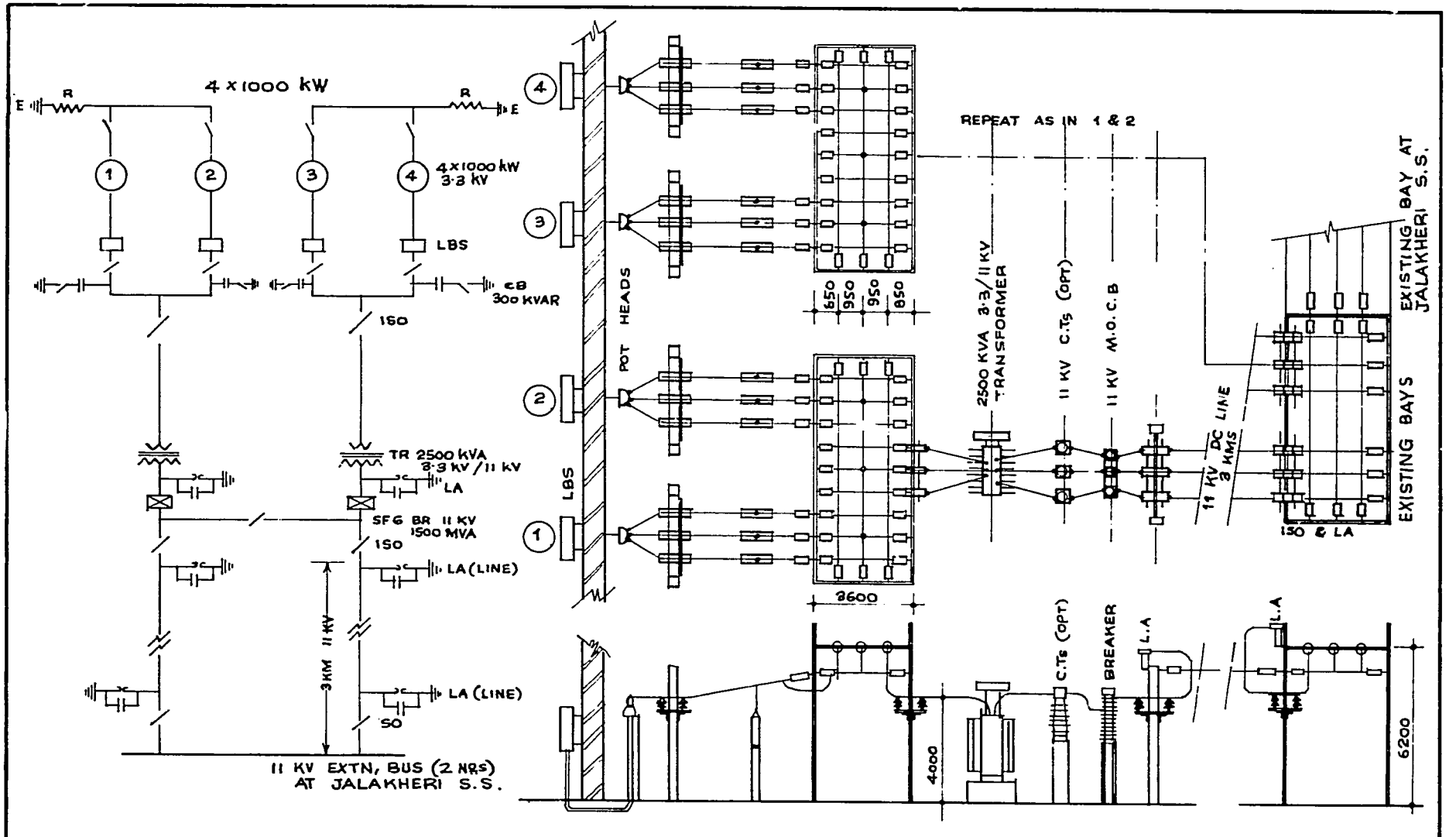
LEGEND:

ISO : ISOLATOR.
LA : LIGHTNING ARRESTER.
BRK : BREAKER (MOCB).
LBS : LOAD BREAK SWITCH.
PT : POWER TRANSFORMER.

NOTE :
ALL DIMENSIONS ARE IN 'MM'.

MINI HYDRO POWER PROJECT
ESMAP STUDY
CHAKBHAI PROJECT
ELECTRICAL LAYOUT
(PUNJAB)

sads/w48595(73)



MINI HYDRO POWER PROJECT
ESMAP STUDY

CHANARTHAL PROJECT
ELECTRICAL LAYOUT

(PUNJAB)

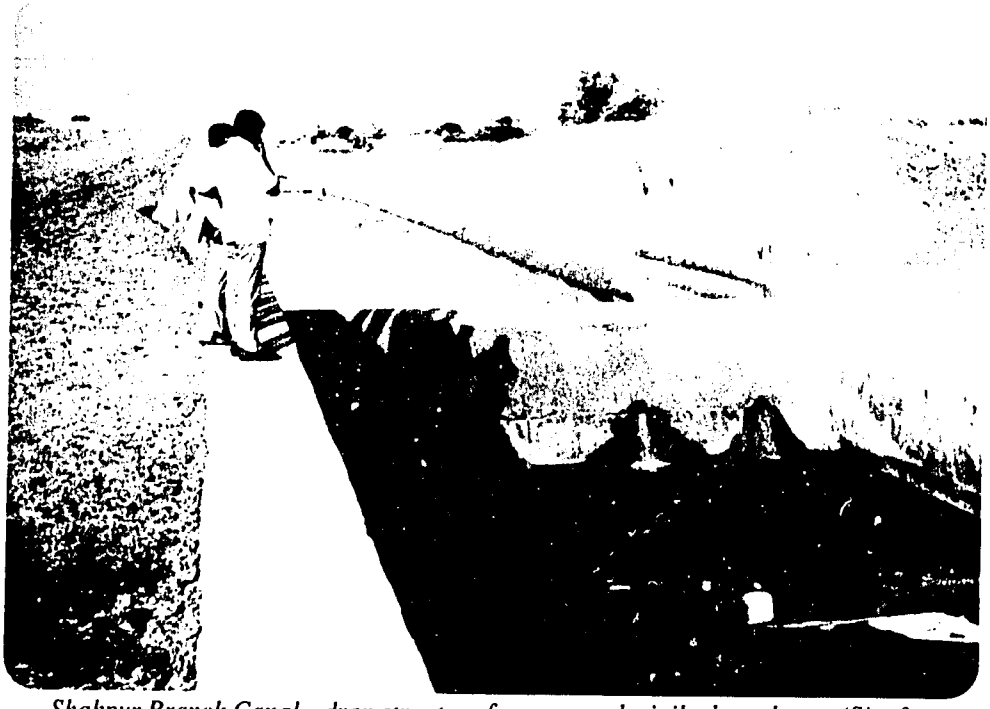
sads/w48595(44)

148A

SECTION VI

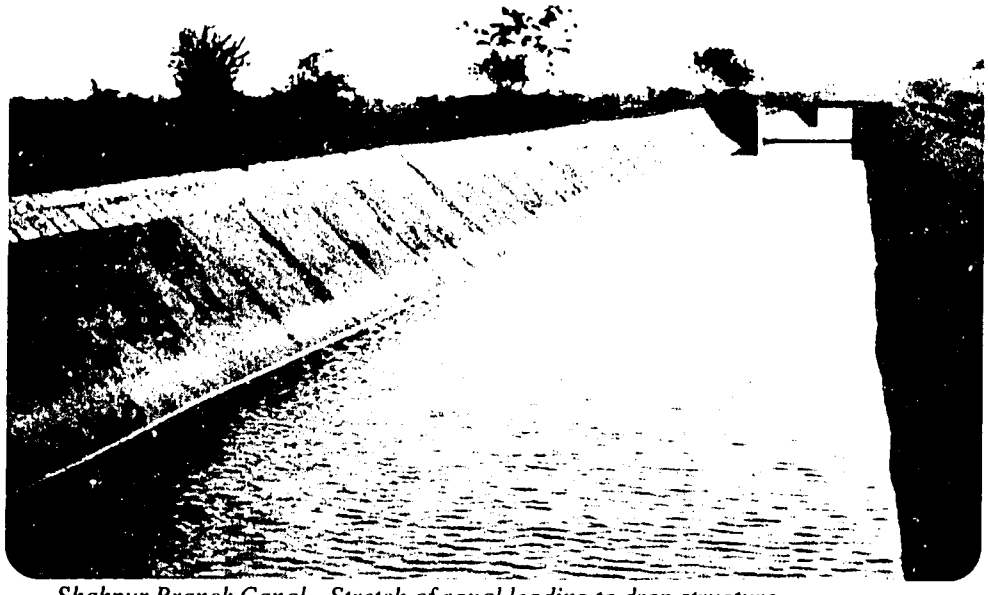
PHOTOGRAPHS OF PROSPECTIVE MINI-HYDRO SITES

SHAHPUR BRANCH CANAL CLUSTER, KARNATAKA

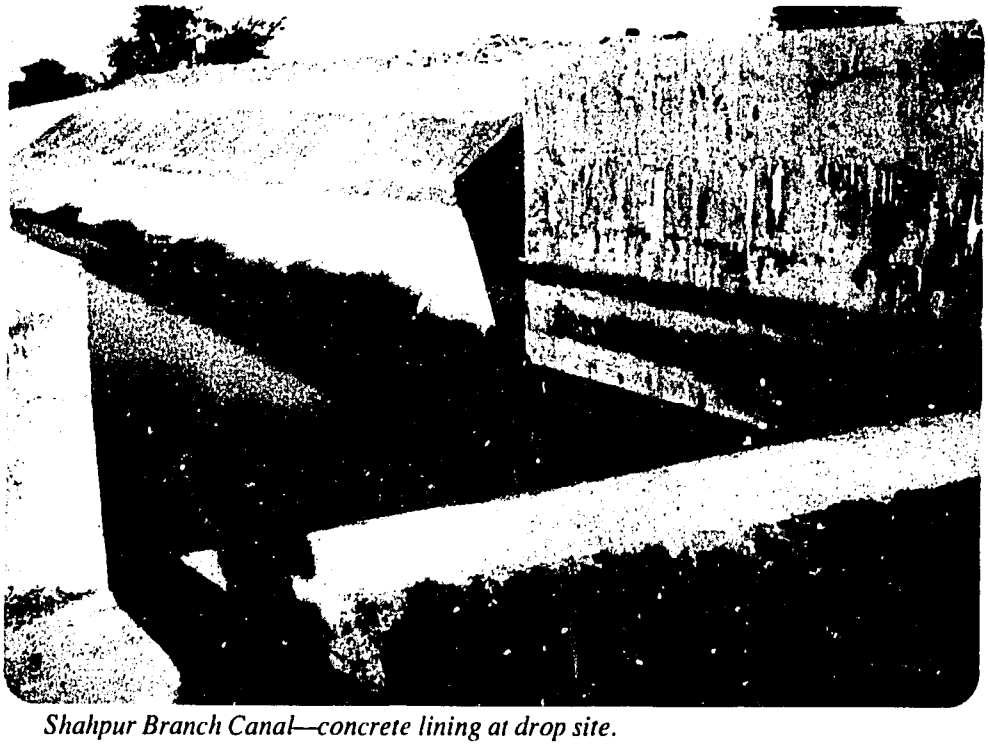


Shahpur Branch Canal—drop structure for proposed minihydro scheme. (Site for 3 x 350 kW scheme).

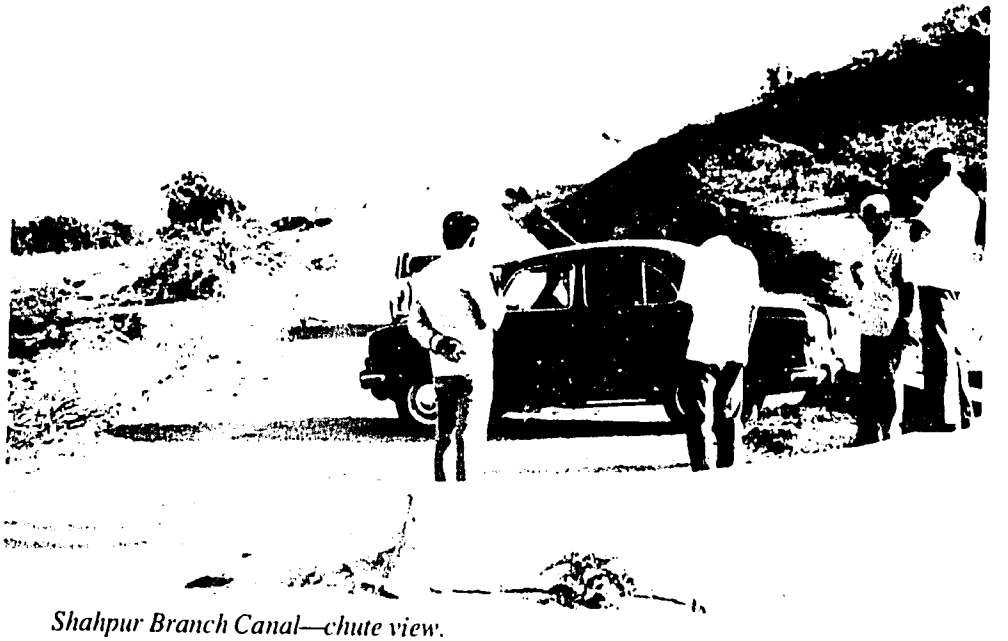
Shahpur Branch Canal—close-up view of drop structure.



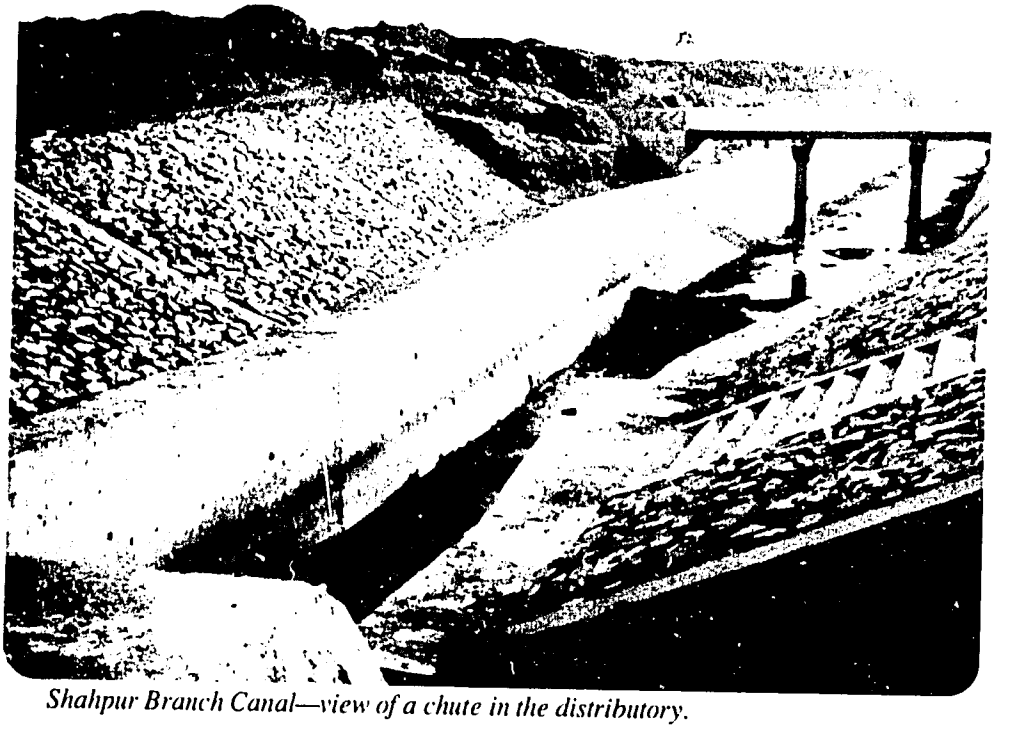
Shahpur Branch Canal—Stretch of canal leading to drop structure



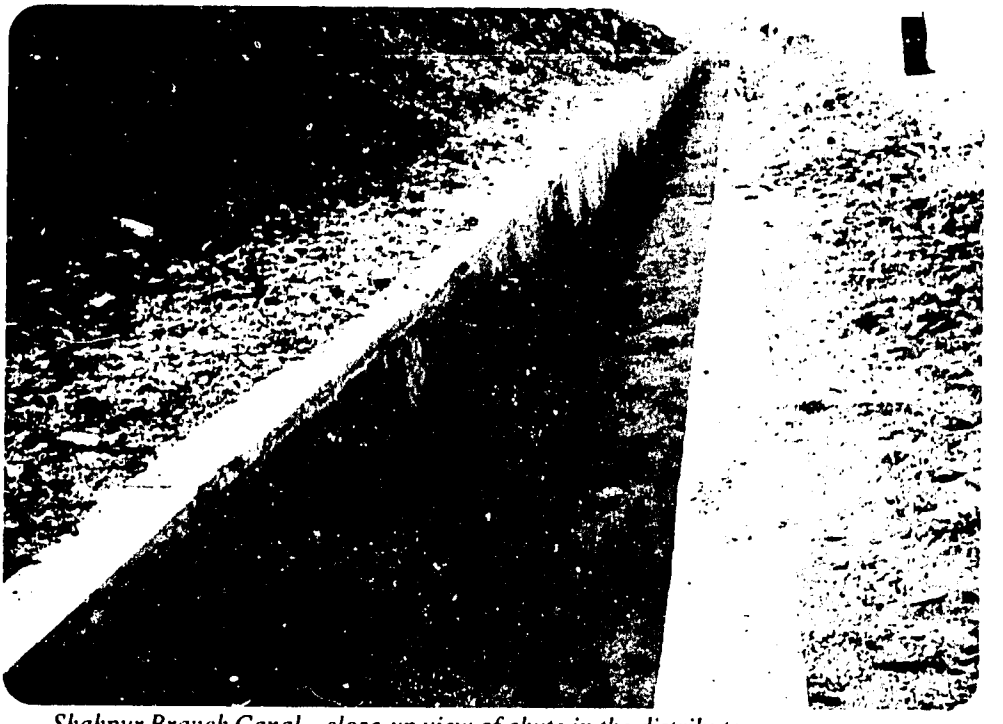
Shahpur Branch Canal—concrete lining at drop site.



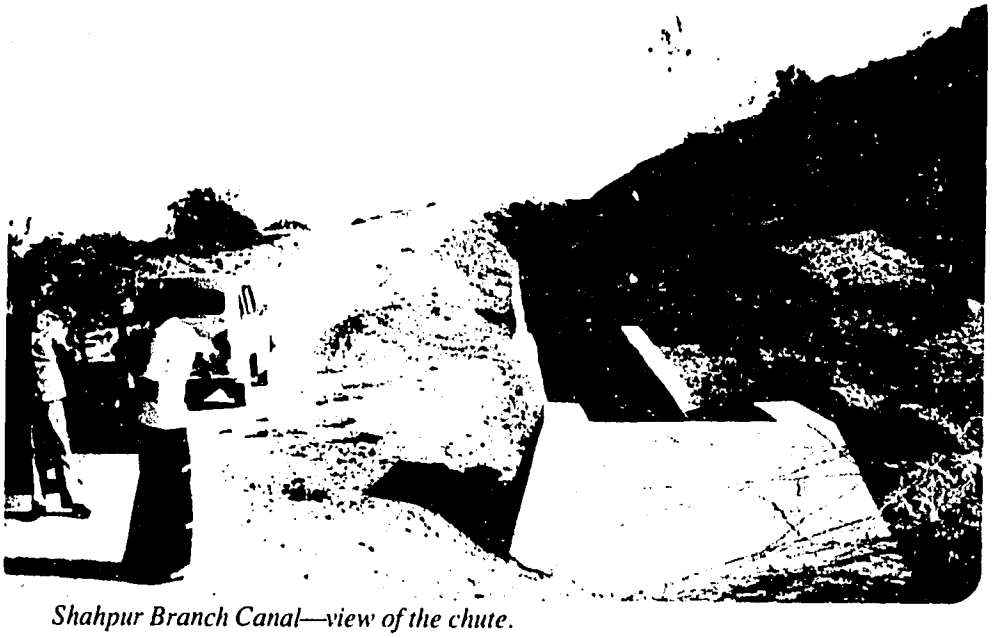
Shahpur Branch Canal—chute view.



Shahpur Branch Canal—view of a chute in the distributory.



Shahpur Branch Canal—close-up view of chute in the distributory.

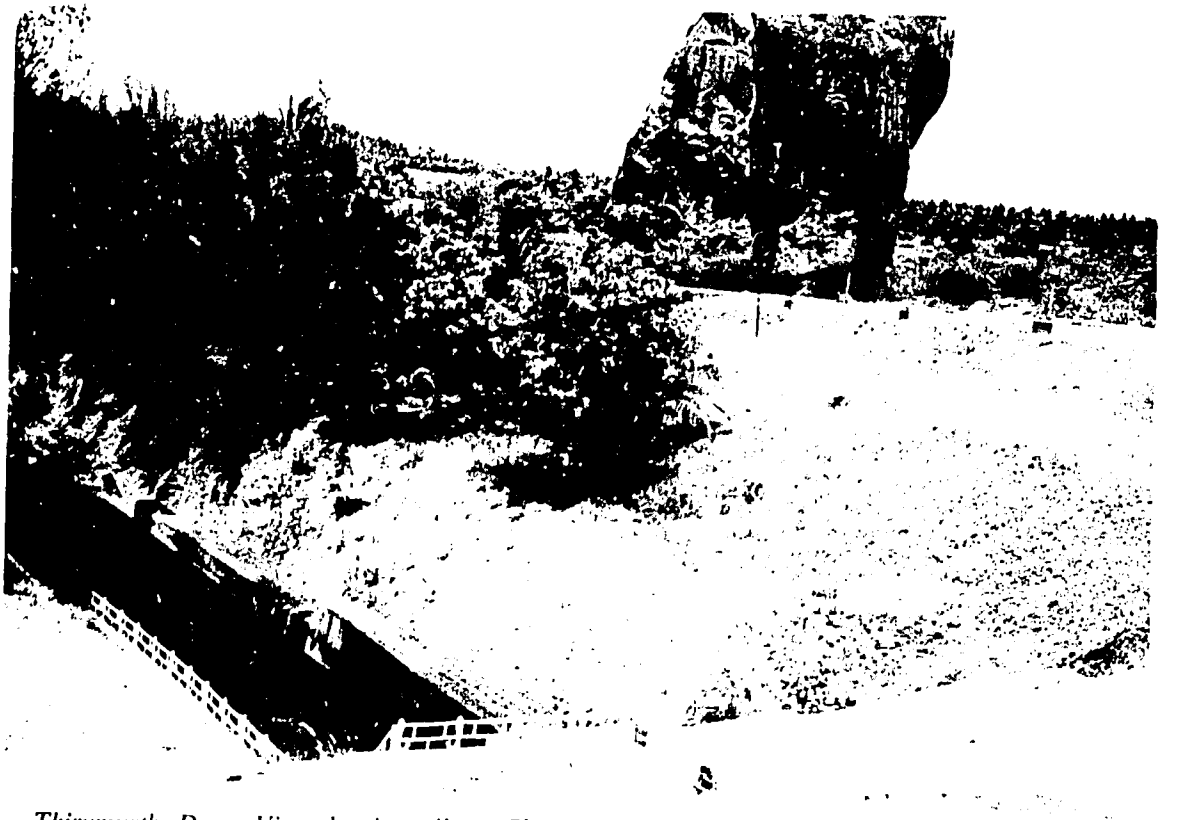


Shahpur Branch Canal—view of the chute.

Shahpur Branch Canal—beginning of the chute in the distributory.

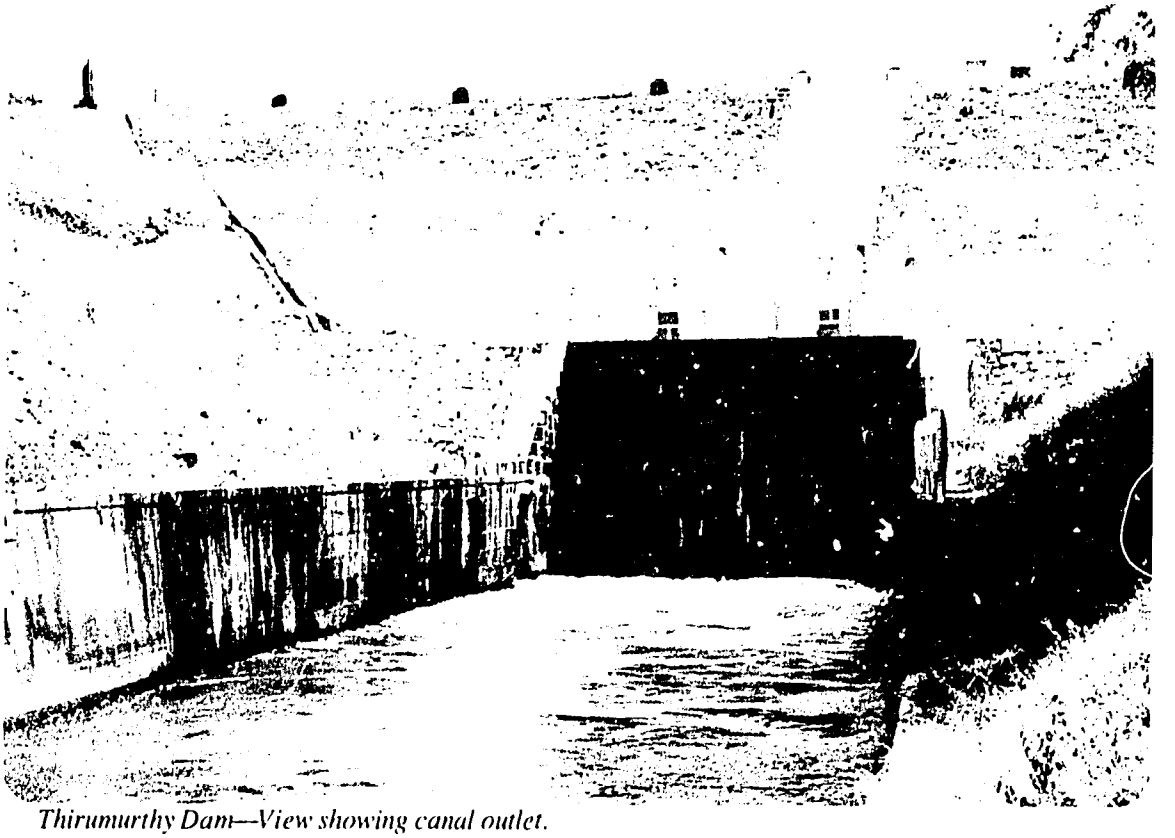
THIRUMURTHY DAM, TAMIL NADU

Thirumurthy Dam—View showing surge tank and power house locations proposed by Tamul Nadu Electricity Board (TNEB) for 3 x 650 kW scheme.



Thirumurthy Dam—View showing tailrace Channel proposed by TNEB.

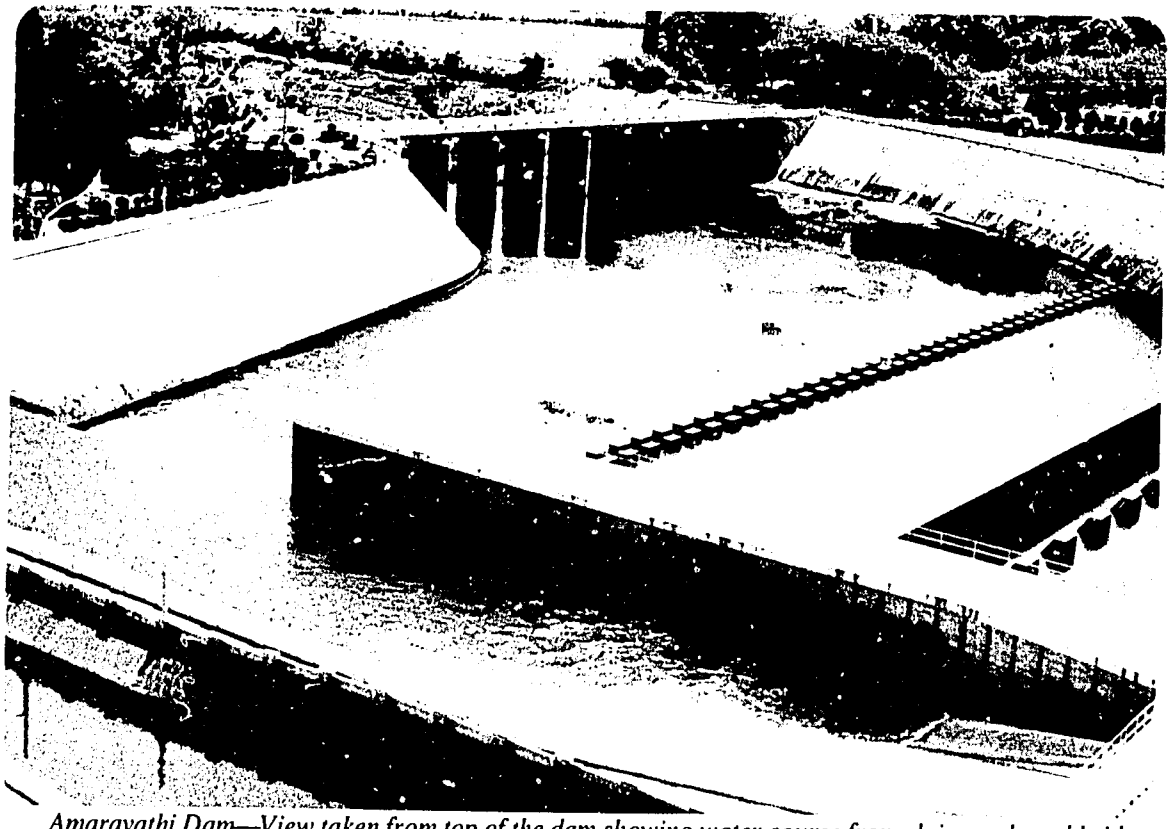
Thirumurthy Dam—View showing canal entry and outlet.



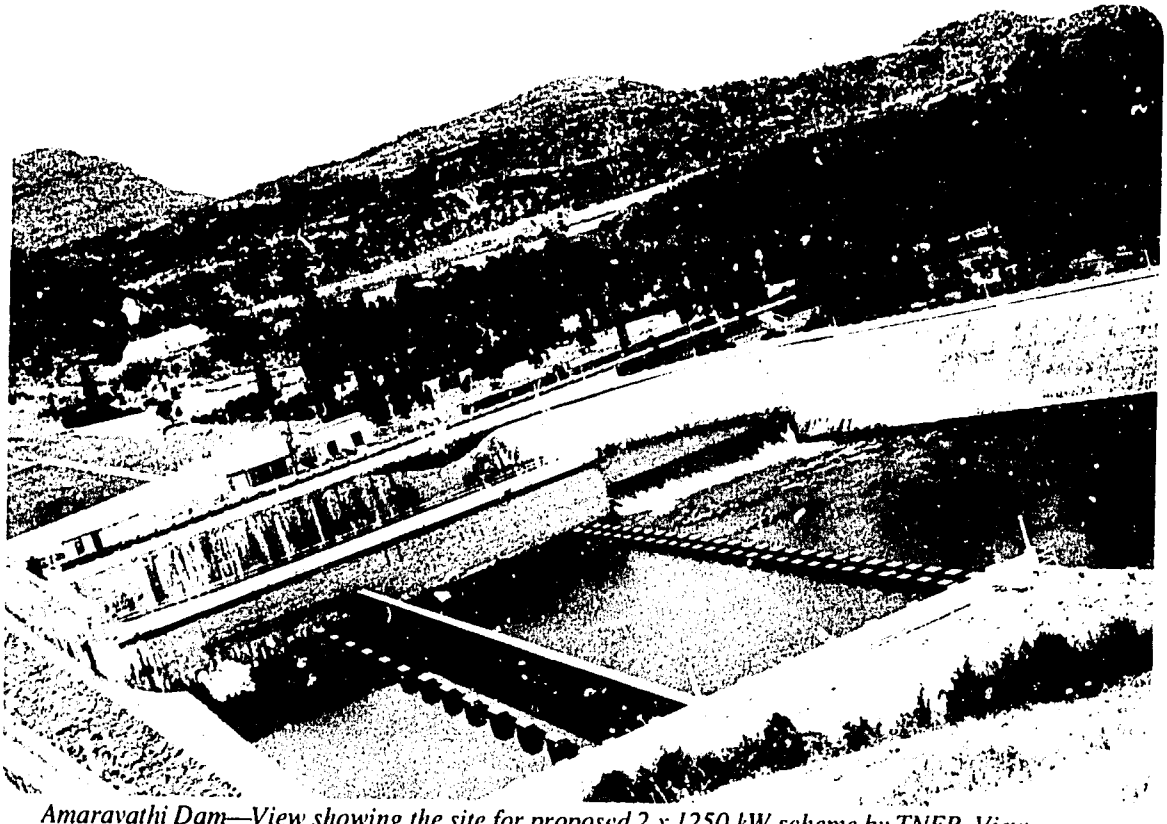
Thirumurthy Dam—View showing canal outlet.

Thirumurthy Dam—View showing tunnel entry point proposed by TNEB.

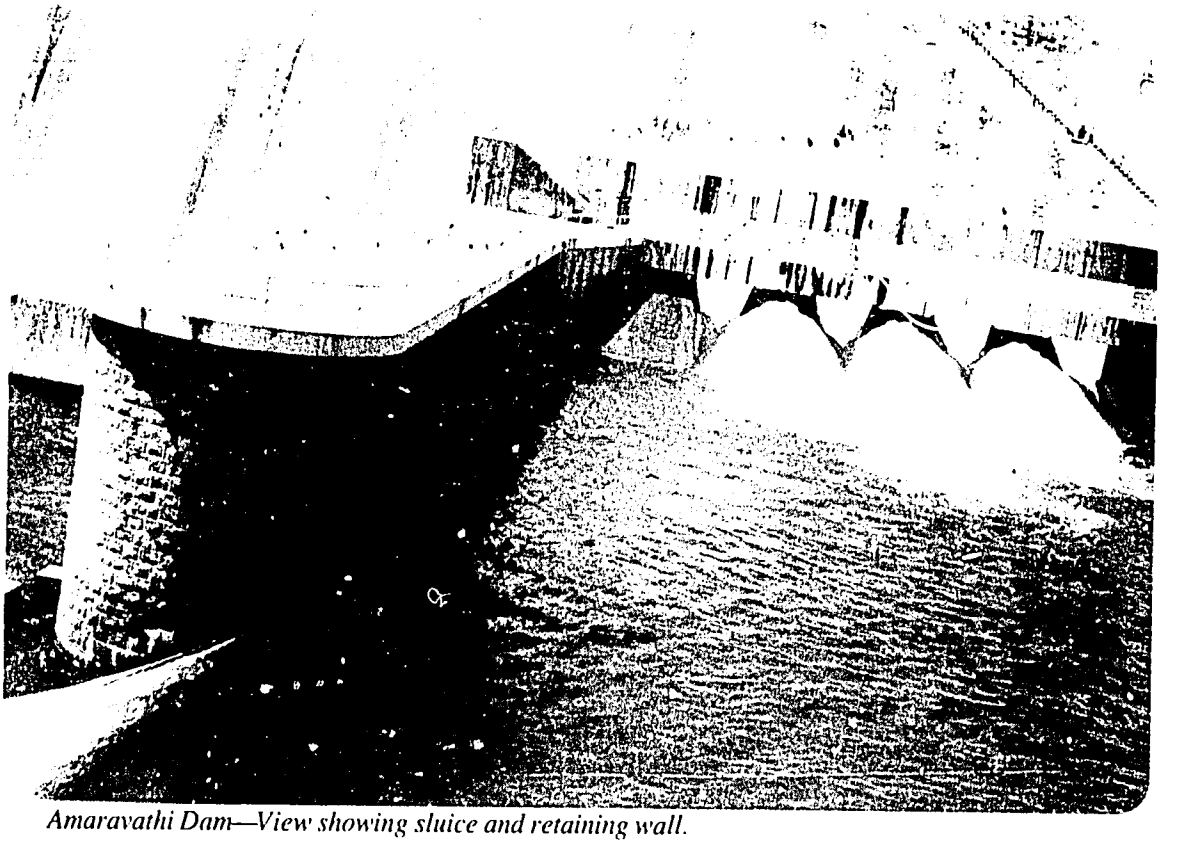
AMARAVATHI DAM, TAMIL NADU



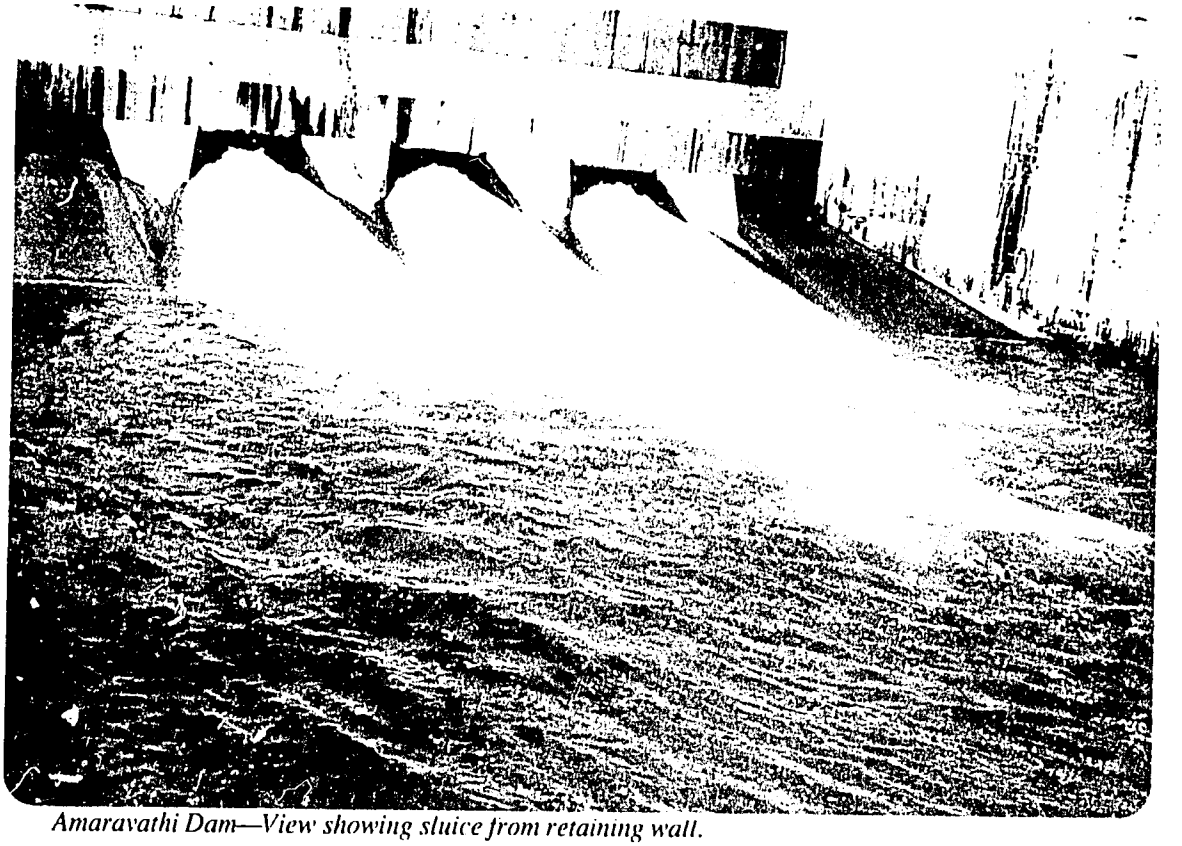
Amaravathi Dam—View taken from top of the dam showing water course from sluice and road bridge.



Amaravathi Dam—View showing the site for proposed 2 x 1250 kW scheme by TNEB. View taken from top of the dam.

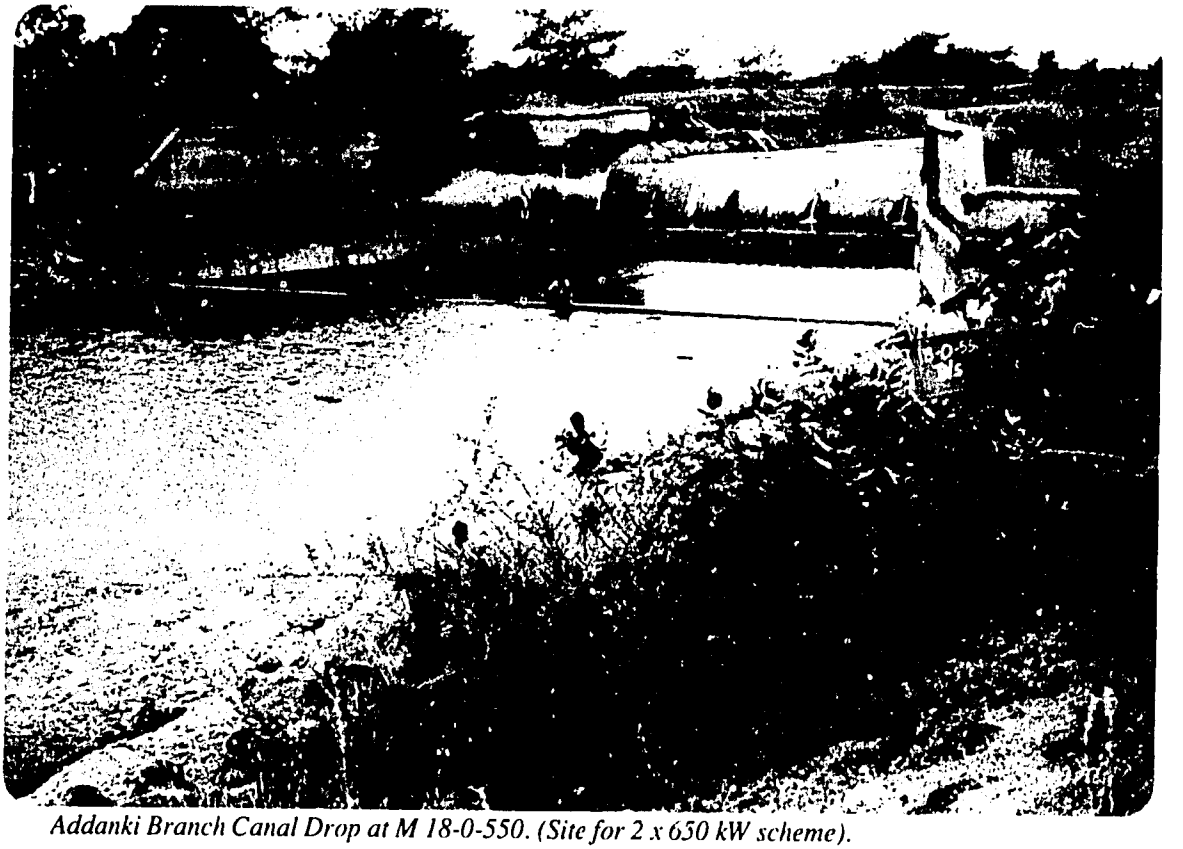


Amaravathi Dam—View showing sluice and retaining wall.

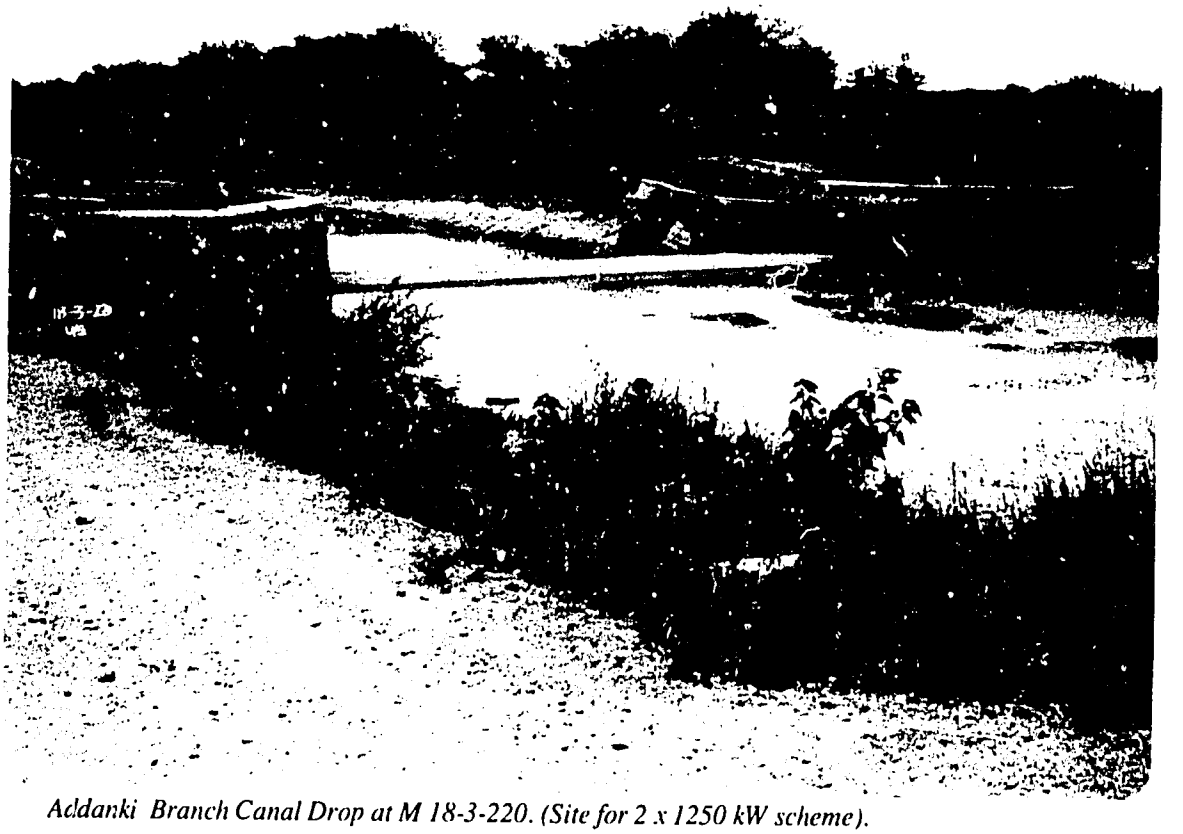


Amaravathi Dam—View showing sluice from retaining wall.

ADDANKI BRANCH CANAL, ANDRA PRADESH

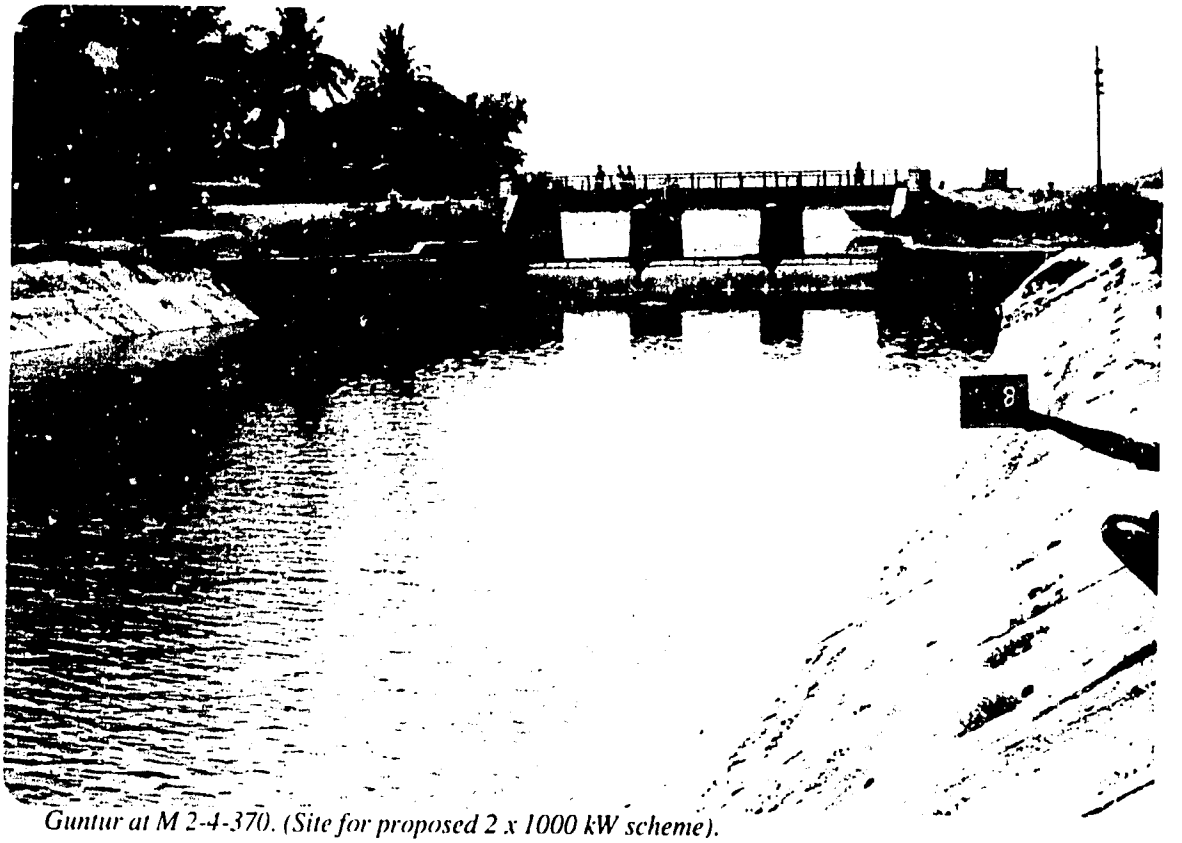


Addanki Branch Canal Drop at M 18-0-550. (Site for 2 x 630 kW scheme).

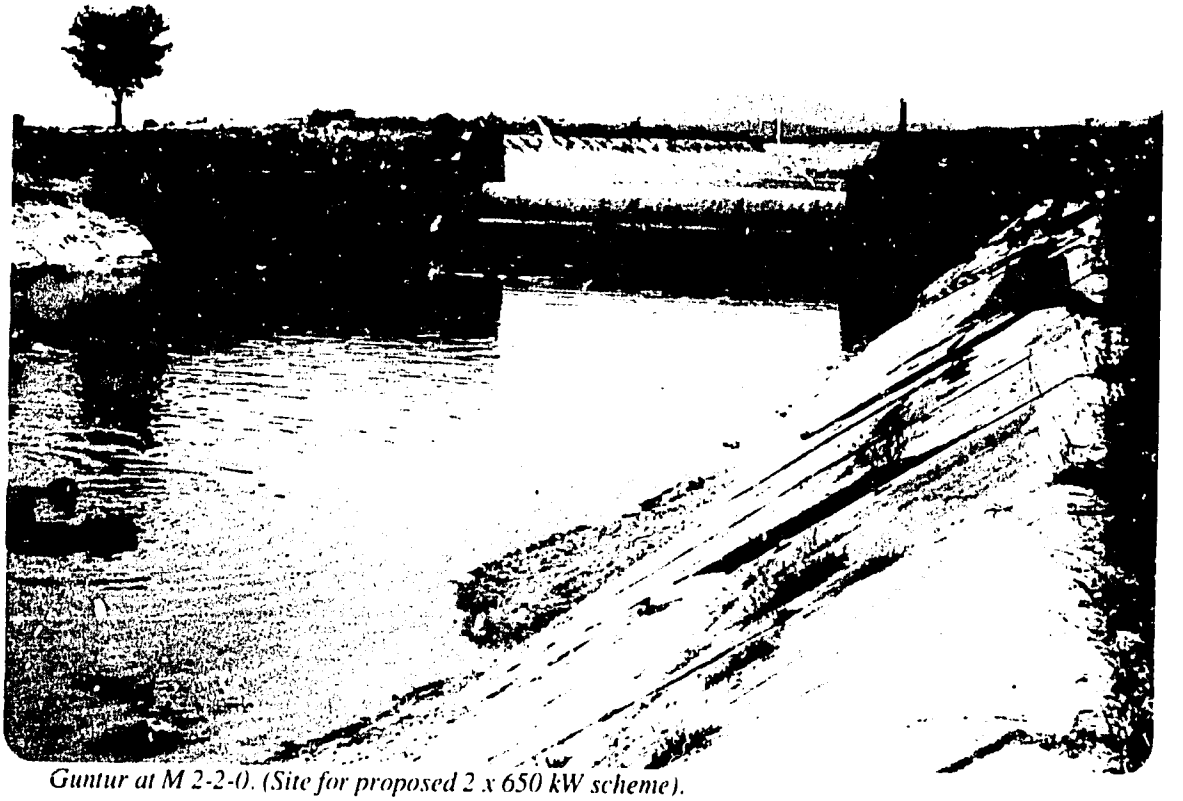


Addanki Branch Canal Drop at M 18-3-220. (Site for 2 x 1250 kW scheme).

GUNTUR BRANCH CANAL, ANDRA PRADESH



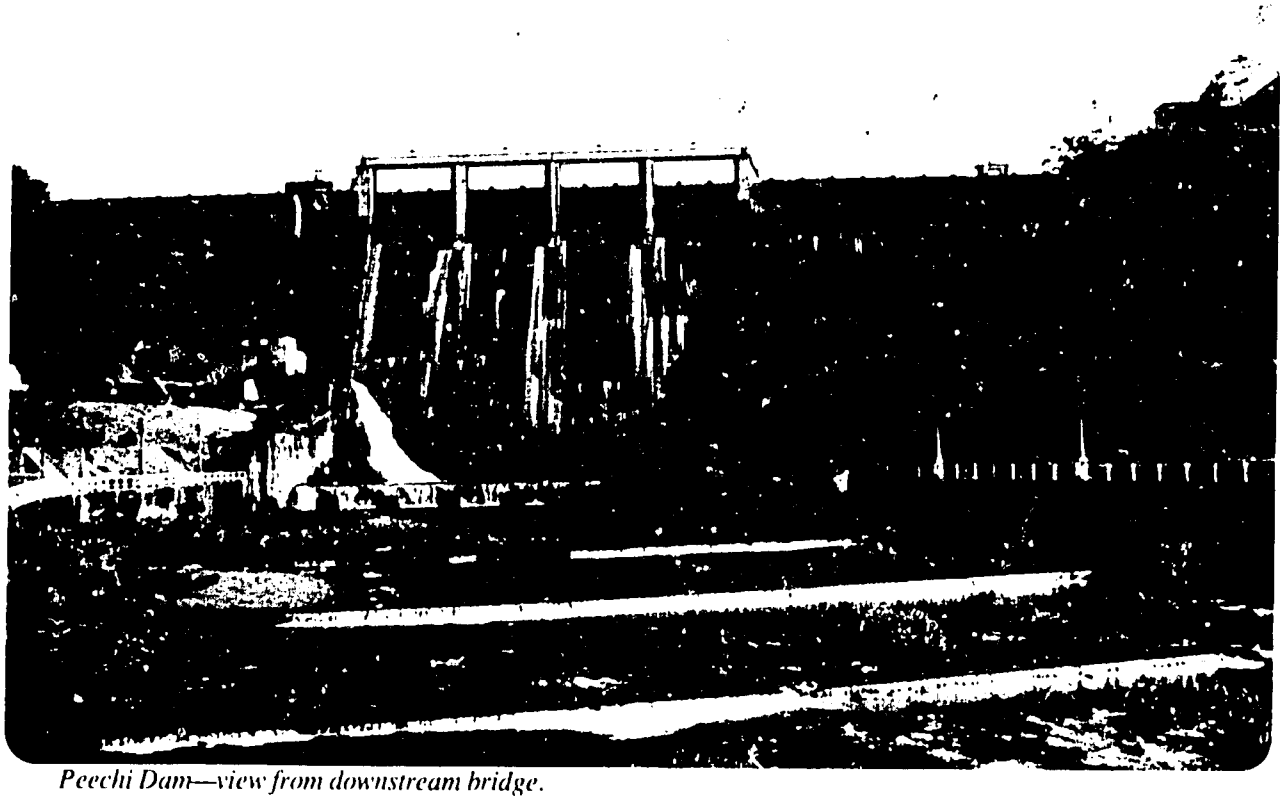
Guntur at M 2-4-370. (Site for proposed 2 x 1000 kW scheme).



Guntur at M 2-2-0. (Site for proposed 2 x 650 kW scheme).

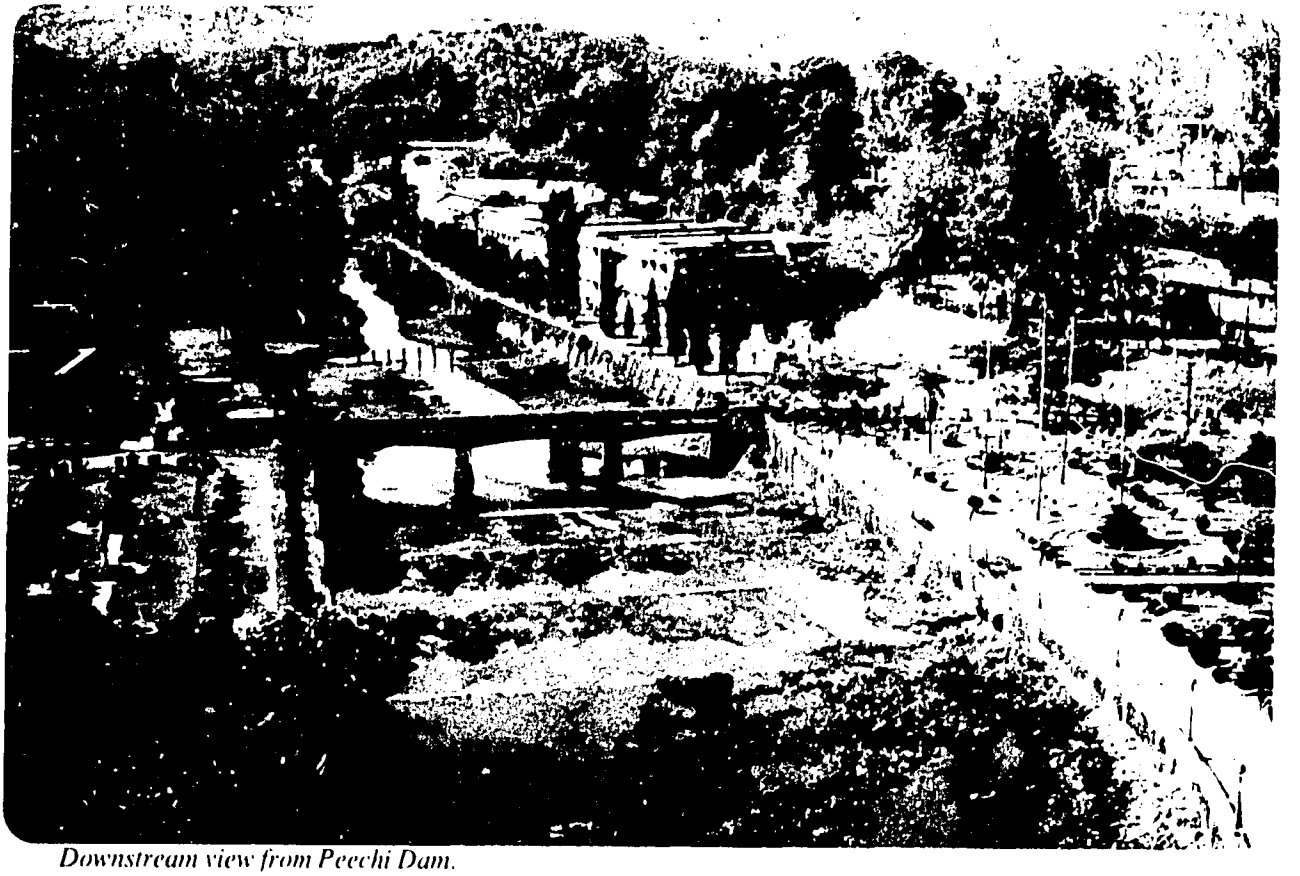
PEECHI DAM, KERALA

Peechi Reservoir

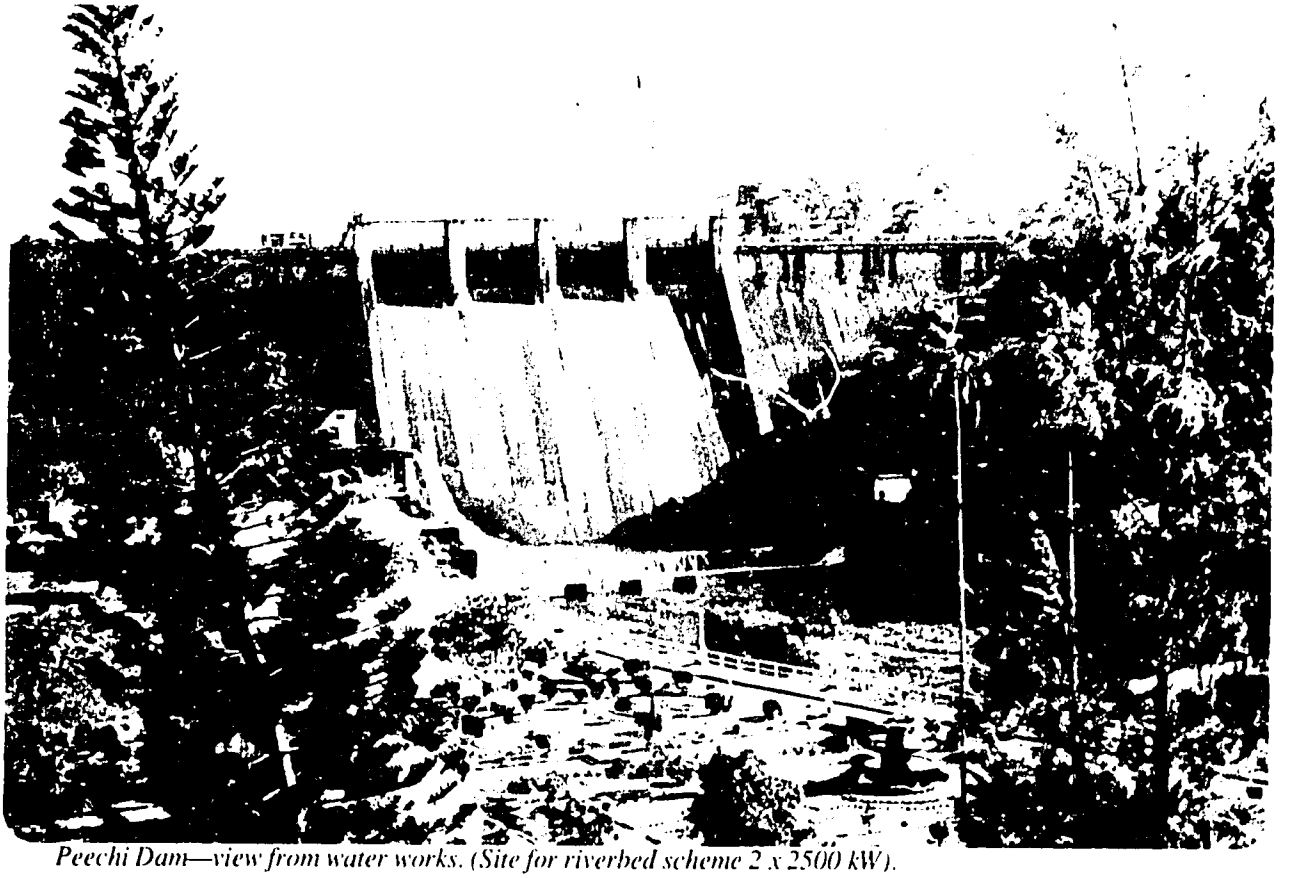


Peechi Dam—view from downstream bridge.

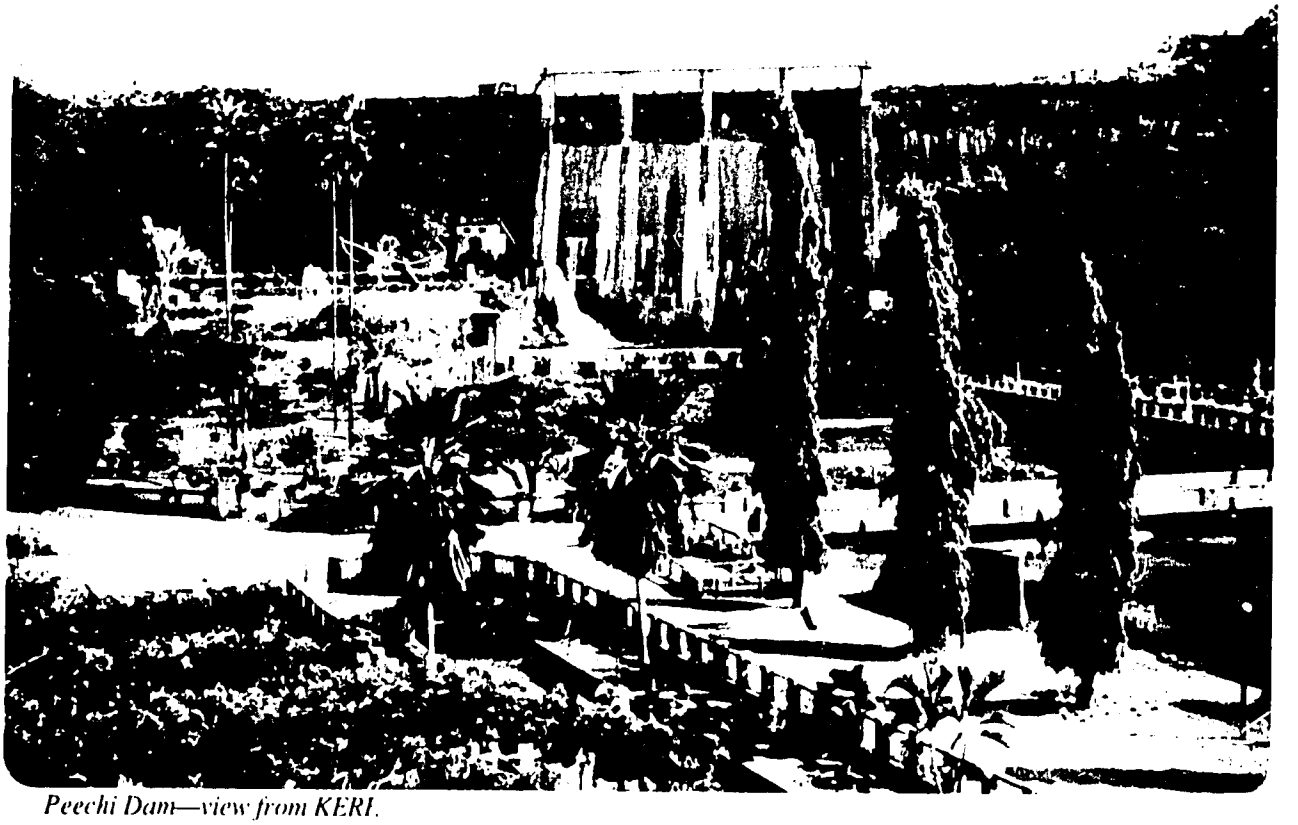
Peechi Dam—Right bank canal sluice and river sluice.



Downstream view from Peechi Dam.



Peechi Dam—view from water works. (Site for riverbed scheme 2 x 2500 kW).

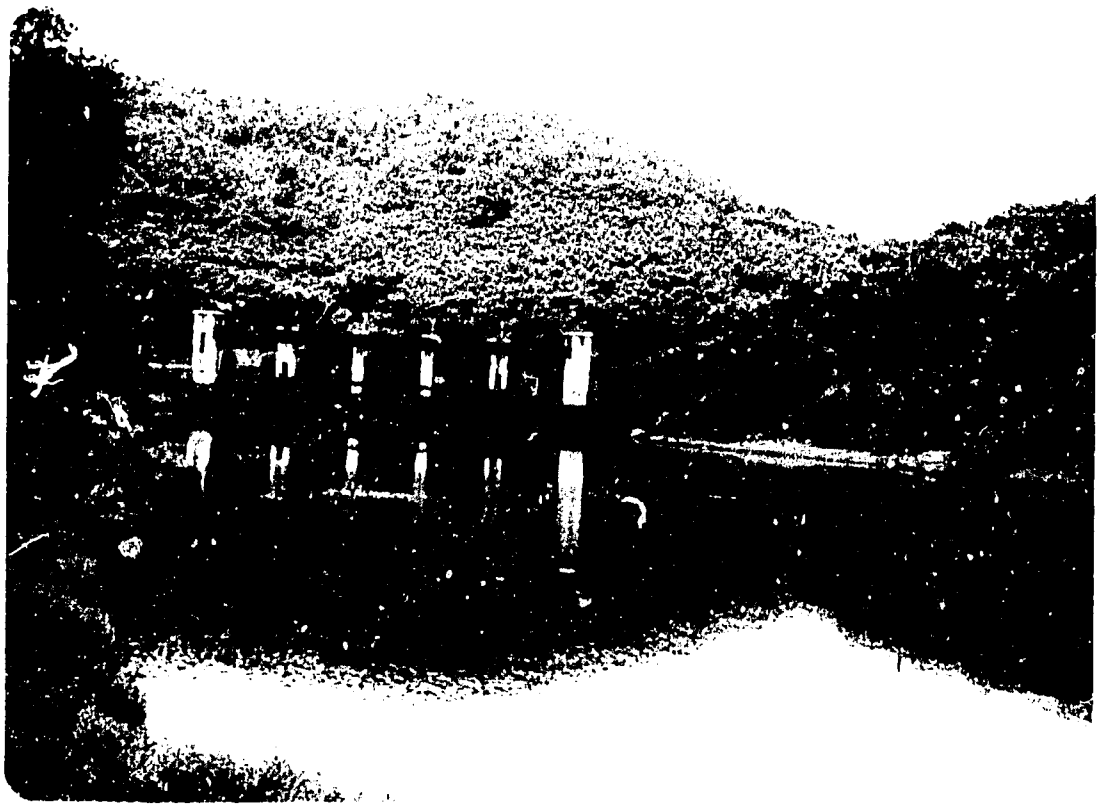


Peechi Dam—view from KERI.

Peechi Dam—left bank sluice and canal. (Site for 1 x 1000 kW scheme).

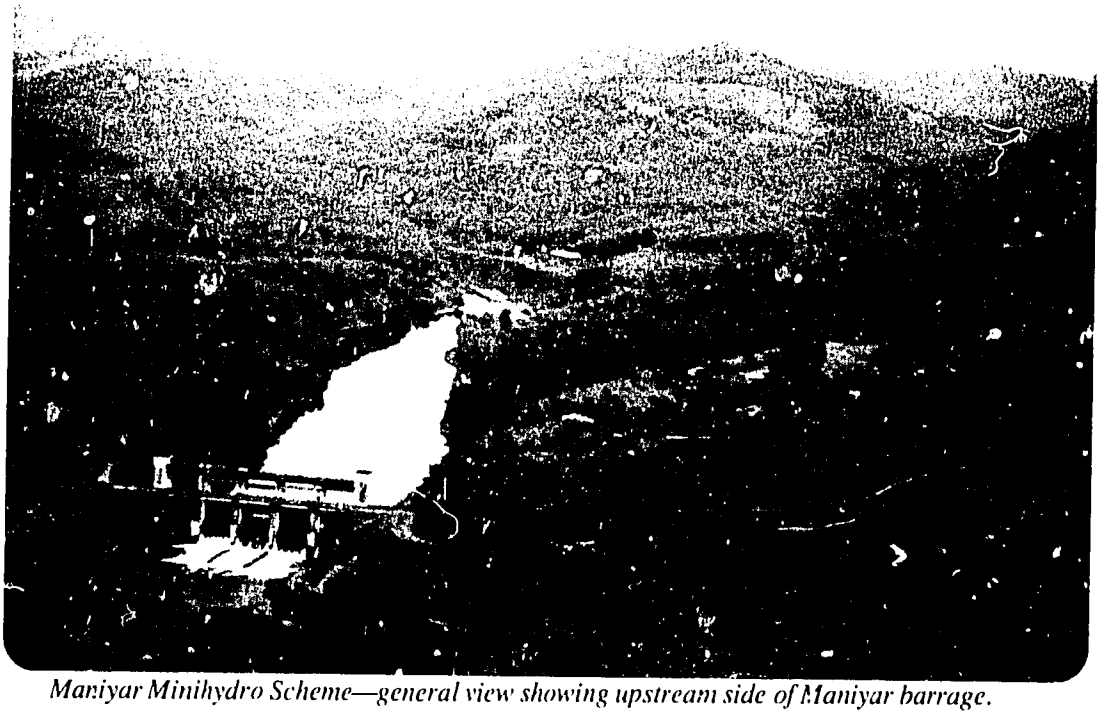
MANIYAR BARRAGE SCHEME, KERALA

Maniyar Minihydro Scheme—view of Maniyar barrage from downstream side.



Maniyar Minihydro Scheme—upstream side view showing the location of power tunnel inlet.

Maniyar Minihydro Scheme—power tunnel exit and power house location.

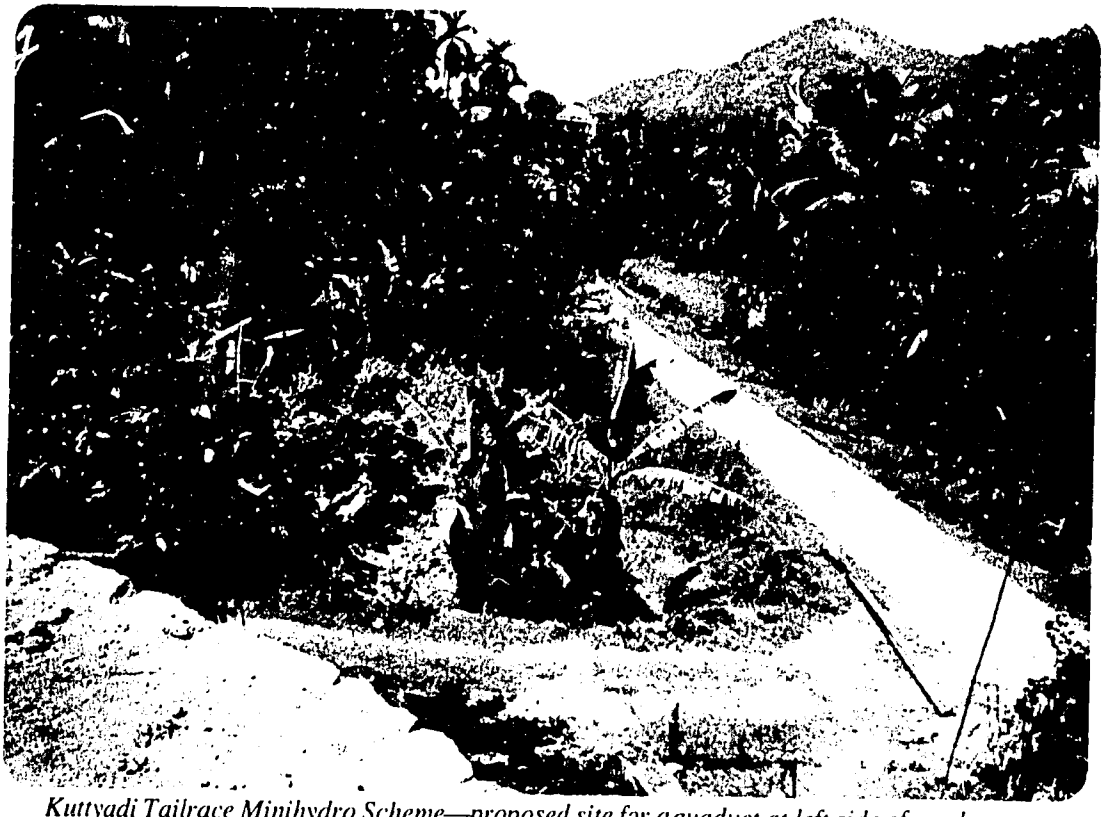


Maniyar Minihydro Scheme—general view showing upstream side of Maniyar barrage.

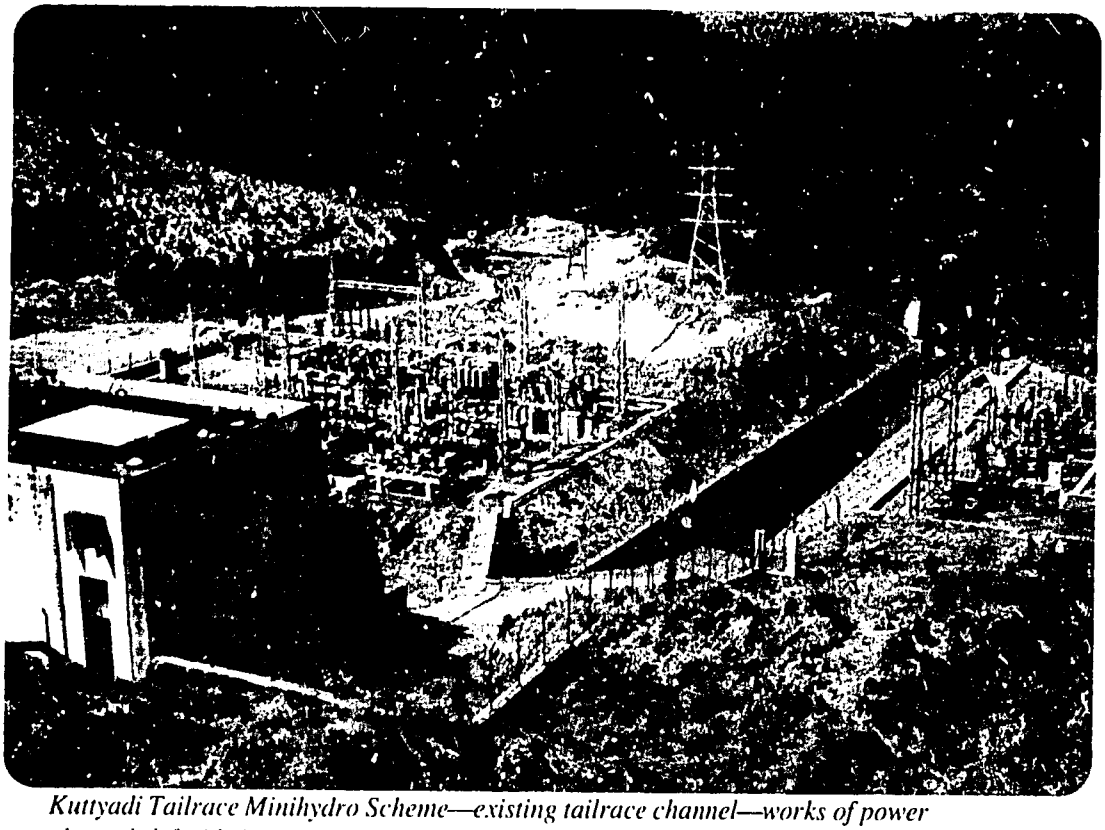
Maniyar Minihydro Scheme—general view of right bank of Maniyar barrage.

KUTTIYADI TAILRACE MINIHYDRO SCHEME, KERALA

Kuttyadi Tailrace Minihydro Scheme—proposed tailrace channel at right side of stream.



Kuttyadi Tailrace Minihydro Scheme—proposed site for aquaduct at left side of road.

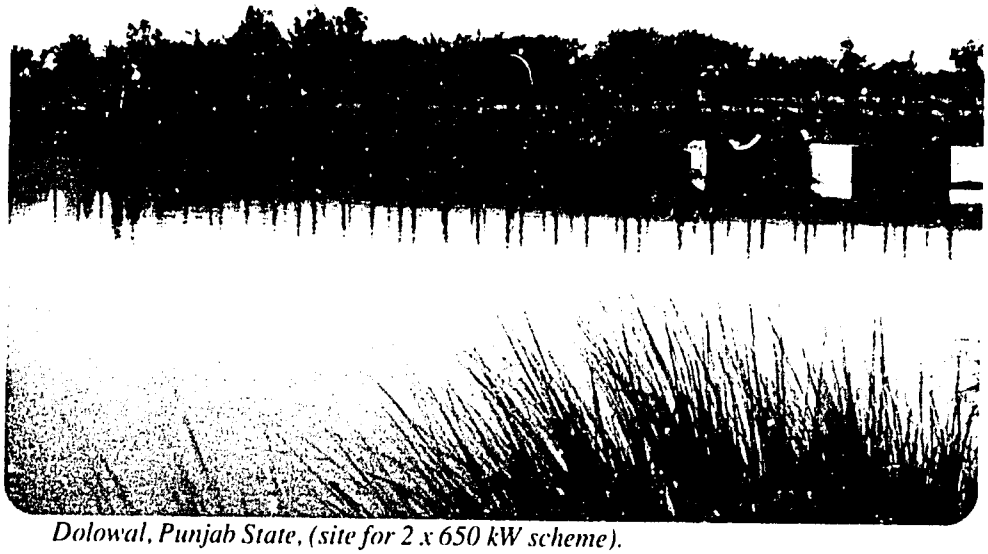


Kuttyadi Tailrace Minihydro Scheme—existing tailrace channel—works of power channel (left side in progress).

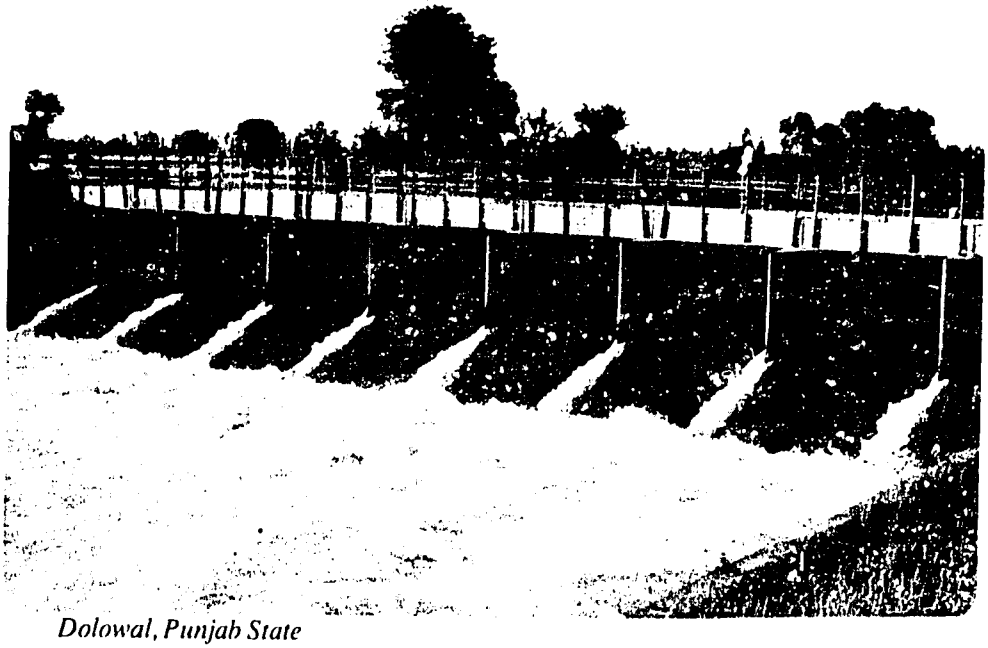
Kuttyadi Tailrace Minihydro Scheme—proposed power house site at right side of road. (The alignment of tailrace channel will pass along the construction of culvert seen in the photo).

Kuttyadi Tailrace Minihydro Scheme—site for forebay tank.

DOLOWAL CANAL DROP, PUNJAB



Dolowal, Punjab State, (site for 2 x 650 kW scheme).

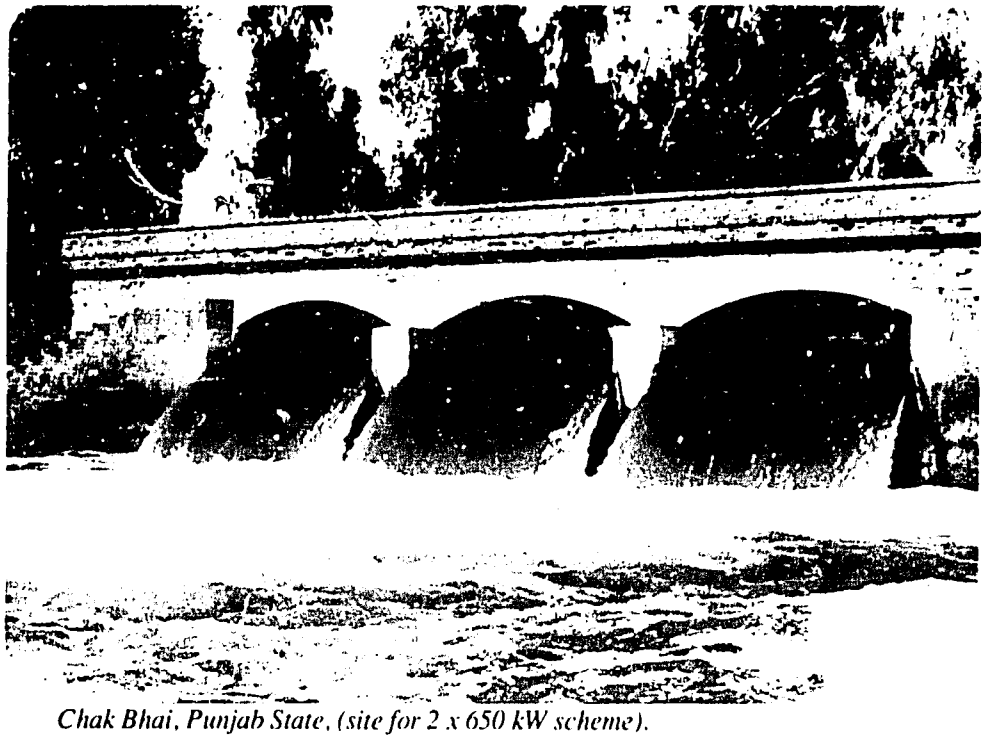


Dolowal, Punjab State

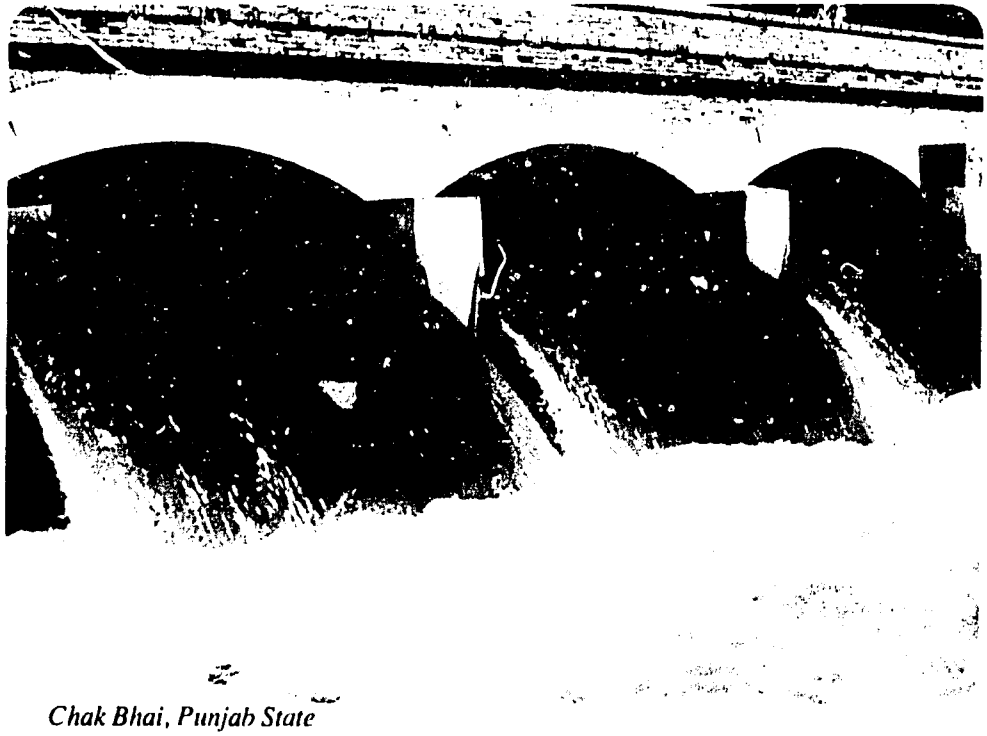
Dolowal, Punjab State

Dolowal, Punjab State

CHAK BHAI CANAL DROP, PUNJAB



Chak Bhai, Punjab State, (site for 2 x 650 kW scheme).



Chak Bhai, Punjab State

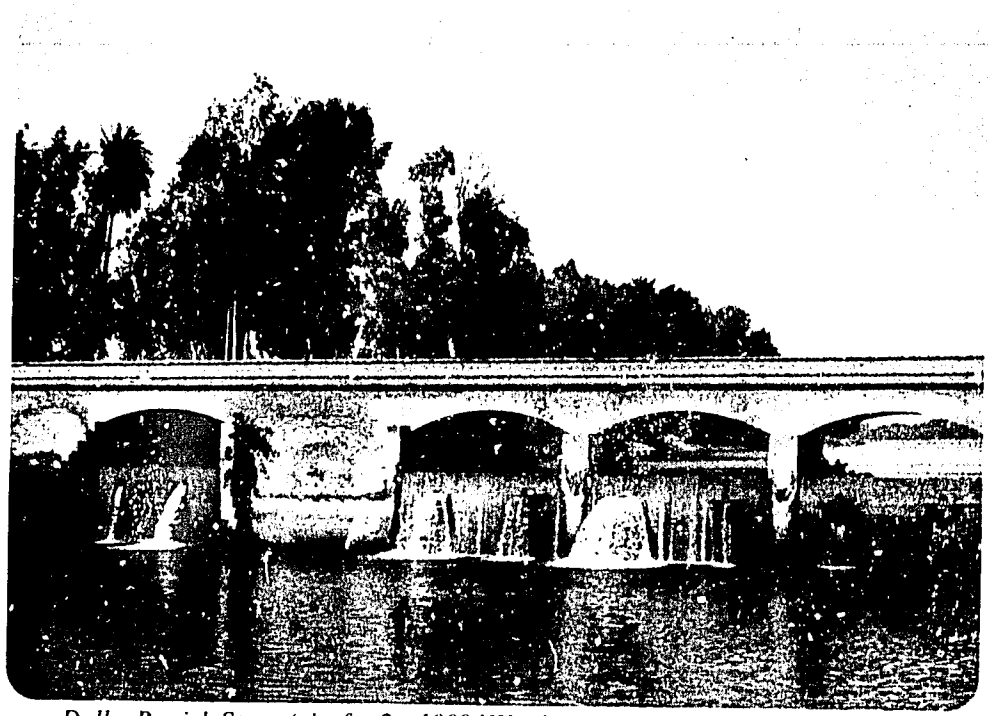
BABANPUR CANAL DROP, PUNJAB

Babandur, Punjab State, (site for 2 x 650 kW scheme).

Babandur, Punjab State

Babandur, Punjab State

DALLA CANAL DROP, PUNJAB



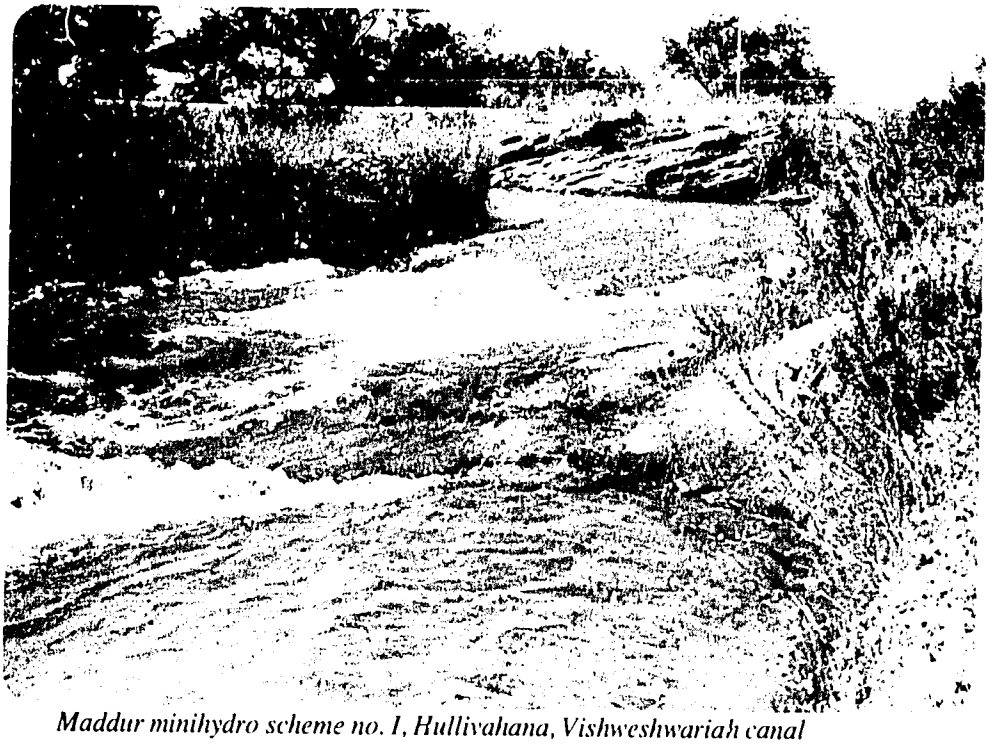
Dalla, Punjab State, (site for 2 x 1000 kW scheme).

Dalla, Punjab State

TUGAL CANAL DROP, PUNJAB

Tugal, Punjab State, (site for 3 x 350 kW scheme).

MADDUR CANAL DROP, KARNATAKA

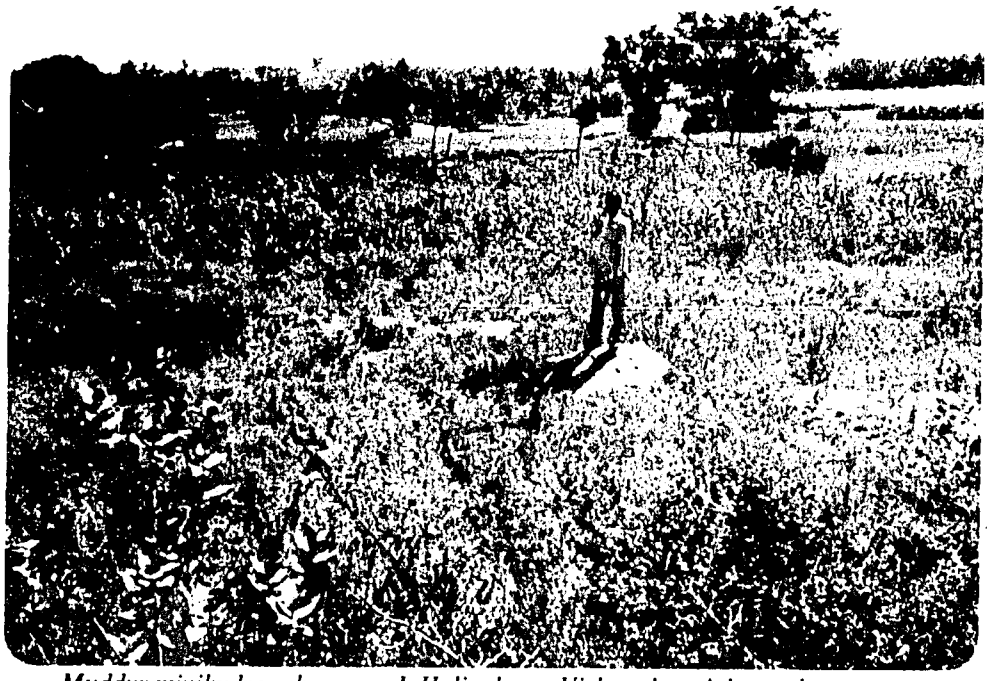


Maddur minihydro scheme no. I, Hullivahana, Vishweshwariah canal branch—View showing rapids between power house area and tailrace showing bedrock exposed.

Maddur minihydro scheme no. I, Hullivahana, Vishweshwariah canal branch—View showing the rapids between power house area and tailrace in the curved portion.

Maddur minihydro scheme no. I, Hullivahana, Vishweshwariah canal branch—View of the first canal drop viewed from downstream to upstream.

Maddur minihydro scheme no. I, Hullivahana, Vishweshwariah canal branch—View of the second drop and also showing 13th and 14 distributory gate structure.



Muddur minihydro scheme no. I, Hulivahana, Vishweshwariah canal branch—View of the power house area and tailrace alighment.

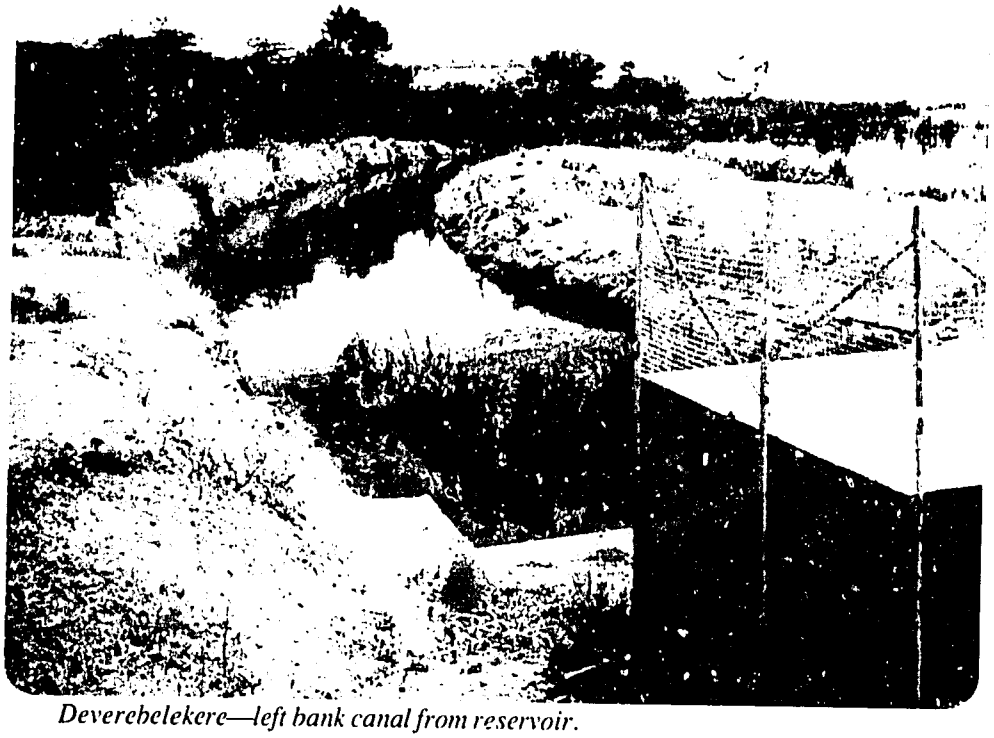
Maddur minihydro scheme no. I, Hullivahana, Vishweshwariah canal branch—View of the rapids between power house area and scheme no. II drop.

Maddur minihydro scheme no. I, Hullivahana, Vishweshwariah canal branch—View of the acquired KPC land for the construction of staff quarters and material yard.

Maddur minihydro scheme no. I, Hullivahana, Vishweshwariah canal branch—View of the drop .

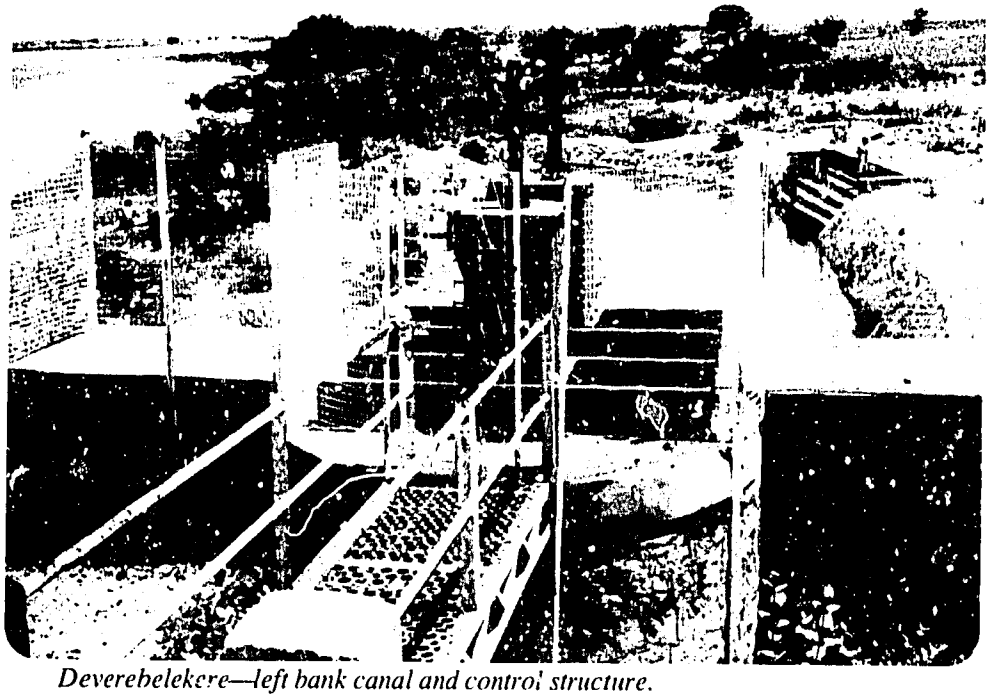
Maddur minihydro scheme no. I, Hullivahana, Vishweshwariah canal branch—View of the bucket portion.

DEVEREBELEKERE IRRIGATION TANK, KARNATAKA



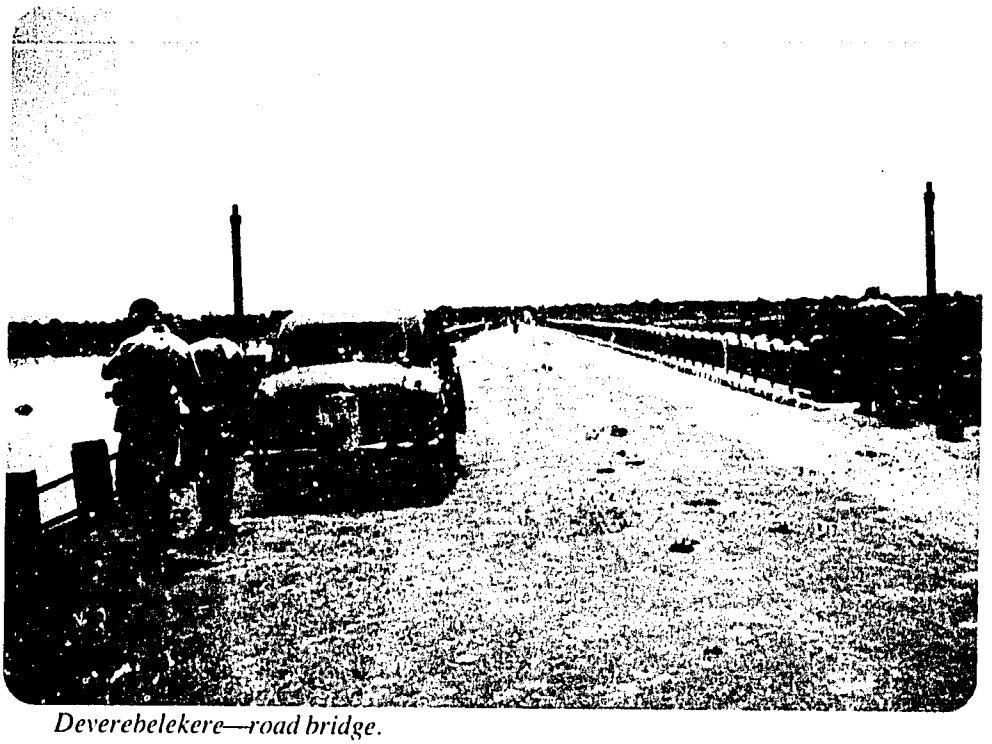
Deverebelekere—left bank canal from reservoir.

Deverebelekere—left bank canal.

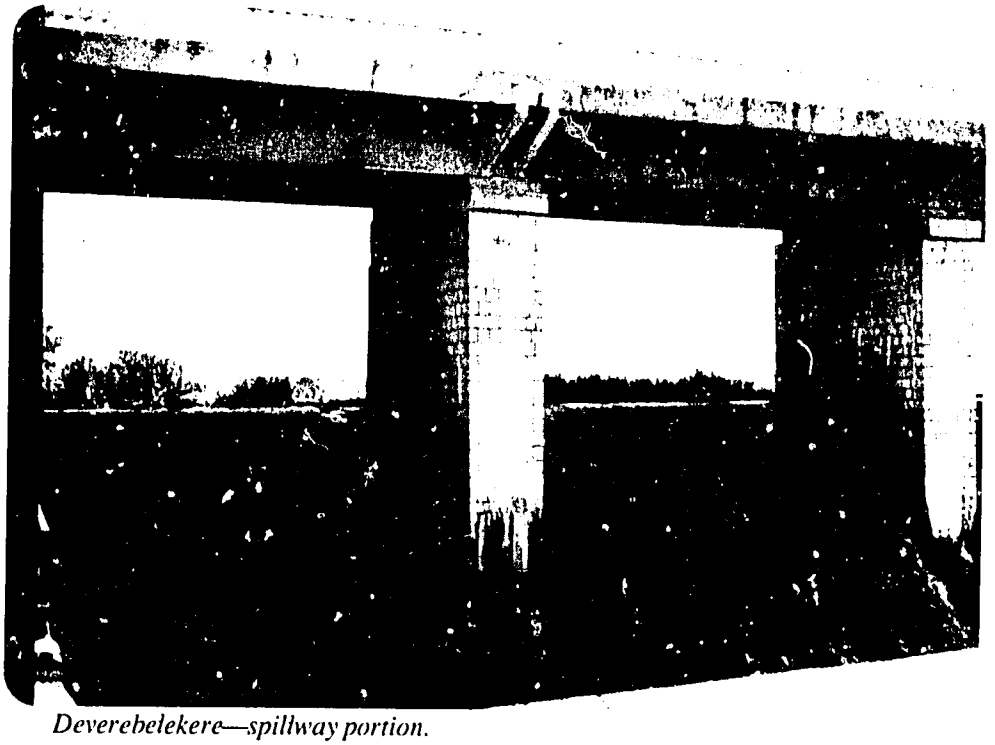


Deverebelekere—left bank canal and control structure.

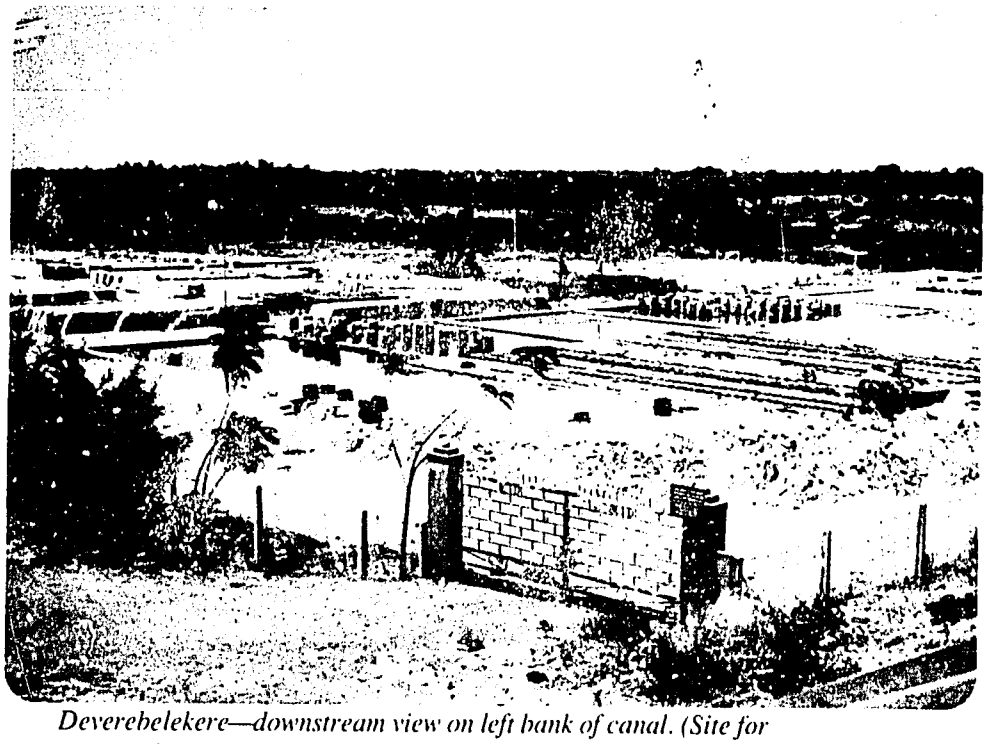
Deverebelekere—downstream on right bank and canal.



Deverebelekere—road bridge.

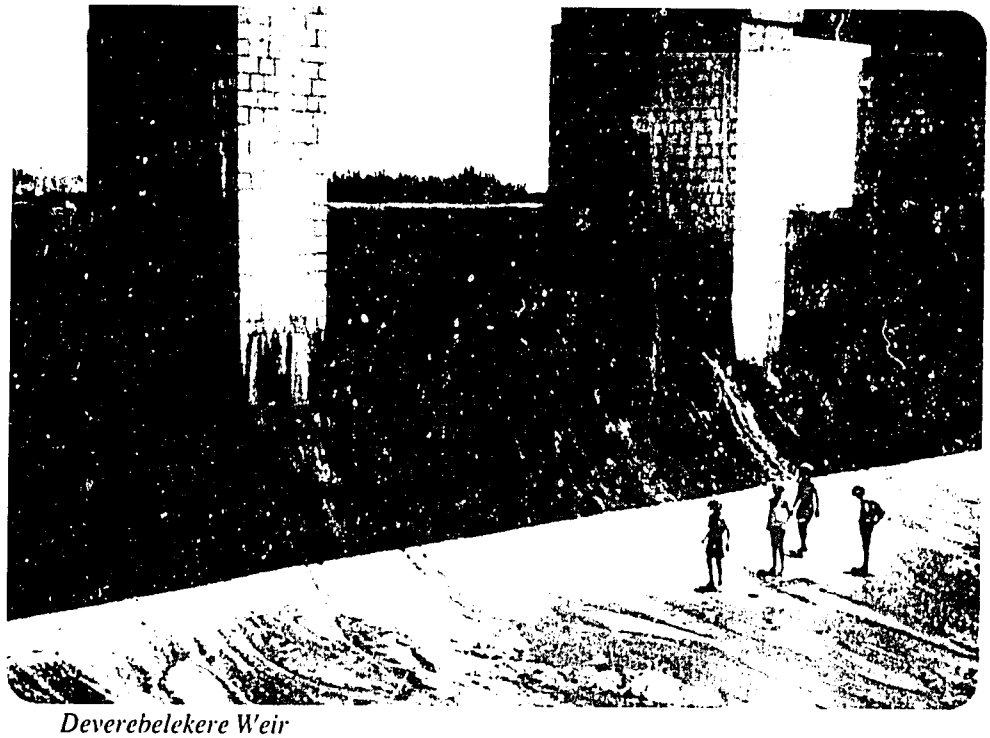


Deverebelekere—spillway portion.



Deverebelekere—downstream view on left bank of canal. (Site for proposed 1000 x 2000 kW scheme).

Deverebelekere Lake—storage facility.



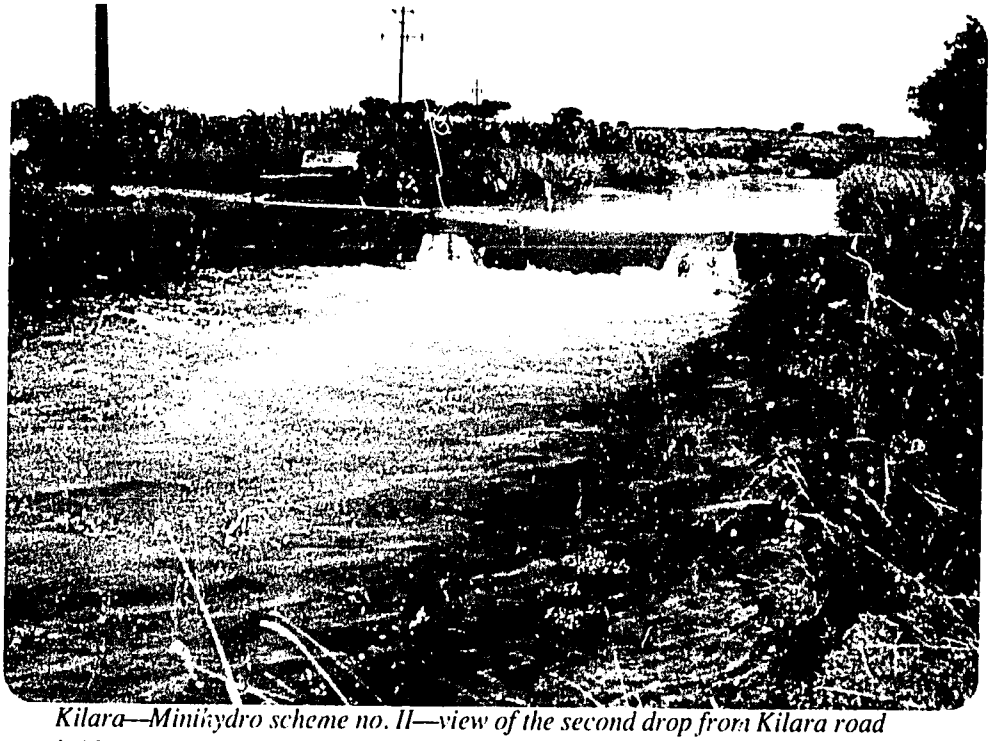
Deverebelekere Weir

KILARA CANAL DROP, KARNATAKA

Kilara—Minihydro scheme no. II—view of the canal from power house area to downstream of the canal.

Kilara—Minihydro scheme no. II—view of the canal showing the rapids from upstream view.

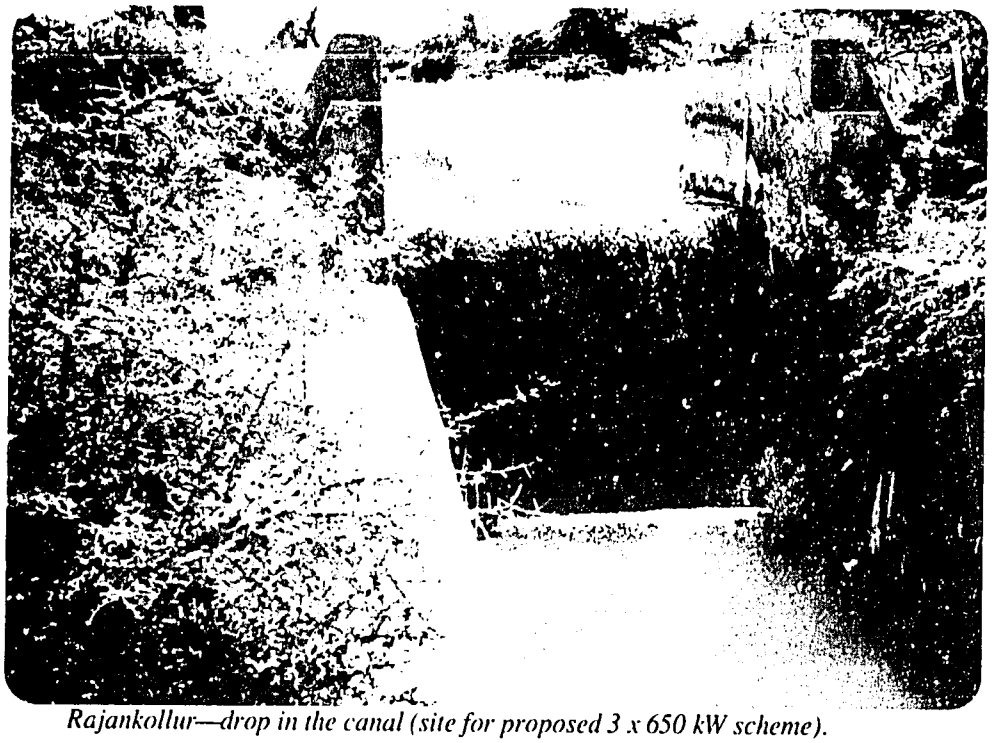
Kilara—Minihydro scheme no. II—view of the first drop from Kilara road bridge.



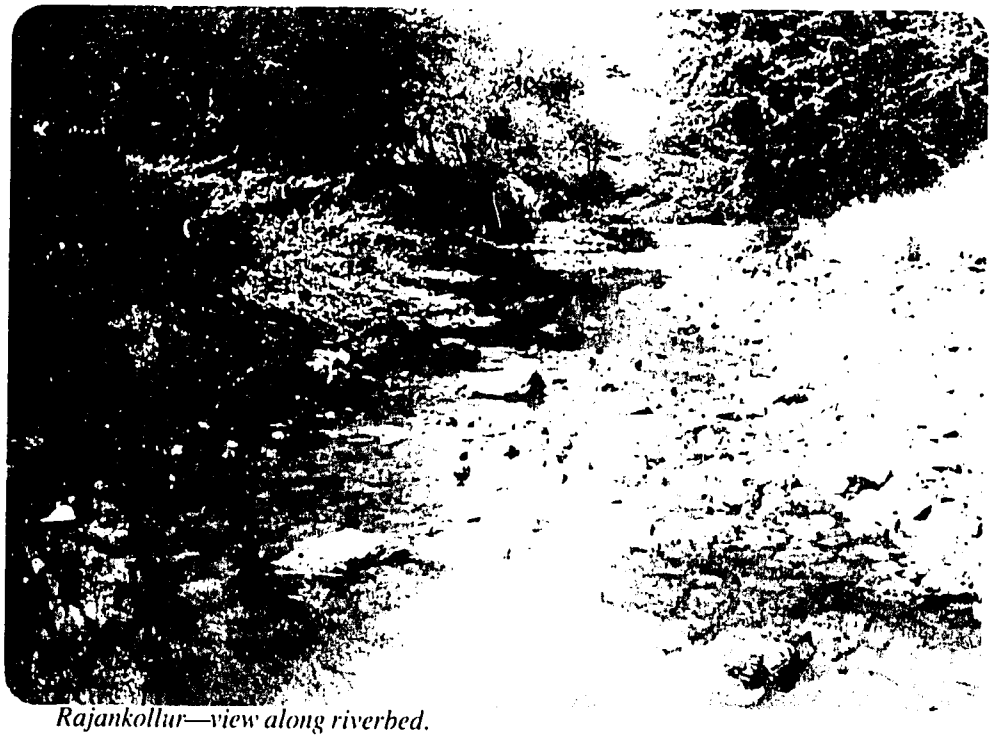
Kilara—Minihydro scheme no. II—view of the second drop from Kilara road bridge.

Kilara—Minihydro scheme no. II—View of the power house area and also showing the crop area.

RAJANKOLLUR CANAL DROP, KARNATAKA

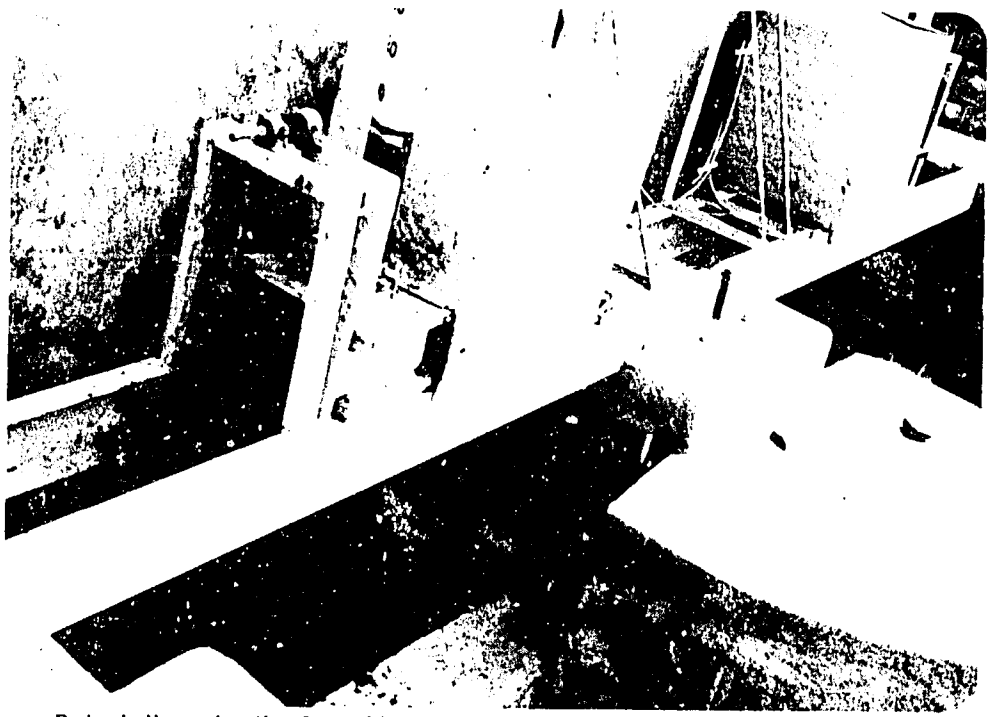


Rajankollur—drop in the canal (site for proposed 3 x 650 kW scheme).

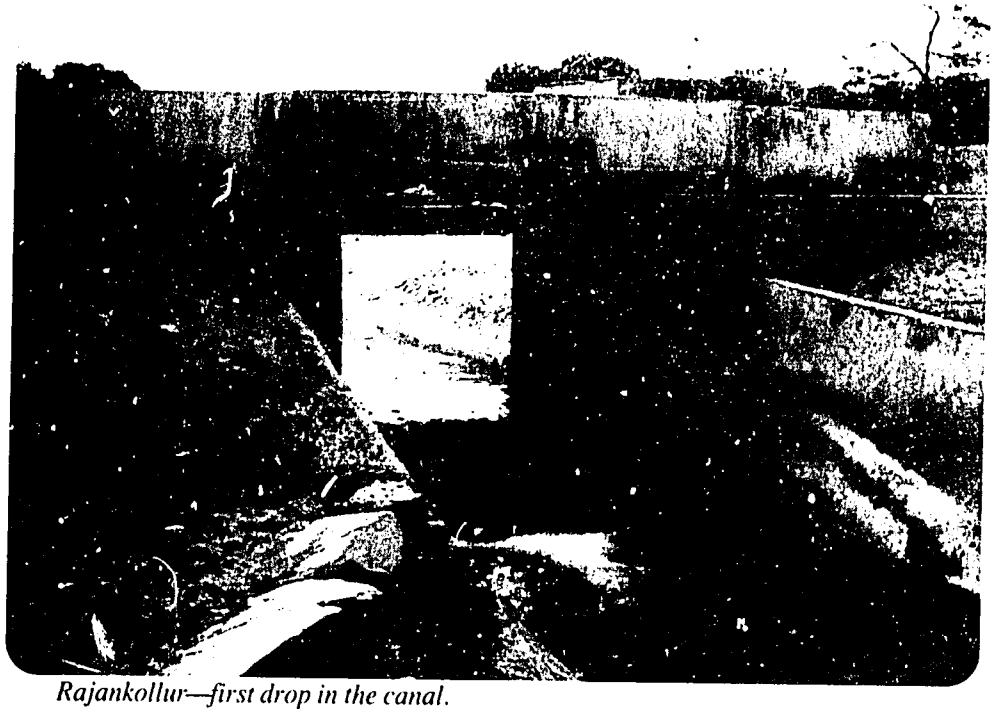


Rajankollur—view along riverbed.

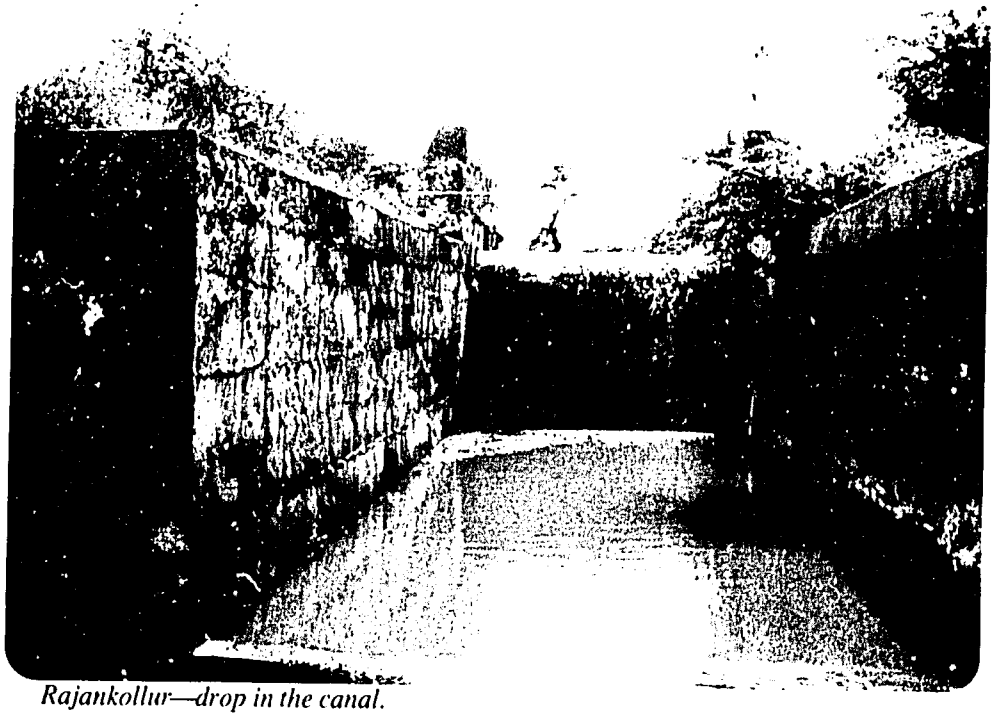
Rajankollur—pickup weir.



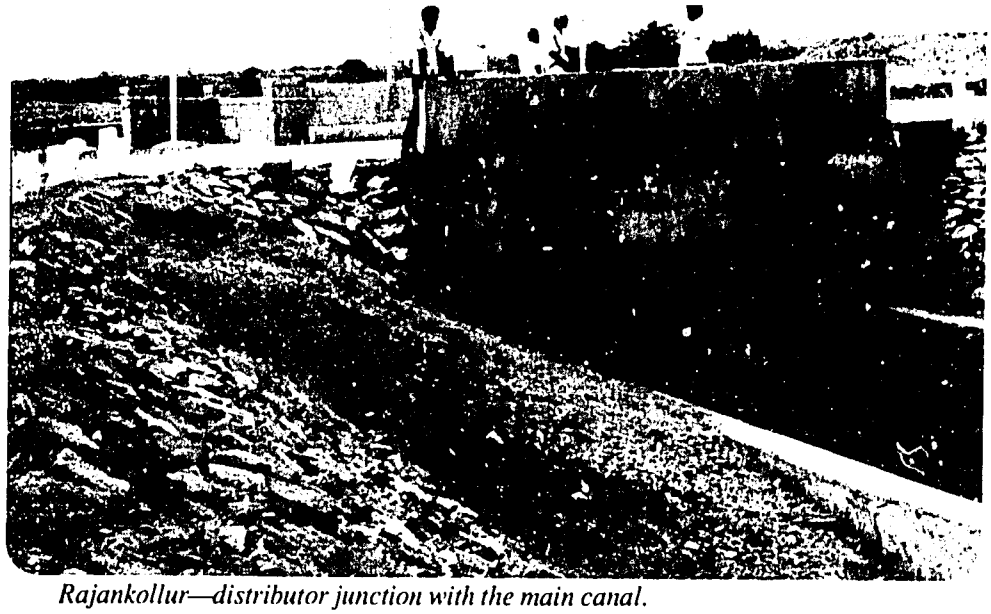
Rajankollur—details of canal headworks.



Rajankollur—first drop in the canal.



Rajankollur—drop in the canal.



Rajankollur—distributor junction with the main canal.

Rajankollur—canal portion.

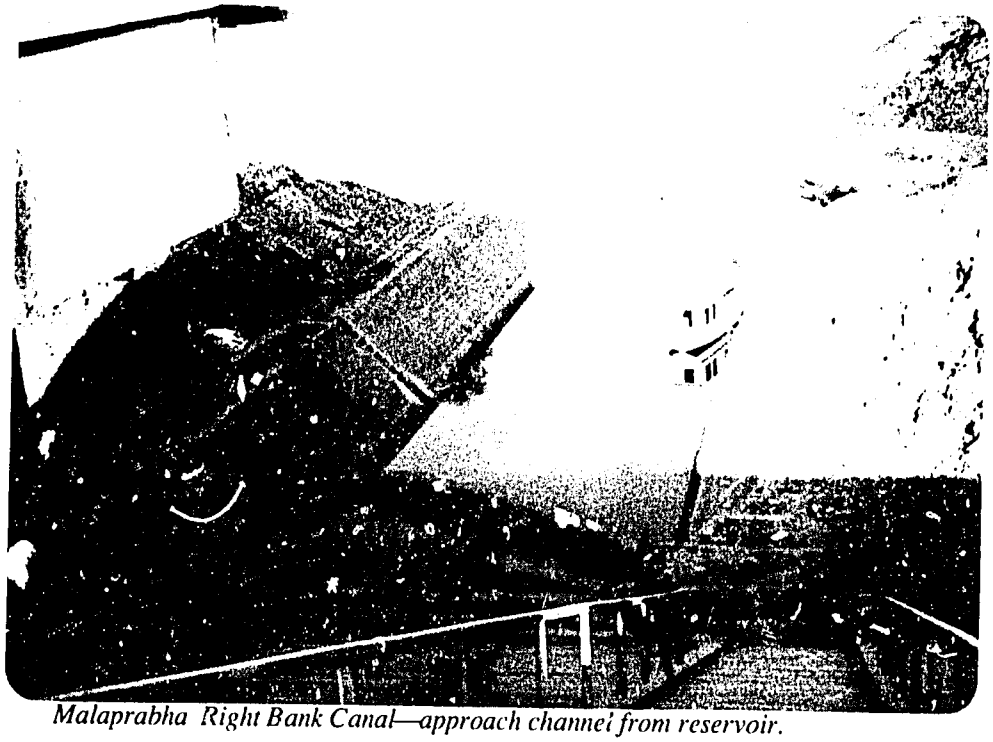
MUDHOL RESERVOIR, KARNATAKA

Mudhol Scheme—beginning of chute (alignment for water conveyance for 1 x 1000 kW scheme.

Mudhol Scheme—view of chute.

Mudhol Scheme—chute.

MALAPRABHA RESERVOIR, KARNATAKA

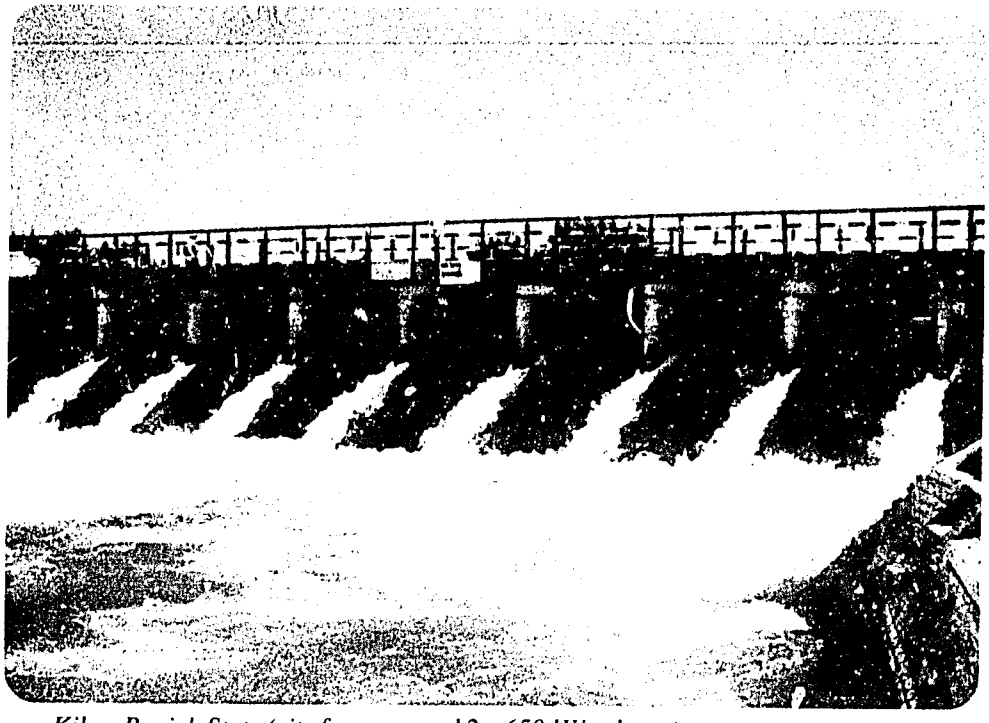


Malaprabha Right Bank Canal—approach channel from reservoir.

Malaprabha Right Bank Canal—downstream of headworks (site for proposed 2 x 1000 kW scheme.

Malaprabha Right Bank Canal—view of canal.

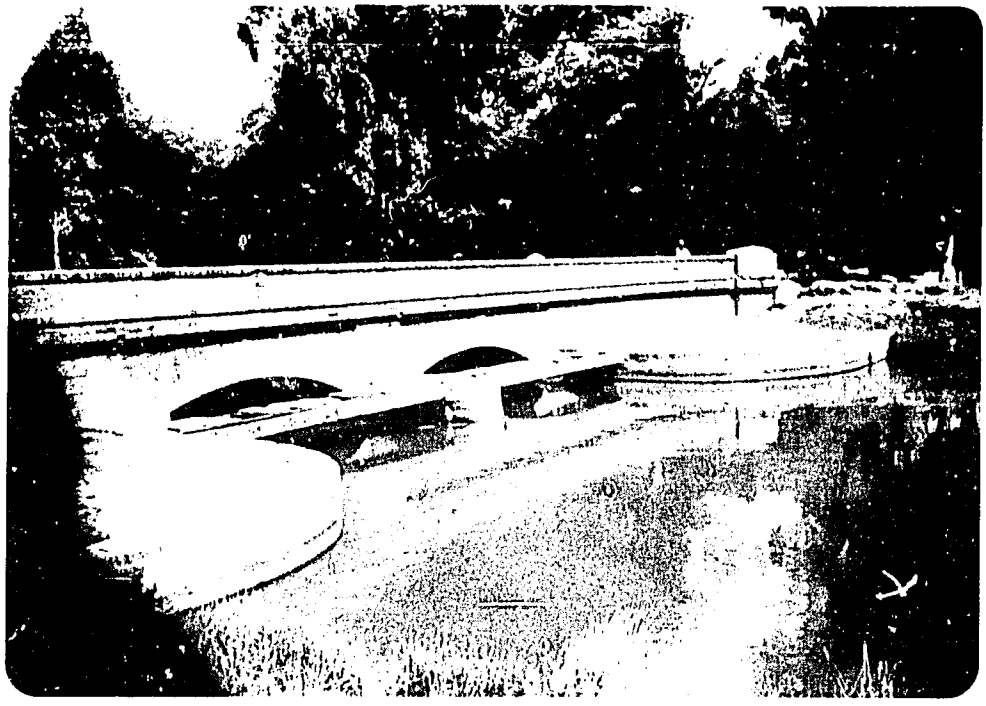
KILA CANAL DROP, PUNJAB



Kila—Punjab State (site for proposed 2 x 650 kW scheme).

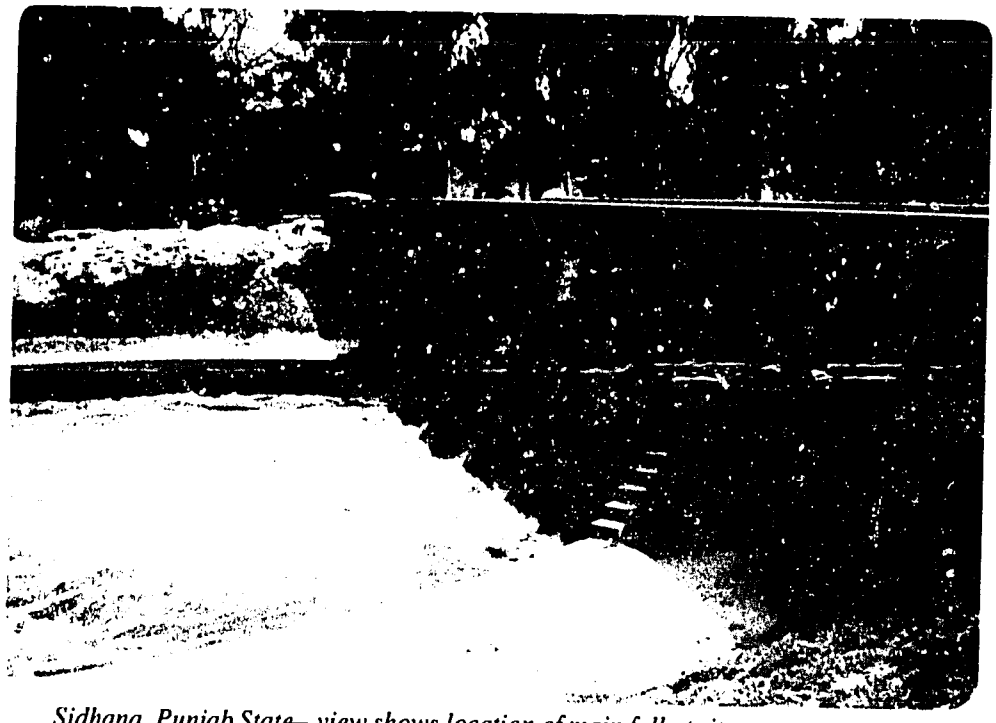
Kila—Punjab State

SIDHANA CANAL DROP, PUNJAB



Sidhana, Punjab State—view shows immediate upstream location of the fall. (Site for proposed 2 x 350 kW scheme).

Sidhana, Punjab State—view shows downstream of fall from the bridge.



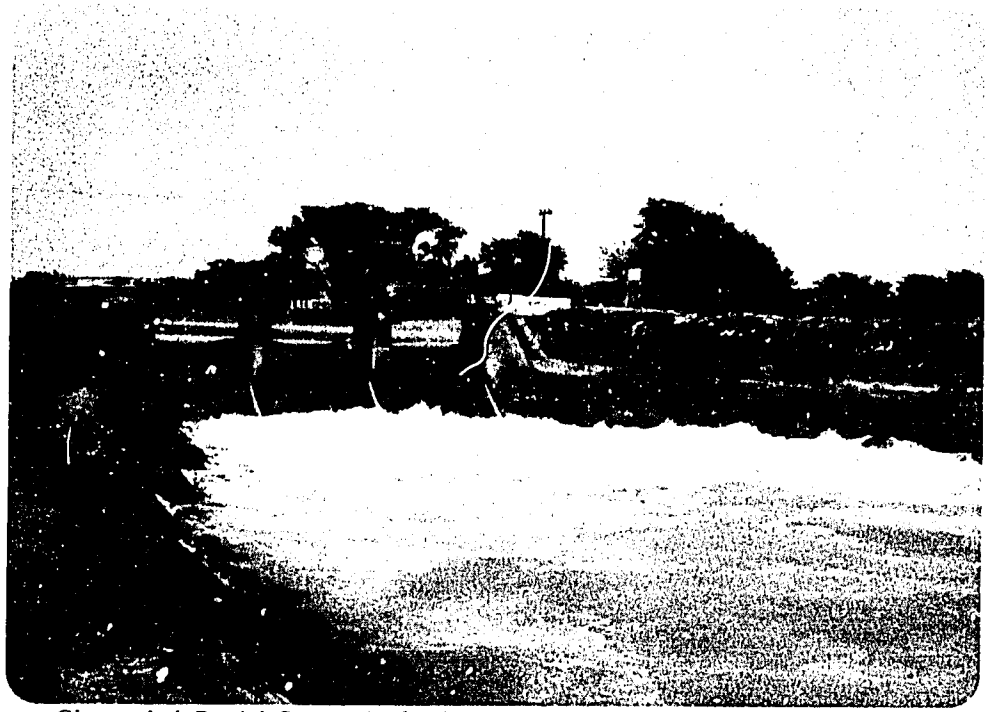
Sidhana, Punjab State—view shows location of main fall at site.

Sidhana Punjab State—Location of site for minihydro scheme.

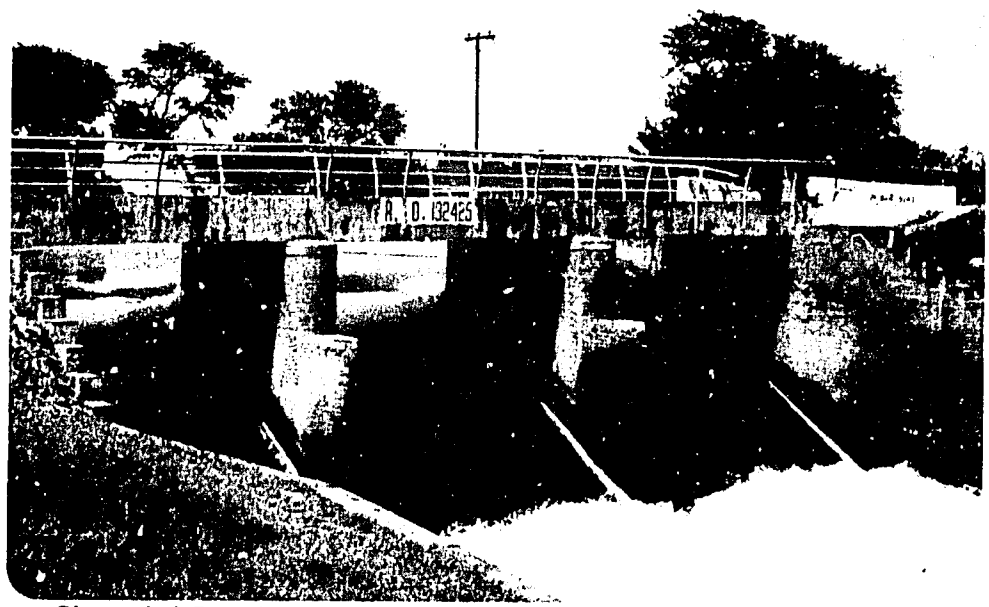
Sidhana—shows landscape to the side of fall, upstream side.

Sidhana—Landscape to the side of canal, downstream of fall.

CHANARTHAL CANAL DROP, PUNJAB



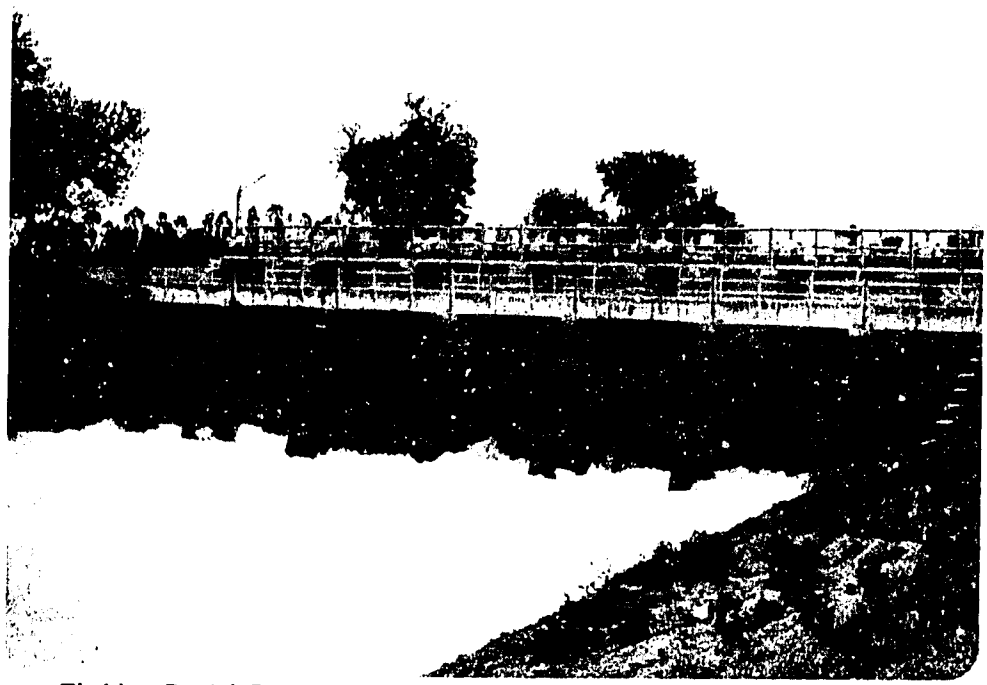
Chanarthal, Punjab State, (site for 4 x 1000 kW scheme).



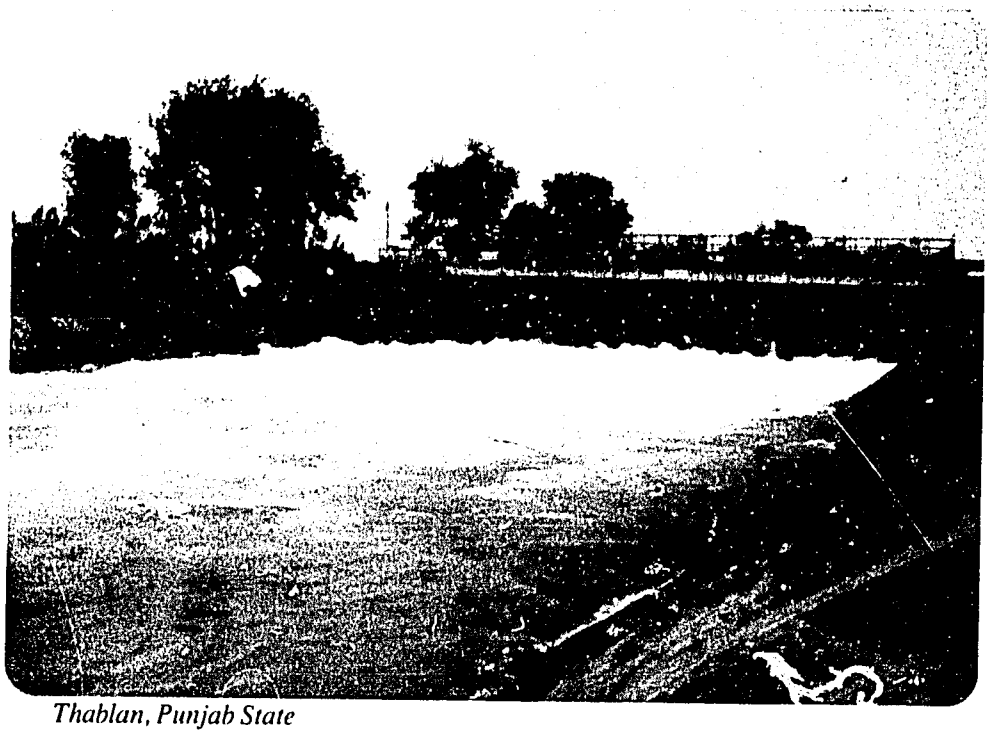
Chanarthal, Punjab State

THABLAN CANAL DROP, PUNJAB

Thablan, Punjab State, (site for 6 x 1000 kW scheme).



Thablan, Punjab State



Thablan, Punjab State

Thablan, Punjab State

ENERGY SECTOR MANAGEMENT ASSISTANCE PROGRAMME

COMPLETED ACTIVITIES

Country	*Activity*	*Date*	*Number*
	SUB-SAHARAN AFRICA		
Africa Regional	Anglophone Africa Household Energy Workshop	07/88	085/88
	Regional Power Seminar on Reducing Electric Power System Losses in Africa	08/88	087/88
	Institutional Evaluation of EGL	02/89	098/89
	Biomass Mapping Regional Workshops	05/89	--
	Francophone Household Energy Workshop	08/89	103/89
	Interafrican Electrical Engineering College: Proposals for Short- and Long-Term Development	03/90	112/90
	Biomass Assessment and Mapping	03/90	--
Angola	Energy Assessment	05/89	4708-ANG
Benin	Energy Assessment	06/85	5222-BEN
Botswana	Energy Assessment	09/84	4998-BT
	Pump Electrification Prefeasibility Study	01/86	047/86
	Review of Electricity Service Connection Policy	07/87	071/87
	Tuli Block Farms Electrification Study	07/87	072/87
	Household Energy Issues Study	02/88	--
	Urban Household Energy Strategy Study	05/91	132/91
Burkina Faso	Energy Assessment	01/86	5730-BUR
	Technical Assistance Program	03/86	052/86
	Urban Household Energy Strategy Study	06/91	134/91
Burundi	Energy Assessment	06/82	3778-BU
	Petroleum Supply Management	01/84	012/84
	Status Report	02/84	011/84
	Presentation of Energy Projects for the Fourth Five-Year Plan (1983-1987)	05/85	036/85
	Improved Charcoal Cookstove Strategy	09/85	042/85
	Peat Utilization Project	11/85	046/85
Cape Verde	Energy Assessment	08/84	5073-CV
	Household Energy Strategy Study	02/90	110/90
Comoros	Energy Assessment	01/88	7104-COM
Congo	Energy Assessment	01/88	6420-COB
	Power Development Plan	03/90	106/90
Côte d'Ivoire	Energy Assessment	04/85	5250-IVC
	Improved Biomass Utilization	04/87	069/87
	Power System Efficiency Study	12/87	--
Ethiopia	Energy Assessment	07/84	4741-ET
	Power System Efficiency Study	10/85	045/85
	Agricultural Residue Briquetting Pilot Project	12/86	062/86
	Bagasse Study	12/86	063/86
	Cooking Efficiency Project	12/87	--
Gabon	Energy Assessment	07/88	6915-GA

Country	*Activity*	*Date*	*Number*
The Gambia	Energy Assessment	11/83	4743-GM
	Solar Water Heating Retrofit Project	02/85	030/85
	Solar Photovoltaic Applications	03/85	032/85
	Petroleum Supply Management Assistance	04/85	035/85
Ghana	Energy Assessment	11/86	6234-GH
	Energy Rationalization in the Industrial Sector	06/88	084/38
	Sawmill Residues Utilization Study	11/88	074/87
Guinea	Energy Assessment	11/86	6137-GUI
Guinea-Bissau	Energy Assessment	08/84	5083-GUB
	Recommended Technical Assistance Projects	04/85	033/85
	Management Options for the Electric Power and Water Supply Subsectors	02/90	100/90
	Power and Water Institutional Restructuring (French)	04/91	118/91
Kenya	Energy Assessment	05/82	3800-KE
	Power System Efficiency Study	03/84	014/84
	Status Report	05/84	016/84
	Coal Conversion Action Plan	02/87	--
	Solar Water Heating Study	02/87	066/87
	Peri-Urban Woodfuel Development	10/87	076/87
	Power Master Plan	11/87	--
Lesotho	Energy Assessment	01/84	4676-LSO
Liberia	Energy Assessment	12/84	5279-LBR
	Recommended Technical Assistance Projects	06/85	038/85
	Power System Efficiency Study	12/87	081/87
Madagascar	Energy Assessment	01/87	5700-MAG
	Power System Efficiency Study	12/87	075/87
Malawi	Energy Assessment	08/82	3903-MAL
	Technical Assistance to Improve the Efficiency of Fuelwood Use in the Tobacco Industry	11/83	009/83
	Status Report	01/84	013/84
Islamic Republic of Mauritania	Energy Assessment	04/85	5224-MAU
	Household Energy Strategy Study	07/90	123/90
Mauritius	Energy Assessment	12/81	3510-MAS
	Status Report	10/83	008/83
	Power System Efficiency Audit	05/87	070/87
	Bagasse Power Potential	10/87	077/87
Mozambique	Energy Assessment	01/87	6128-MOZ
	Household Electricity Utilization Study	03/90	113/90
Niger	Energy Assessment	05/84	4642-NIR
	Status Report	02/86	051/86
	Improved Stoves Project	12/87	080/87
	Household Energy Conservation and Substitution	01/88	082/88
Nigeria	Energy Assessment	08/83	4440-UNI
Rwanda	Energy Assessment	06/82	3779-RW
	Energy Assessment	07/91	8017-RW
	Status Report	05/84	017/84
	Improved Charcoal Cookstove Strategy	08/86	059/86
	Improved Charcoal Production Techniques	02/87	065/87

Country	*Activity*	*Date*	*Number*
Sao Tome and Principe	Energy Assessment	10/85	5803-STP
Senegal	Energy Assessment	07/83	4182-SE
	Status Report	10/84	025/84
	Industrial Energy Conservation Study	05/85	037/85
	Preparatory Assistance for Donor Meeting	04/86	056/86
	Urban Household Energy Strategy	02/89	096/89
Seychelles	Energy Assessment	01/84	4693-SEY
	Electric Power System Efficiency Study	08/84	021/84
Sierra Leone	Energy Assessment	10/87	6597-SL
Somalia	Energy Assessment	12/85	5796-SO
Sudan	Management Assistance to the Ministry of Energy and Mining	05/83	003/83
	Energy Assessment	07/83	4511-SU
	Power System Efficiency Study	06/84	018/84
	Status Report	11/84	026/84
	Wood Energy/Forestry Feasibility	07/87	073/87
Swaziland	Energy Assessment	02/87	6262-SW
Tanzania	Energy Assessment	11/84	4969-TA
	Peri-Urban Woodfuels Feasibility Study	08/88	086/88
	Tobacco Curing Efficiency Study	05/89	102/89
	Remote Sensing and Mapping of Woodlands	06/90	--
	Industrial Energy Efficiency Technical Assistance	08/90	122/90
Togo	Energy Assessment	06/85	5221-TO
	Wood Recovery in the Nangbeto Lake	04/86	055/86
	Power Efficiency Improvement	12/87	078/87
Uganda	Energy Assessment	07/83	4453-UG
	Status Report	08/84	020/84
	Institutional Review of the Energy Sector	01/85	029/85
	Energy Efficiency in Tobacco Curing Industry	02/86	049/86
	Fuelwood/Forestry Feasibility Study	03/86	053/86
	Power System Efficiency Study	12/88	092/88
	Energy Efficiency Improvement in the Brick and Tile Industry	02/89	097/89
	Tobacco Curing Pilot Project	03/89	UNDP Terminal Report
Zaire	Energy Assessment	05/86	5837-ZR
Zambia	Energy Assessment	01/83	4110-ZA
	Status Report	08/85	039/85
	Energy Sector Institutional Review	11/86	060/86
	Power Subsector Efficiency Study	02/89	093/88
	Energy Strategy Study	02/89	094/88
	Urban Household Energy Strategy Study	08/90	121/90
Zimbabwe	Energy Assessment	06/82	3765-ZIM
	Power System Efficiency Study	06/83	005/83
	Status Report	08/84	019/84
	Power Sector Management Assistance Project	04/85	034/85
	Petroleum Management Assistance	12/89	109/89
	Power Sector Management Institution Building	09/89	--
	Charcoal Utilization Prefeasibility Study	06/90	119/90

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Country	*Activity*	*Date*	*Number*
	ASIA AND THE PACIFIC		
Asia Regional	Pacific Household and Rural Energy Seminar	11/90	--
Bangladesh	Energy Assessment	10/82	3873-BD
	Priority Investment Program	05/83	002/83
	Status Report	04/84	015/84
	Power System Efficiency Study	02/85	031/85
	Small Scale Uses of Gas Prefeasibility Study	12/88	--
China	County-Level Rural Energy Assessments	05/89	101/89
	Fuelwood Forestry Preinvestment Study	12/89	105/89
Fiji	Energy Assessment	06/83	4462-FIJ
India	Opportunities for Commercialization of Nonconventional Energy Systems	11/88	091/88
	Maharashtra Bagasse Energy Efficiency Project	05/91	120/91
	Mini-Hydro Development on Irrigation Dams and Canal Drops Vols. I, II and III	07/91	131/91
Indonesia	Energy Assessment	11/81	3543-IND
	Status Report	09/84	022/84
	Power Generation Efficiency Study	02/86	050/86
	Energy Efficiency in the Brick, Tile and Lime Industries	04/87	067/87
	Diesel Generating Plant Efficiency Study	12/88	095/88
	Urban Household Energy Strategy Study	02/90	107/90
	Biomass Gasifier Preinvestment Study Vols. I & II	12/90	124/90
Malaysia	Sabah Power System Efficiency Study	03/87	068/87
Myanmar	Energy Assessment	06/85	5416-BA
Nepal	Energy Assessment	08/83	4474-NEP
	Status Report	01/85	028/84
Papua New Guinea	Energy Assessment	06/82	3882-PNG
	Status Report	07/83	006/83
	Energy Strategy Paper	--	--
	Institutional Review in the Energy Sector	10/84	023/84
	Power Tariff Study	10/84	024/84
Solomon Islands	Energy Assessment	06/83	4404-SOL
South Pacific	Petroleum Transport in the South Pacific	05/86	--
Sri Lanka	Energy Assessment	05/82	3792-CE
	Power System Loss Reduction Study	07/83	007/83
	Status Report	01/84	010/84
	Industrial Energy Conservation Study	03/86	054/86
Thailand	Energy Assessment	09/85	5793-TH
	Rural Energy Issues and Options	09/85	044/85
	Accelerated Dissemination of Improved Stoves and Charcoal Kilns	09/87	079/87
	Northeast Region Village Forestry and Woodfuels Preinvestment Study	02/88	083/88
	Impact of Lower Oil Prices	08/88	--
	Coal Development and Utilization Study	10/89	--
Tonga	Energy Assessment	06/85	5498-TON
Vanuatu	Energy Assessment	06/85	5577-VA
Western Samoa	Energy Assessment	06/85	5497-WSO

Country	*Activity*	*Date*	*Number*
	EUROPE, MIDDLE EAST AND NORTH AFRICA (EMENA)		
Morocco	Energy Assessment	03/84	4157-MOR
	Status Report	01/86	048/86
Pakistan	Household Energy Assessment	05/88	--
	Assessment of Photovoltaic Programs, Applications, and Markets	10/89	103/89
Portugal	Energy Assessment	04/84	4824-PO
Syria	Energy Assessment	05/86	5822-SYR
	Electric Power Efficiency Study	09/88	089/88
	Energy Efficiency Improvement in the Cement Sector	04/89	099/89
	Energy Efficiency Improvement in the Fertilizer Sector	06/90	115/90
Tunisia	Fuel Substitution	03/90	--
Turkey	Energy Assessment	03/83	3877-TU
Yemen	Energy Assessment	12/84	4892-YAR
	Energy Investment Priorities	02/87	6376-YAR
	Household Energy Strategy Study Phase I	03/91	126/91
	LATIN AMERICA AND THE CARIBBEAN (LAC)		
LAC Regional	Regional Seminar on Electric Power System Loss Reduction in the Caribbean	07/89	--
Bolivia	Energy Assessment	04/83	4213-BO
	National Energy Plan	12/87	--
	National Energy Plan (Spanish)	08/91	131/91
	La Paz Private Power Technical Assistance	11/90	111/90
	Natural Gas Distribution	03/91	125/91
	Prefeasibility Evaluation Rural Electrification and Demand Assessment	04/91	129/91
Chile	Energy Sector Review	08/88	7129-CH
Colombia	Energy Strategy Paper	12/86	--
Costa Rica	Energy Assessment	01/84	4655-CR
	Recommended Technical Assistance Projects	11/84	027/84
	Forest Residues Utilization Study	02/90	108/90
Dominican Republic	Energy Assessment	05/91	8234-DO
Ecuador	Energy Assessment	12/85	5865-EC
	Energy Strategy Phase I	07/88	--
	Energy Strategy	04/91	--
Haiti	Energy Assessment	06/82	3672-HA
	Status Report	08/85	041/85
Honduras	Energy Assessment	08/87	6476-HO
	Petroleum Supply Management	03/91	128/91
Jamaica	Energy Assessment	04/85	5466-JM
	Petroleum Procurement, Refining, and Distribution Study	11/86	061/86
	Energy Efficiency Building Code Phase I	03/88	--
	Energy Efficiency Standards and Labels Phase I	03/88	--
	Management Information System Phase I	03/88	--
	Charcoal Production Project	09/88	090/88
	FIDCO Sawmill Residues Utilization Study	09/88	088/88

Country	*Activity*	*Date*	*Number*
Mexico	Improved Charcoal Production Within Forest Management for the State of Veracruz	08/91	138/91
Panama	Power System Efficiency Study	06/83	004/83
Paraguay	Energy Assessment	10/84	5145-PA
	Recommended Technical Assistance Projects	09/85	--
	Status Report	09/85	043/85
Peru	Energy Assessment	01/84	4677-PE
	Status Report	08/85	040/85
	Proposal for a Stove Dissemination Program in the Sierra	02/87	064/87
	Energy Strategy	12/90	--
Saint Lucia	Energy Assessment	09/84	5111-SLU
St. Vincent and the Grenadines	Energy Assessment	09/84	5103-STV
Trinidad and Tobago	Energy Assessment	12/85	5930-TR

GLOBAL

Energy End Use Efficiency: Research and Strategy	11/89	--
Guidelines for Utility Customer Management and Metering	07/91	--
Women and Energy--A Resource Guide The International Network: Policies and Experience	04/90	--

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