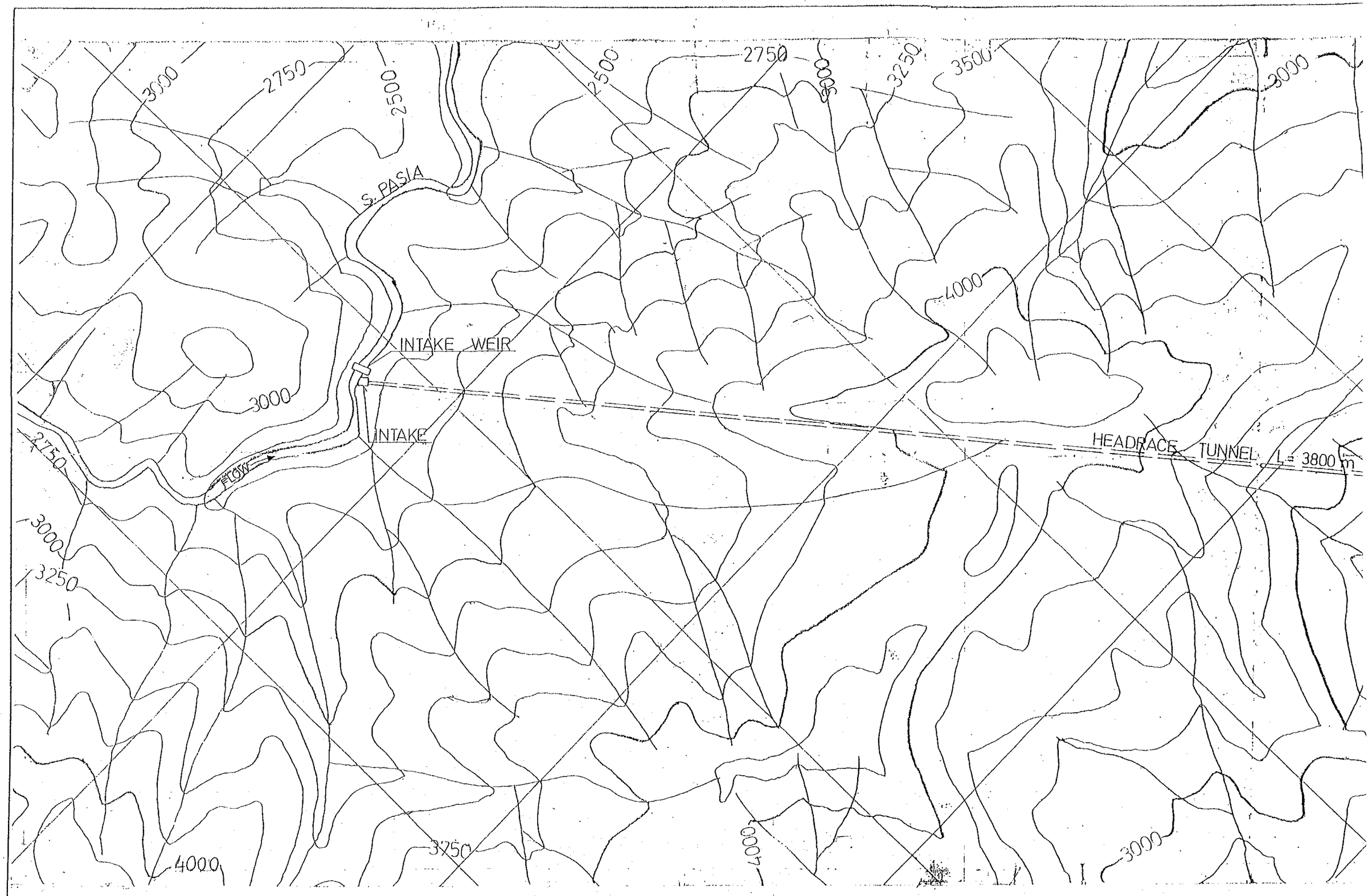
# *APPENDIX VI*

# *BASIC LAYOUT PLAN FOR THE THIRD SCREENING*

## LIST OF FIGURES


3000
2750
2500
S. PASIA
INTAKE WEIR
INTAKE
FLOW
HEADRACE TUNNEL L = 3800 m
2750
3000
3250
4000
2500
2750
3000
3250
3500
4000
3000
3250
4000
3000

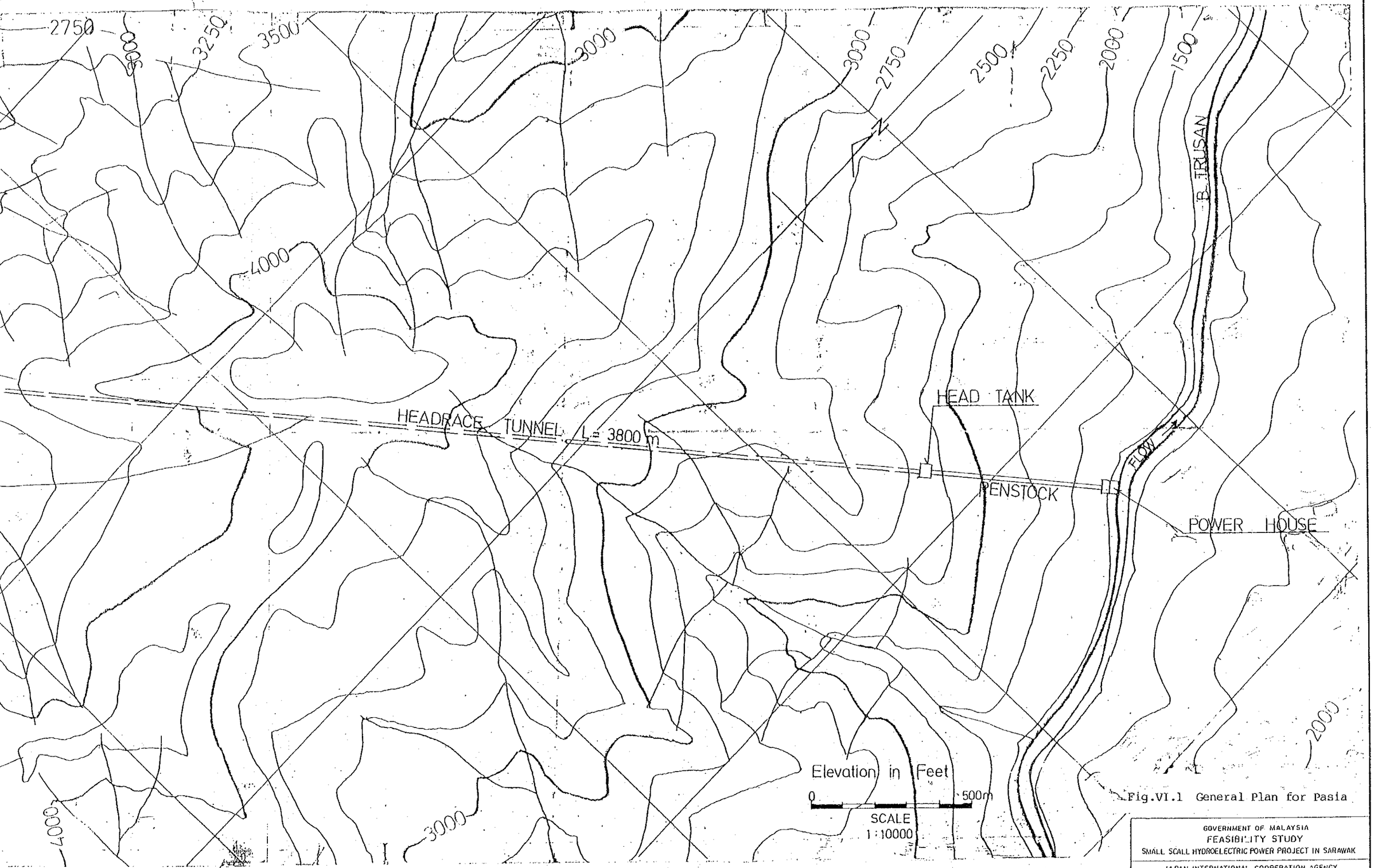



Fig.VI.1 General Plan for Pasia

GOVERNMENT OF MALAYSIA
FEASIBILITY STUDY
SMALL SCALL HYDROELECTRIC POWER PROJECT IN SARAWAK
JAPAN INTERNATIONAL COOPERATION AGENCY

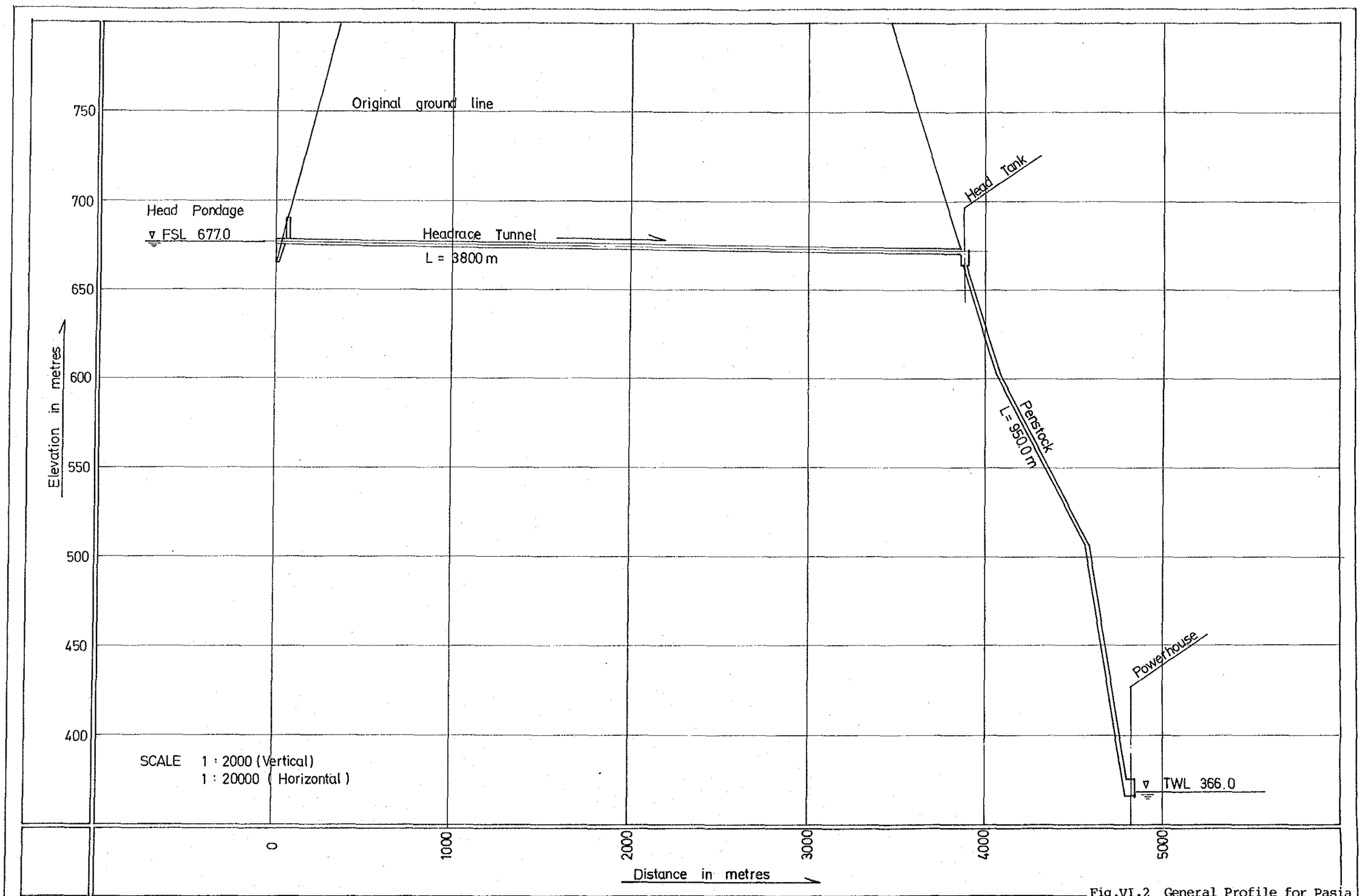
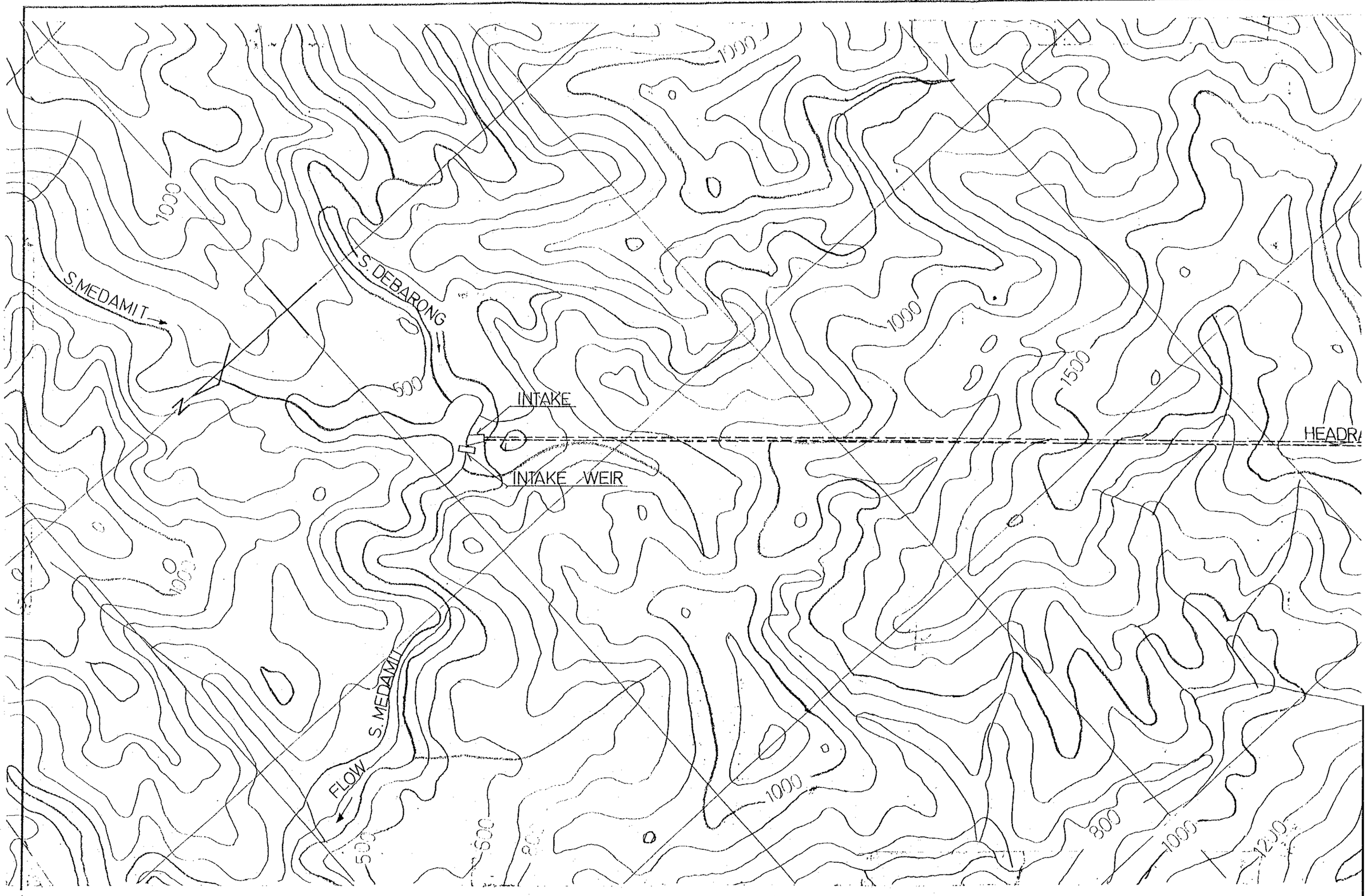



Fig.VI.2 General Profile for Pasia

GOVERNMENT OF MALAYSIA
FEASIBILITY STUDY
SMALL SCALE HYDROELECTRIC POWER PROJECT IN SARAWAK
JAPAN INTERNATIONAL COOPERATION AGENCY


S.MEDAMIT
S. DEBARONG
INTAKE
INTAKE WEIR
HEADR
FLOW
S. MEDAMIT
1000
500
1500
800
1200

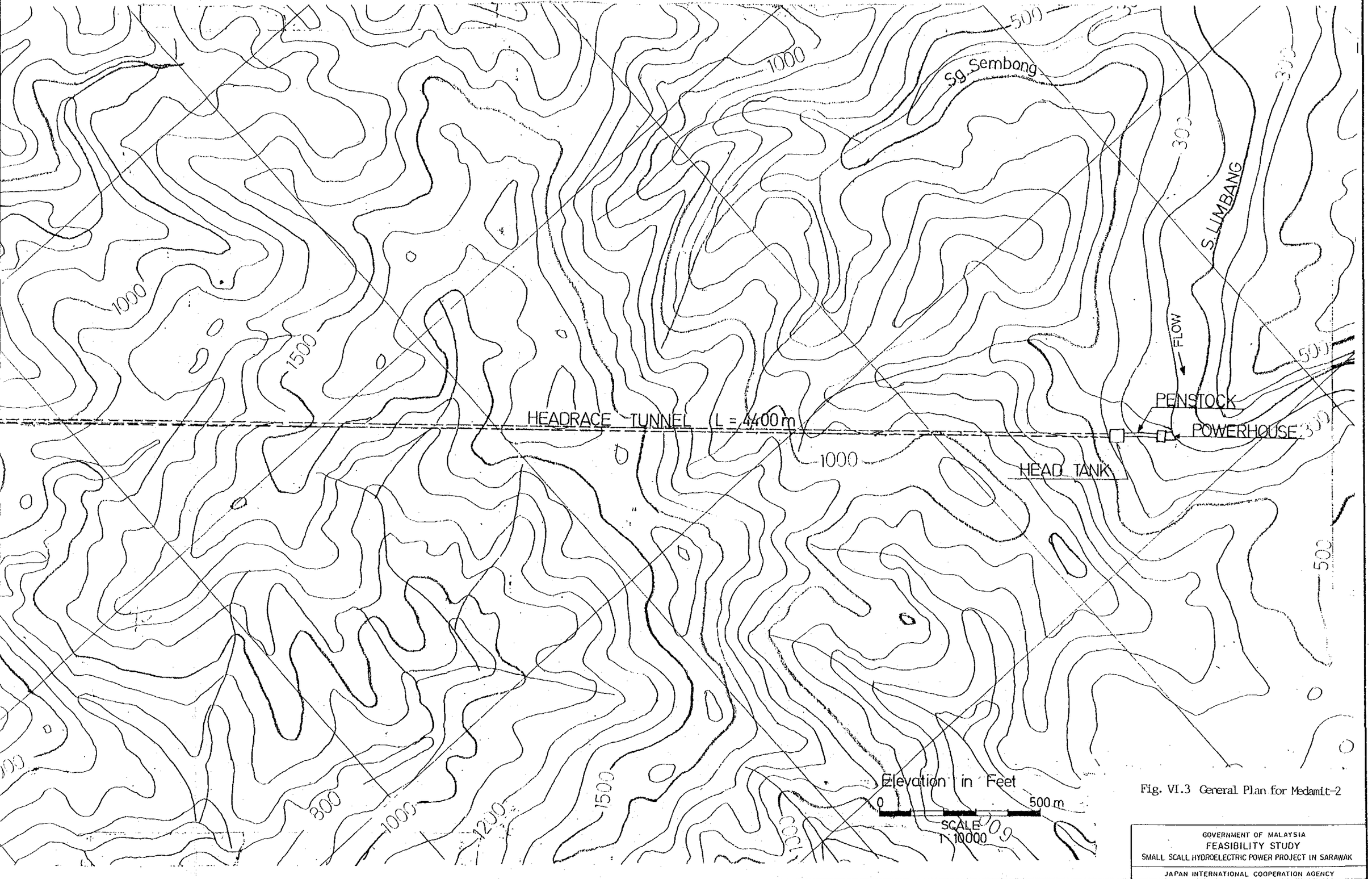



Fig. VI.3 General Plan for Medamit-2

GOVERNMENT OF MALAYSIA
FEASIBILITY STUDY
SMALL SCALL HYDROELECTRIC POWER PROJECT IN SARAWAK
JAPAN INTERNATIONAL COOPERATION AGENCY

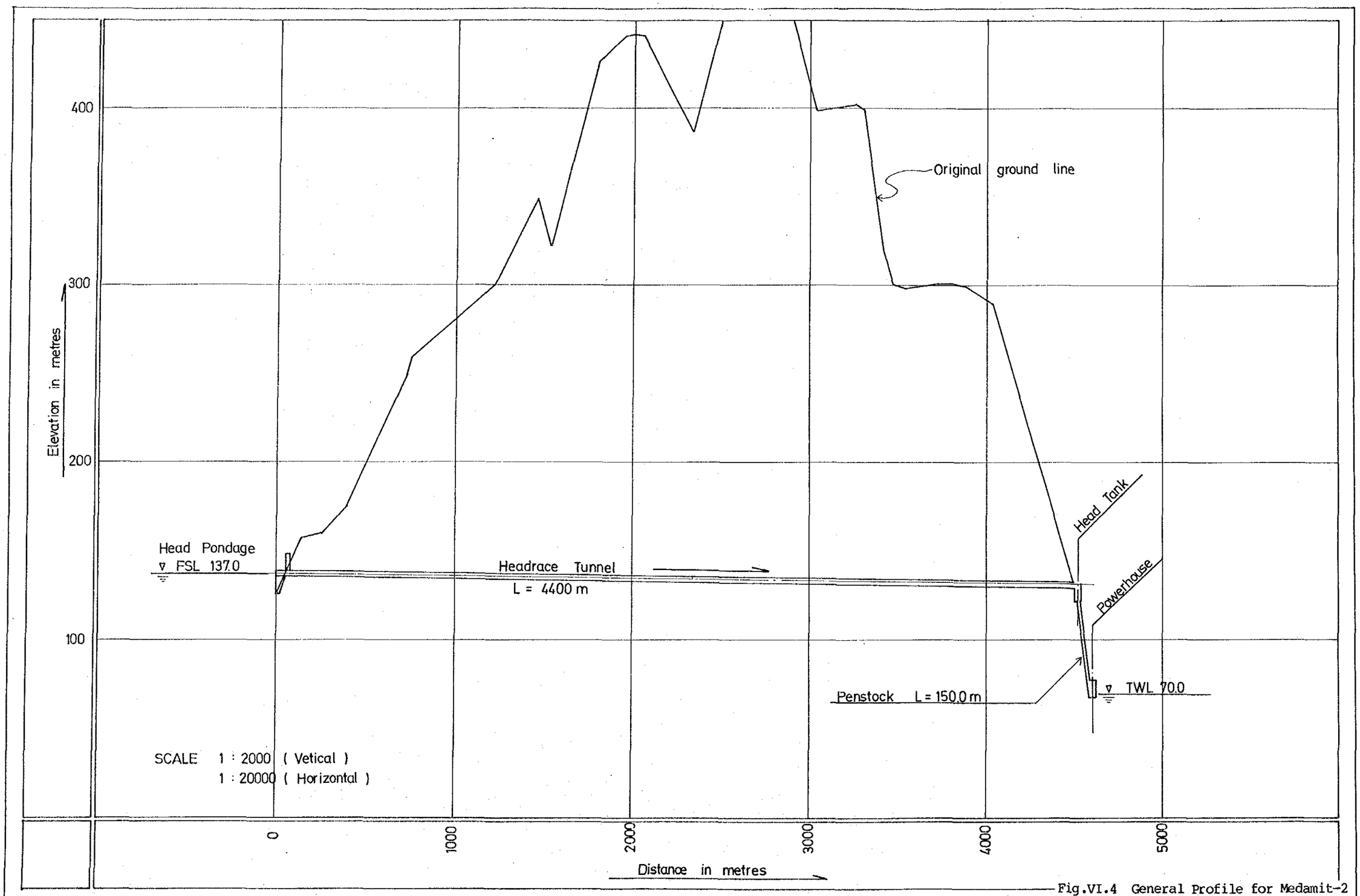



Fig.VI.4 General Profile for Medamit-2

GOVERNMENT OF MALAYSIA
FEASIBILITY STUDY
SMALL SCALE HYDROELECTRIC POWER PROJECT IN SARAWAK
JAPAN INTERNATIONAL COOPERATION AGENCY

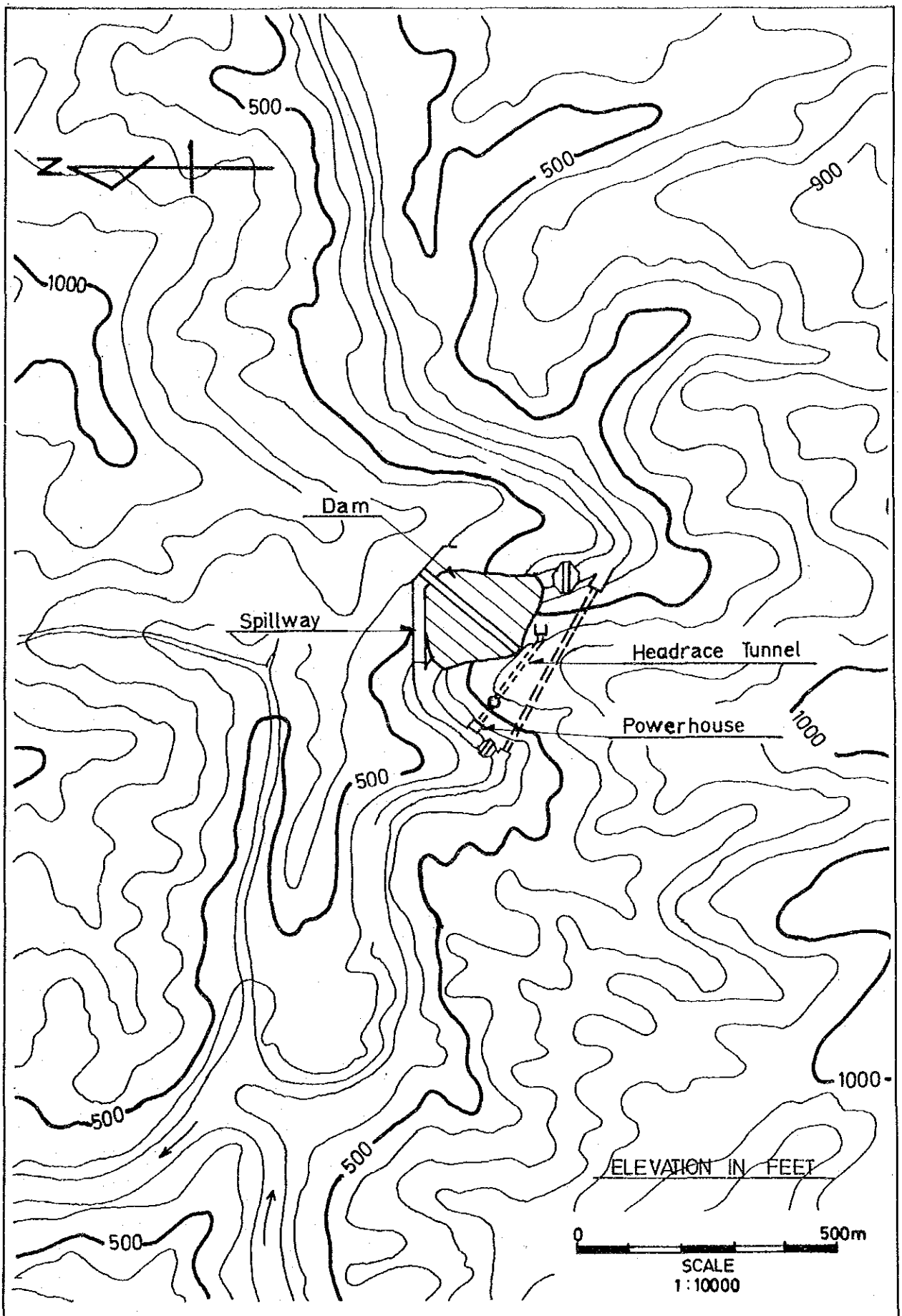



Fig.VI.5 General Plan for Kapit-2

GOVERNMENT OF MALAYSIA
FEASIBILITY STUDY
SMALL SCALE HYDROELECTRIC POWER PROJECT IN SARAWAK
JAPAN INTERNATIONAL COOPERATION AGENCY

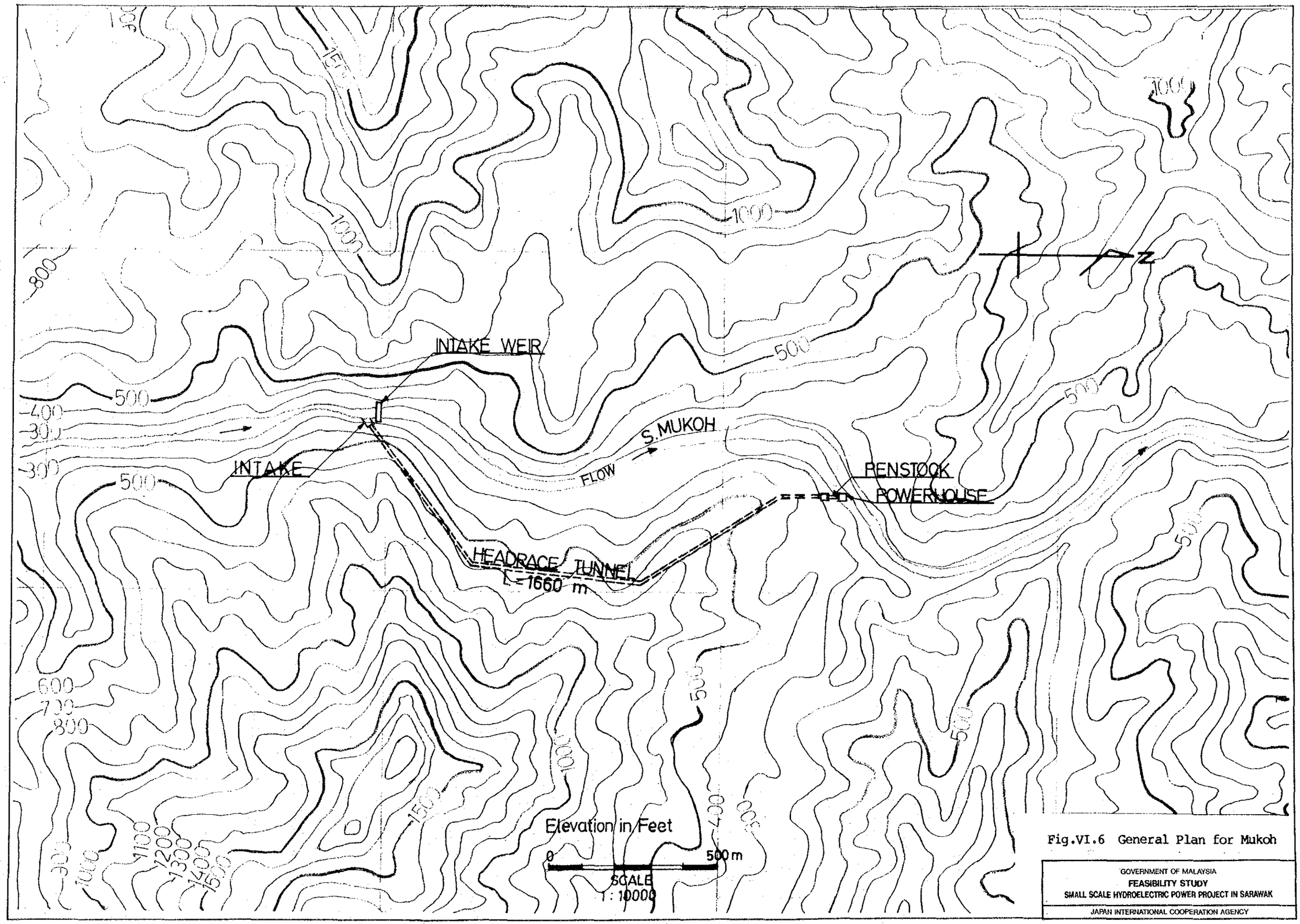



Fig.VI.6 General Plan for Mukoh

GOVERNMENT OF MALAYSIA
FEASIBILITY STUDY
SMALL SCALE HYDROELECTRIC POWER PROJECT IN SARAWAK
JAPAN INTERNATIONAL COOPERATION AGENCY

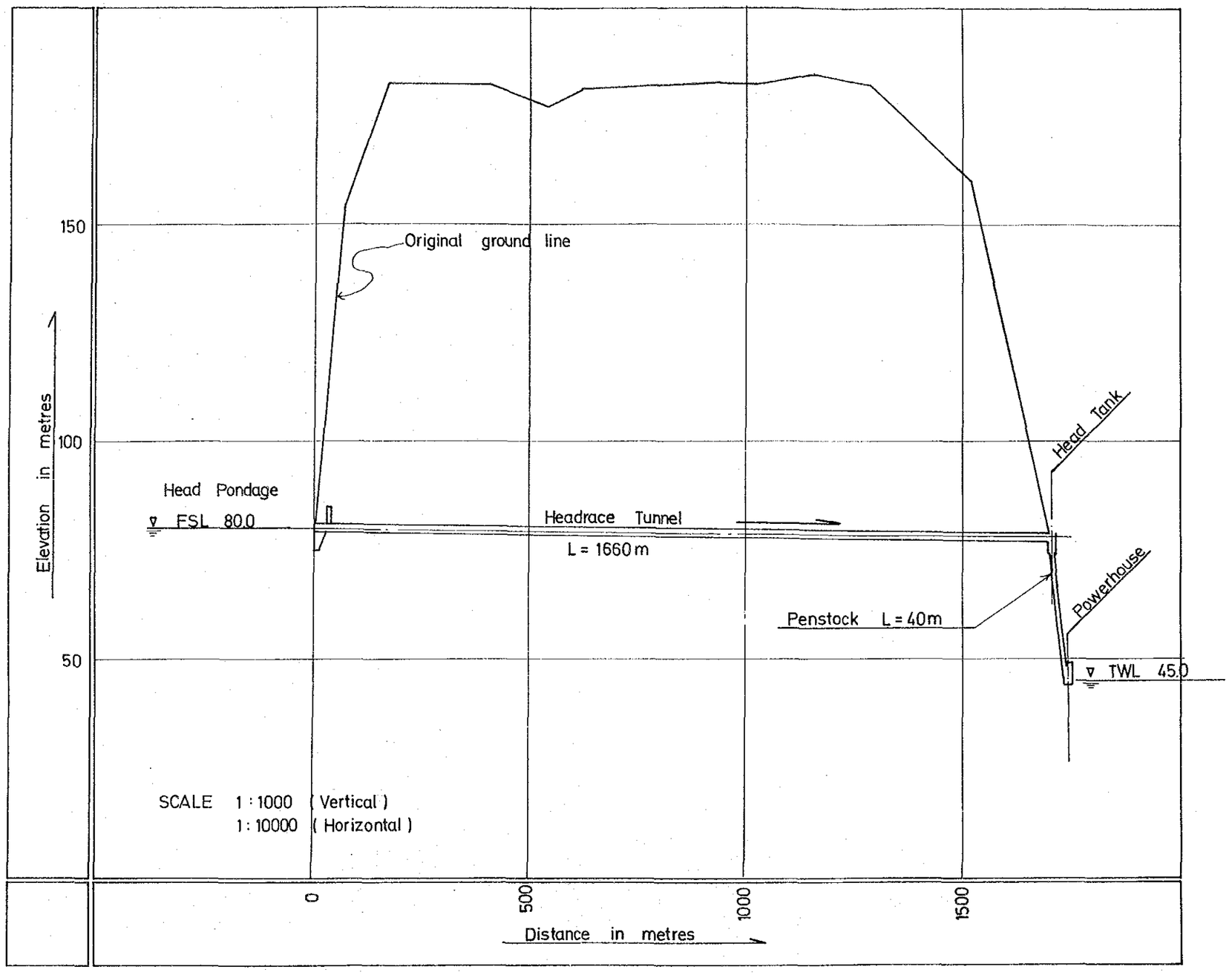



Fig.VI.7 General Profile for Mukoh

GOVERNMENT OF MALAYSIA
FEASIBILITY STUDY
SMALL SCALE HYDROELECTRIC POWER PROJECT IN SARAWAK
JAPAN INTERNATIONAL COOPERATION AGENCY

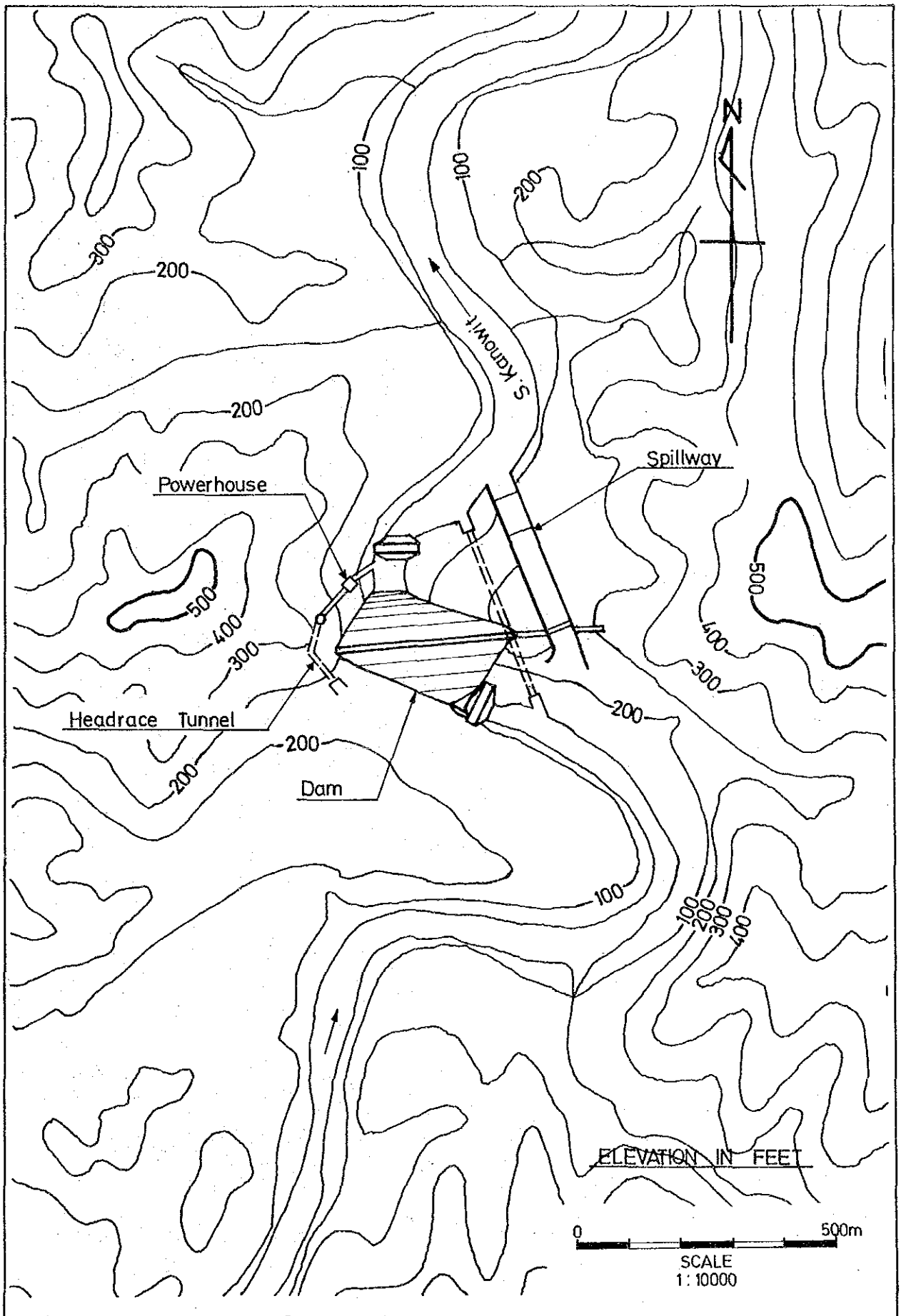



Fig.VI.8 General Plan for Kanowit

GOVERNMENT OF MALAYSIA
FEASIBILITY STUDY
SMALL SCALE HYDROELECTRIC POWER PROJECT IN SARAWAK
JAPAN INTERNATIONAL COOPERATION AGENCY

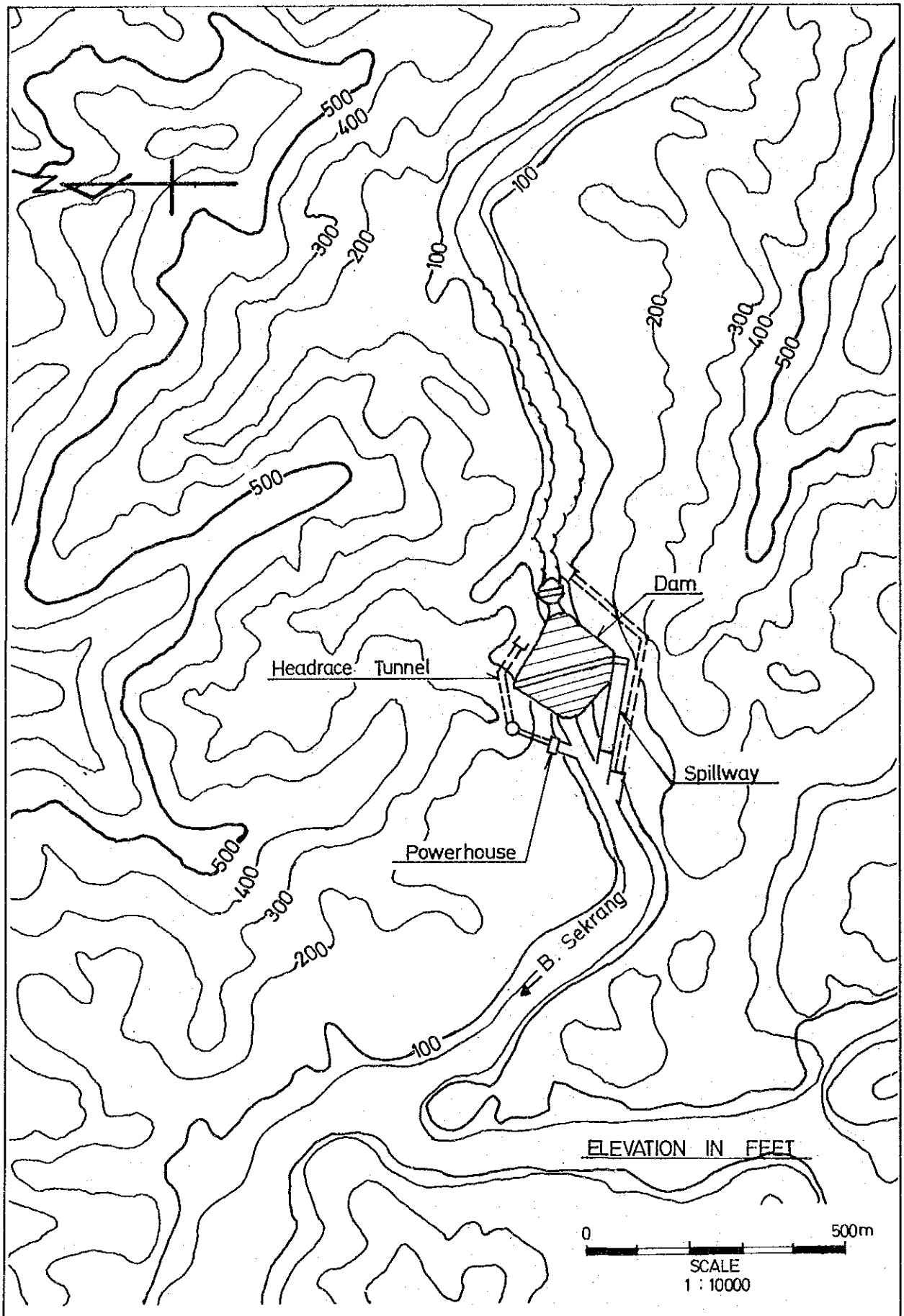



Fig.VI.9 General Plan for Sekrang-1

GOVERNMENT OF MALAYSIA
**FEASIBILITY STUDY**
**SMALL SCALE HYDROELECTRIC POWER PROJECT IN SARAWAK**
JAPAN INTERNATIONAL COOPERATION AGENCY

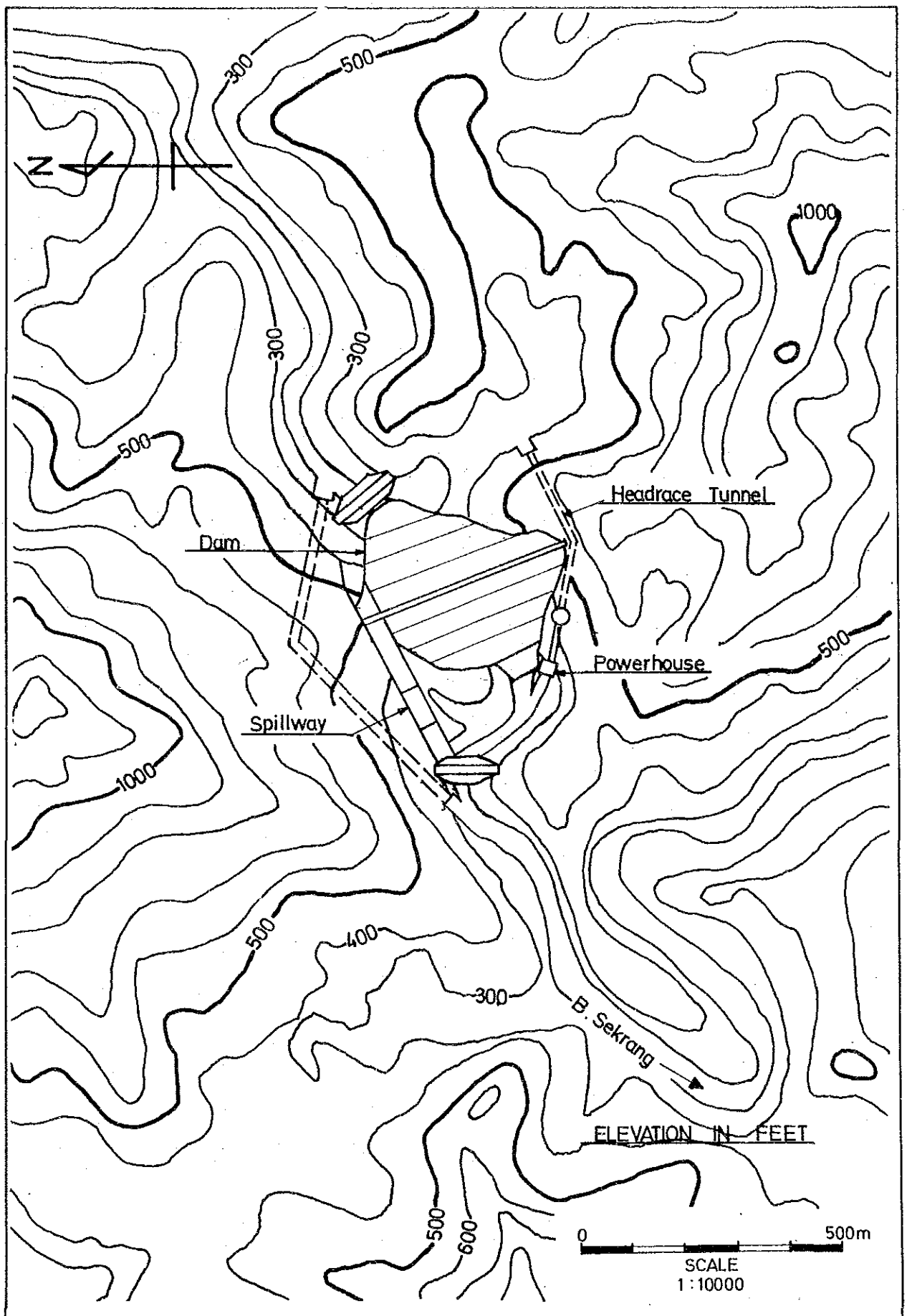



Fig.VI.10 General Plan for Sekrang-2

GOVERNMENT OF MALAYSIA
FEASIBILITY STUDY
SMALL SCALE HYDROELECTRIC POWER PROJECT IN SARAWAK
JAPAN INTERNATIONAL COOPERATION AGENCY

# APPENDIX VII

# PRELIMINARY COST ESTIMATE FOR THE THIRD SCREENINGT

## LIST OF TABLES

## TABLE VII.1 CONSTRUCTION COST FOR SEKRANG-1

Damsite : SEKRANG-1
Development Type : RESERVOIR ROCKFILL DAM
Installed Capacity = 11,845 KW FSL= 62.0 m Qmax= 44.8 CMS
Dam height, crest length, bottom width (m) : 54, 189, 50
Headrace tunnel = 300 m
Penstock length = 20 m
Diversion length = 580 m

*** CONSTRUCTION COST ( Units : M$,1986 : 1US$=2.6M$ )

| Item | Unit | Q'ty | Unit Cost | Amts(M$'000) |
|---|---|---|---|---|
| 1. DIVERSION WORKS (Nos of TUNNEL= 3 ) | | | | |
| a. Dam exca | cum | 4,285 | 6 | 26 |
| b. Embankmt | cum | 12,752 | 8 | 102 |
| c. Tnl exca | cum | 61,322 | 150 | 9,198 |
| d. Concrete | cum | 13,475 | 330 | 4,447 |
| e. Reinf. Bar | ton | 539 | 1,500 | 809 |
| f. Gate | ton | 66.6 | 10,000 | 666 |
| | | | Sum+20%= | 18,297 |
| 2. ROCKFILL DAM | | | | |
| a. Excavation | cum | 102,240 | 7 | 716 |
| b. Embankment | cum | 607,306 | 15 | 9,110 |
| | | | Sum+20%= | 11,790 |
| 3. SPILLWAY | | | | |
| a. Excavation | cum | 223,602 | 8 | 1,789 |
| b. Concrete | cum | 34,605 | 180 | 6,229 |
| c. Reinf. Bar | ton | 692 | 1,500 | 1,038 |
| d. Gate | ton | 534.6 | 15,000 | 8,019 |
| | | | Sum+20%= | 20,490 |
| 4. INTAKE | | | | |
| a. Excavation | cum | 4,745 | 15 | 71 |
| b. Concrete | cum | 2,135 | 260 | 555 |
| c. Reinf. Bar | ton | 64 | 1,500 | 96 |
| d. Gate | ton | 41.5 | 15,000 | 623 |
| | | | Sum+20%= | 1,614 |
| 5. PRESSURE TUNNEL Dia= 4.4 | | | | |
| a. Excavation | cum | 6,451 | 200 | 1,290 |
| b. Concrete | cum | 1,971 | 420 | 828 |
| c. Reinf. Bar | ton | 79 | 1,500 | 118 |
| | | | Sum+20%= | 2,683 |
| 6. SURGE TANK | | | | |
| a. Excavation | cum | 7,133 | 170 | 1,213 |
| b. Concrete | cum | 2,065 | 360 | 743 |
| c. Reinf. Bar | ton | 103 | 1,500 | 155 |
| | | | Sum+20%= | 2,533 |
| 7. PENSTOCK LINE Dia= 3.1 | | | | |
| a. Excavation | cum | 986 | 13 | 13 |
| b. Concrete | cum | 258 | 180 | 46 |
| c. Reinf. Bar | ton | 3 | 1,500 | 4 |
| d. Penstock | ton | 10.7 | 10,000 | 107 |
| | | | Sum+20%= | 204 |
| 8. POWERHOUSE | | | | |
| a. Excavation | cum | 8,901 | 18 | 160 |
| b. Concrete | cum | 3,179 | 220 | 699 |
| c. Reinf. Bar | ton | 165 | 1,500 | 248 |
| d. Building | cum | 5,215 | 300 | 1,564 |
| e. Gate | ton | 22.4 | 15,000 | 336 |
| | | | Sum+20%= | 3,610 |
| 9. GENERATING AND HYDRO-MECHANICAL EQUIPMENT | KW | 11,845 | 1,059 | 12,539 |
| 10. TRANSMISSION LINE | Km | 30 | 160,000 | 4,800 |
| 11. ACCESS ROAD | Km | 16 | 320,000 | 5,120 |
| 12. PREPARATORY WORKS (15%) | | | | 9,183 |
| 13. DIRECT CONSTRUCTION COST | | | | 92,864 |
| 14. *COMPENSATION AND* LAND ACQUISITION | Ha | 50 | 1,500 | 75 |
| 15. ENGINEERING SERVICES AND ADMINISTRATION COST | (10%) | | | 9,286 |
| 16. CONTINGENCIES | (15%) | | | 15,334 |
| 17. TOTAL CONSTRUCTION COST | | | | 117,559 M$ |
| | | | | 45,215 US$ |

# TABLE VII.2 CONSTRUCTION COST FOR SEKRANG-2

Damsite : SEKRANG-2
Development Type : RESERVOIR ROCKFILL DAM
Installed Capacity = 17,050 KW FSL= 145.9 m Qmax= 29.3 cms
Net Head = 64.3 ' MOL= 138.4
Dam height, crest length, bottom width (m) : 85, 332, 70
Headrace tunnel = 400 m
Penstock length = 40 m
Diversion length = 650 m

*** CONSTRUCTION COST ( Units : M$,1986 : 1US$=2.6M$ )

| Item | Unit | Q'ty | Unit Cost | Amts(M$'000) |
|---|---|---|---|---|
| 1. DIVERSION WORKS | (Nos of TUNNEL= 2 ) | | | |
| a. Dam exca | cum | 4,285 | 6 | 26 |
| b. Embankmt | cum | 12,752 | 8 | 102 |
| c. Tnl exca | cum | 53,526 | 150 | 8,029 |
| d. Concrete | cum | 11,311 | 330 | 3,733 |
| e. Reinf. Bar | ton | 452 | 1,500 | 679 |
| f. Gate | ton | 43.6 | 10,000 | 436 |
| | | | Sum+20%= | 15,604 |
| 2. ROCKFILL DAM | | | | |
| a. Excavation | cum | 281,528 | 7 | 1,971 |
| b. Embankment | cum | 2,629,190 | 15 | 39,438 |
| | | | Sum+20%= | 49,690 |
| 3. SPILLWAY | | | | |
| a. Excavation | cum | 309,219 | 8 | 2,474 |
| b. Concrete | cum | 47,855 | 180 | 8,614 |
| c. Reinf. Bar | ton | 957 | 1,500 | 1,436 |
| d. Gate | ton | 413.6 | 15,000 | 6,204 |
| | | | Sum+20%= | 22,473 |
| 4. INTAKE | | | | |
| a. Excavation | cum | 3,595 | 15 | 54 |
| b. Concrete | cum | 1,618 | 260 | 421 |
| c. Reinf. Bar | ton | 49 | 1,500 | 73 |
| d. Gate | ton | 26.8 | 15,000 | 402 |
| | | | Sum+20%= | 1,139 |
| 5. PRESSURE TUNNEL | Dia= 3.5 | | | |
| a. Excavation | cum | 5,846 | 200 | 1,169 |
| b. Concrete | cum | 1,940 | 420 | 815 |
| c. Reinf. Bar | ton | 78 | 1,500 | 116 |
| | | | Sum+20%= | 2,520 |
| 6. SURGE TANK | | | | |
| a. Excavation | cum | 5,002 | 170 | 850 |
| b. Concrete | cum | 1,448 | 360 | 521 |
| c. Reinf. Bar | ton | 72 | 1,500 | 109 |
| | | | Sum+20%= | 1,776 |
| 7. PENSTOCK LINE | Dia= 2.5 | | | |
| a. Excavation | cum | 1,396 | 13 | 18 |
| b. Concrete | cum | 380 | 180 | 68 |
| c. Reinf. Bar | ton | 4 | 1,500 | 6 |
| d. Penstock | ton | 24.9 | 10,000 | 249 |
| | | | Sum+20%= | 410 |
| 8. POWERHOUSE | | | | |
| a. Excavation | cum | 9,318 | 18 | 168 |
| b. Concrete | cum | 3,328 | 220 | 732 |
| c. Reinf. Bar | ton | 173 | 1,500 | 260 |
| d. Building | cum | 5,257 | 300 | 1,577 |
| e. Gate | ton | 14.7 | 15,000 | 220 |
| | | | Sum+20%= | 3,548 |
| 9. GENERATING AND HYDRO-MECHANICAL EQUIPMENT | KW | 17,050 | 741 | 12,637 |
| 10. TRANSMISSION LINE | Km | 45 | 160,000 | 7,200 |
| 11. ACCESS ROAD | Km | 35 | 395,000 | 13,825 |
| 12. PREPARATORY WORKS (15%) | | | | 14,574 |
| 13. DIRECT CONSTRUCTION COST | | | | 148,667 |
| 14. COMPENSATION AND LAND ACQUISITION | Ha | 500 | 1,500 | 750 |
| 15. ENGINEERING SERVICES AND ADMINISTRATION COST | (10%) | | | 14,867 |
| 16. CONTINGENCIES | (15%) | | | 24,643 |
| 17. TOTAL CONSTRUCTION COST | | | | 188,926 M$ |
| | | | | 72,664 US$ |

## TABLE VII.3 CONSTRUCTION COST FOR KANOWIT

Damsite : KANOWIT
Development Type : RESERVOIR ROCKFILL DAM
Installed Capacity = 25,099 KW FSL= 61.0 m Qmax= 102.8 CMS
Dam height, crest length, bottom width (m) : 55, 433, 60
Headrace tunnel = 200 m
Penstock length = 140 m
Diversion length = 600 m

*** CONSTRUCTION COST ( Units : M$,1986 : 1US$=2.6M$ )

| Item | Unit | Q'ty | Unit Cost | Amts(M$'000) |
|---|---|---|---|---|
| 1. DIVERSION WORKS | (Nos of TUNNEL= 4 ) | | | |
| a. Dam exca | cum | 4,285 | 6 | 26 |
| b. Embankmt | cum | 12,752 | 8 | 102 |
| c. Tnl exca | cum | 112,287 | 150 | 16,843 |
| d. Concrete | cum | 22,945 | 495 | 11,358 |
| e. Reinf. Bar | ton | 918 | 1,500 | 1,377 |
| f. Gate | ton | 152.9 | 10,000 | 1,529 |
| | | | Sum+20%= | 37,481 |
| 2. ROCKFILL DAM | | | | |
| a. Excavation | cum | 238,333 | 7 | 1,668 |
| b. Embankment | cum | 1,441,920 | 27 | 38,932 |
| | | | Sum+20%= | 48,720 |
| 3. SPILLWAY | | | | |
| a. Excavation | cum | 392,020 | 8 | 3,136 |
| b. Concrete | cum | 40,447 | 270 | 10,921 |
| c. Reinf. Bar | ton | 809 | 1,500 | 1,213 |
| d. Gate | ton | 704.0 | 15,000 | 10,560 |
| | | | Sum+20%= | 30,996 |
| 4. INTAKE | | | | |
| a. Excavation | cum | 10,321 | 15 | 155 |
| b. Concrete | cum | 4,645 | 390 | 1,811 |
| c. Reinf. Bar | ton | 139 | 1,500 | 209 |
| d. Gate | ton | 103.3 | 15,000 | 1,549 |
| | | | Sum+20%= | 4,469 |
| 5. PRESSURE TUNNEL | Dia= 6.6 | | | |
| a. Excavation | cum | 7,137 | 200 | 1,427 |
| b. Concrete | cum | 2,283 | 630 | 1,439 |
| c. Reinf. Bar | ton | 91 | 1,500 | 137 |
| | | | Sum+20%= | 4,083 |
| 6. SURGE TANK | | | | |
| a. Excavation | cum | 15,033 | 170 | 2,556 |
| b. Concrete | cum | 4,352 | 540 | 2,350 |
| c. Reinf. Bar | ton | 218 | 1,500 | 326 |
| | | | Sum+20%= | 6,278 |
| 7. PENSTOCK LINE | Dia= 4.7 | | | |
| a. Excavation | cum | 14,331 | 13 | 186 |
| b. Concrete | cum | 3,808 | 270 | 1,028 |
| c. Reinf. Bar | ton | 38 | 1,500 | 57 |
| d. Penstock | ton | 144.6 | 10,000 | 1,446 |
| | | | Sum+20%= | 3,261 |
| 8. POWERHOUSE | | | | |
| a. Excavation | cum | 19,367 | 18 | 349 |
| b. Concrete | cum | 6,917 | 330 | 2,283 |
| c. Reinf. Bar | ton | 360 | 1,500 | 540 |
| d. Building | cum | 9,071 | 300 | 2,721 |
| e. Gate | ton | 51.4 | 15,000 | 771 |
| | | | Sum+20%= | 7,996 |
| 9. GENERATING AND HYDRO-MECHANICAL EQUIPMENT | KW | 25,099 | 849 | 21,300 |
| 10. TRANSMISSION LINE | Km | 65 | 160,000 | 10,400 |
| 11. QUARRY ROAD | Km | 40 | 320,000 | 12,800 |
| 12. PREPARATORY WORKS (15%) | | | | 21,493 |
| 13. DIRECT CONSTRUCTION COST | | | | 209,776 |
| 14. COMPENSATION AND LAND ACQUISITION | Ha | 3,200 | 1,500 | 4,800 |
| 15. ENGINEERING SERVICES AND ADMINISTRATION COST | (10%) | | | 20,978 |
| 16. CONTINGENCIES | (15%) | | | 35,333 |
| 17. TOTAL CONSTRUCTION COST | | | | 270,887 M$ |
| | | | | 104,187 US$ |

## TABLE VII.4 CONSTRUCTION COST FOR MUKOH

Damsite : MUKOH
Development Type : RUN-OF-RIVER
Installed Capacity = 1,942 KW Qmax = 7.40 CMS
Dam height, crest length, bottom width (m) : 7, 60, 50
Headrace tunnel = 1,660 m
Penstock length = 40 m

*** CONSTRUCTION COST ( Units : M$,1986 : 1US$=2.6NT$ )

| Item | Unit | Q'ty | Unit Cost | Amts(M$'000) |
|---|---|---|---|---|
| 1. INTAKE WEIR | | | | |
| a. Excavation | cum | 3,744 | 25 | 94 |
| b. Concrete | cum | 1,020 | 350 | 357 |
| c. Gate | ton | 4 | 15,000 | 61 |
| | | | Sum+20%= | 614 |
| 2. INTAKE | | | | |
| a. Excavation | cum | 565 | 20 | 11 |
| b. Concrete | cum | 279 | 370 | 103 |
| c. Reinf. Bar | ton | 11 | 1,600 | 18 |
| d. Gate | ton | 12.8 | 15,000 | 192 |
| | | | Sum+20%= | 389 |
| 3. SAND-TRAP BASIN | | | | |
| a. Excavation | cum | 2,692 | 20 | 54 |
| b. Concrete | cum | 852 | 370 | 315 |
| c. Reinf. Bar | ton | 85 | 1,600 | 136 |
| d. Gate | ton | 2.0 | 15,000 | 30 |
| | | | Sum+20%= | 643 |
| 4. NON-PRESSURE TUNNEL Dia= 2.0 | | | | |
| a. Excavation | cum | 8,715 | 200 | 1,743 |
| b. Concrete | cum | 3,593 | 400 | 1,401 |
| c. Reinf. Bar | ton | 53 | 1,600 | 84 |
| | | | Sum+20%= | 3,974 |
| 5. HEAD TANK | | | | |
| a. Excavation | cum | 4,903 | 15 | 74 |
| b. Concrete | cum | 1,026 | 370 | 379 |
| c. Reinf. Bar | ton | 51 | 1,600 | 82 |
| | | | Sum+20%= | 777 |
| 6. PENSTOCK LINE Dia= 1.5 | | | | |
| a. Excavation | cum | 817 | 25 | 20 |
| b. Concrete | cum | 227 | 400 | 91 |
| c. Reinf. Bar | ton | 2 | 1,600 | 4 |
| d. Penstock | ton | 9.5 | 9,000 | 86 |
| | | | Sum+20%= | 241 |
| 7. POWERHOUSE | | | | |
| a. Excavation | cum | 5,173 | 15 | 78 |
| b. Concrete | cum | 522 | 360 | 188 |
| c. Reinf. Bar | ton | 38 | 1,600 | 61 |
| d. Building | cum | 1,475 | 300 | 442 |
| e. Gate | ton | 3.7 | 15,000 | 56 |
| | | | Sum+20%= | 990 |
| 8. GENERATING AND HYDRO-MECHANICAL EQUIPMENT | KW | 1,942 | 1,927 | 3,742 |
| 9. TRANSMISSION LINE | Km | 25 | 72,000 | 1,800 |
| 10. ACCESS ROAD | Km | 6 | 330,000 | 1,980 |
| 11. ROAD MAINT. | Km | 10 | 40,000 | 400 |
| 12. PREPARATORY WORKS (15%) | | | | 1,162 |
| 13. DIRECT CONSTRUCTION COST | | | | 16,832 |
| 14. ENGINEERING SERVICES AND ADMINISTRATION COST (10%) | | | | 1,683 |
| 15. CONTINGENCIES (15%) | | | | 2,777 |
| 16. TOTAL CONSTRUCTION COST | | | | 21,292 M$ |
| | | | | 8,189 US$ |

## TABLE VII.5 CONSTRUCTION COST FOR KAPIT-2

Damsite : KAPIT-2
Development Type : RESERVOIR ROCKFILL DAM
Installed Capacity = 4,189 KW FSL= 152.4 m Qmax= 13.2 CMS
Dam height, crest length, bottom width (m) : 56, 143, 30
Headrace tunnel = 300 m
Penstock length = 50 m
Diversion length = 400 m

*** CONSTRUCTION COST ( Units : M$,1986 : 1US$=2.6M$ )

| Item | Unit | Q'ty | Unit Cost | Amts(M$'000) |
|---|---|---|---|---|
| 1. DIVERSION WORKS | (Nos of TUNNEL= 1 ) | | | |
| a. Dam exca | cum | 4,285 | 6 | 26 |
| b. Embankmt | cum | 12,752 | 8 | 102 |
| c. Tnl exca | cum | 18,714 | 150 | 2,807 |
| d. Concrete | cum | 3,824 | 330 | 1,262 |
| e. Reinf. Bar | ton | 153 | 1,500 | 229 |
| f. Gate | ton | 19.6 | 10,000 | 196 |
| | | | Sum+20%= | 5,547 |
| 2. ROCKFILL DAM | | | | |
| a. Excavation | cum | 80,574 | 7 | 564 |
| b. Embankment | cum | 499,880 | 15 | 7,498 |
| | | | Sum+20%= | 9,675 |
| 3. SPILLWAY | | | | |
| a. Excavation | cum | 153,516 | 8 | 1,228 |
| b. Concrete | cum | 23,758 | 180 | 4,277 |
| c. Reinf. Bar | ton | 475 | 1,500 | 713 |
| d. Gate | ton | 231.0 | 15,000 | 3,465 |
| | | | Sum+20%= | 11,619 |
| 4. INTAKE | | | | |
| a. Excavation | cum | 3,046 | 15 | 46 |
| b. Concrete | cum | 1,371 | 260 | 356 |
| c. Reinf. Bar | ton | 41 | 1,500 | 62 |
| d. Gate | ton | 12.7 | 15,000 | 191 |
| | | | Sum+20%= | 765 |
| 5. PRESSURE TUNNEL | Dia= 2.4 | | | |
| a. Excavation | cum | 2,086 | 200 | 417 |
| b. Concrete | cum | 766 | 420 | 322 |
| c. Reinf. Bar | ton | 31 | 1,500 | 46 |
| | | | Sum+20%= | 942 |
| 6. SURGE TANK | | | | |
| a. Excavation | cum | 2,114 | 170 | 359 |
| b. Concrete | cum | 612 | 360 | 220 |
| c. Reinf. Bar | ton | 31 | 1,500 | 46 |
| | | | Sum+20%= | 751 |
| 7. PENSTOCK LINE | Dia= 1.7 | | | |
| a. Excavation | cum | 954 | 13 | 12 |
| b. Concrete | cum | 310 | 180 | 56 |
| c. Reinf. Bar | ton | 3 | 1,500 | 5 |
| d. Penstock | ton | 13.3 | 10,000 | 133 |
| | | | Sum+20%= | 247 |
| 8. POWERHOUSE | | | | |
| a. Excavation | cum | 2,962 | 18 | 53 |
| b. Concrete | cum | 1,058 | 220 | 233 |
| c. Reinf. Bar | ton | 55 | 1,500 | 83 |
| d. Building | cum | 2,363 | 300 | 709 |
| e. Gate | ton | 6.6 | 15,000 | 99 |
| | | | Sum+20%= | 1,412 |
| 9. GENERATING AND HYDRO-MECHANICAL EQUIPMENT | KW | 4,189 | 1,403 | 5,878 |
| 10. TRANSMISSION LINE | Km | 27 | 72,000 | 1,944 |
| 11. ACCESS ROAD | Km | 4 | 470,000 | 1,880 |
| 12. ROAD MAINT. | Km | 10 | 50,000 | 500 |
| 13. PREPARATORY WORKS (15%) | | | | 4,647 |
| 14. DIRECT CONSTRUCTION COST | | | | 45,826 |
| 15. COMPENSATION AND LAND ACQUISITION | Ha | 2 | 1,500 | 3 |
| 16. ENGINEERING SERVICES AND ADMINISTRATION COST | (10%) | | | 4,583 |
| 17. CONTINGENCIES | (15%) | | | 7,562 |
| 18. TOTAL CONSTRUCTION COST | | | | 57,973 M$ |
| | | | | 22,297 US$ |

## TABLE VII.6 CONSTRUCTION COST FOR PASIA

Damsite : PASIA
Development Type : RUN-OF-RIVER
Installed Capacity = 12,357 KW  Qmax = 5.30 CMS
Dam height, crest length, bottom width (m) : 6, 40, 30
Headrace tunnel = 3,800 m
Penstock length = 950 m

*** CONSTRUCTION COST ( Units : M₱,1986 : 1US$=2.6M₱ )

| Item | Unit | Q'ty | Unit Cost | Amts(M₱'000) |
|---|---|---|---|---|
| 1. INTAKE WEIR | | | | |
| a. Excavation | cum | 1,555 | 25 | 39 |
| b. Concrete | cum | 500 | 350 | 175 |
| c. Gate | ton | 3 | 15,000 | 52 |
| | | | Sum+20%= | 319 |
| 2. INTAKE | | | | |
| a. Excavation | cum | 983 | 20 | 20 |
| b. Concrete | cum | 465 | 370 | 172 |
| c. Reinf. Bar | ton | 19 | 1,600 | 30 |
| d. Gate | ton | 10.3 | 15,000 | 154 |
| | | | Sum+20%= | 451 |
| 3. SAND-TRAP BASIN | | | | |
| a. Excavation | cum | 4,192 | 20 | 84 |
| b. Concrete | cum | 1,327 | 370 | 491 |
| c. Reinf. Bar | ton | 66 | 1,600 | 106 |
| d. Gate | ton | 1.9 | 15,000 | 29 |
| | | | Sum+20%= | 852 |
| 4. NON-PRESSURE TUNNEL Dia= 1.8 | | | | |
| a. Excavation | cum | 16,886 | 200 | 3,377 |
| b. Concrete | cum | 7,221 | 400 | 2,888 |
| c. Reinf. Bar | ton | 108 | 1,600 | 173 |
| | | | Sum+20%= | 7,726 |
| 5. HEAD TANK | | | | |
| a. Excavation | cum | 4,002 | 15 | 60 |
| b. Concrete | cum | 1,409 | 370 | 521 |
| c. Reinf. Bar | ton | 42 | 1,600 | 67 |
| | | | Sum+20%= | 814 |
| 6. PENSTOCK LINE Dia= 1.1 | | | | |
| a. Excavation | cum | 14,745 | 25 | 369 |
| b. Concrete | cum | 4,488 | 400 | 1,795 |
| c. Reinf. Bar | ton | 45 | 1,600 | 72 |
| d. Penstock | ton | 450.4 | 9,000 | 4,054 |
| | | | Sum+20%= | 7,547 |
| 7. POWERHOUSE | | | | |
| a. Excavation | cum | 3,181 | 15 | 48 |
| b. Concrete | cum | 1,606 | 360 | 578 |
| c. Reinf. Bar | ton | 118 | 1,600 | 189 |
| d. Building | cum | 2,507 | 300 | 752 |
| e. Gate | ton | 2.7 | 15,000 | 40 |
| | | | Sum+20%= | 1,928 |
| 8. GENERATING AND HYDRO-MECHANICAL EQUIPMENT | KW | 12,357 | 503 | 6,221 |
| 9. TRANSMISSION LINE | Km | 110 | 240,000 | 25,400 |
| 10. ACCESS ROAD | Km | 20 | 450,000 | 9,000 |
| 11. ROAD MAINT. | Km | 15 | 40,000 | 600 |
| 12. PREPARATORY WORKS (15%) | | | | 2,945 |
| 13. DIRECT CONSTRUCTION COST | | | | 64,803 |
| 14. ENGINEERING SERVICES AND ADMINISTRATION COST (10%) | | | | 6,480 |
| 15. CONTINGENCIES (15%) | | | | 10,692 |
| 16. TOTAL CONSTRUCTION COST | | | | 81,976 M₱ |
| | | | | 31,529 US$ |

TABLE VII.7 CONSTRUCTION COST FOR MEDAMIT-2 (without pondage)

Damsite : MEDAMIT-2
Max MW= 4.57 MW Qmax = 9.10 cms Dam H,L,B (m): 6, 70, 40
Headrace= 4.4 Km Penstock= 130 m

| Item | Unit | Q'ty | Unit Cost | Amts(M$'000) |
|---|---|---|---|---|
| 1. INTAKE WEIR | | | | |
| a. Excavation | cum | 1,498 | 25 | 37 |
| b. Concrete | cum | 2,536 | 350 | 888 |
| c. Gate | ton | 5 | 15,000 | 68 |
| | | | Sum+20%= | 1,191 |
| 2. INTAKE | | | | |
| a. Excavation | cum | 1,813 | 20 | 36 |
| b. Concrete | cum | 881 | 370 | 326 |
| c. Reinf. Bar | ton | 35 | 1,600 | 56 |
| d. Gate | ton | 14.9 | 15,000 | 223 |
| | | | Sum+20%= | 770 |
| 3. SAND-TRAP BASIN | | | | |
| a. Excavation | cum | 6,287 | 20 | 126 |
| b. Concrete | cum | 1,991 | 370 | 737 |
| c. Reinf. Bar | ton | 100 | 1,600 | 159 |
| d. Gate | ton | 2.1 | 15,000 | 31 |
| | | | Sum+20%= | 1,264 |
| 4. NON-PRESSURE TUNNEL Dia= 2.2 | | | | |
| a. Excavation | cum | 27,881 | 200 | 5,576 |
| b. Concrete | cum | 11,163 | 400 | 4,465 |
| c. Reinf. Bar | ton | 167 | 1,600 | 268 |
| | | | Sum+20%= | 12,371 |
| 5. HEAD TANK | | | | |
| a. Excavation | cum | 5,559 | 15 | 83 |
| b. Concrete | cum | 2,070 | 370 | 766 |
| c. Reinf. Bar | ton | 58 | 1,600 | 93 |
| | | | Sum+20%= | 1,130 |
| 6. PENSTOCK LINE Dia= 1.8 | | | | |
| a. Excavation | cum | 3,209 | 25 | 80 |
| b. Concrete | cum | 858 | 400 | 343 |
| c. Reinf. Bar | ton | 9 | 1,600 | 14 |
| d. Penstock | ton | 44 | 9,000 | 392 |
| | | | Sum+20%= | 995 |
| 7. POWERHOUSE | | | | |
| a. Excavation | cum | 9,809 | 15 | 147 |
| b. Concrete | cum | 991 | 360 | 357 |
| c. Reinf. Bar | ton | 73 | 1,600 | 117 |
| d. Building | cum | 2,139 | 300 | 642 |
| e. Gate | ton | 5 | 15,000 | 68 |
| | | | Sum+20%= | 1,596 |
| 8. G/E & HYDROMECHA | KW | 4,571 | 1,169 | 5,343 |
| 9. TRANSMISSION LINE | Km | 60 | 160,000 | 9,600 |
| 10. ACCESS ROAD | Km | 1 | 260,000 | 260 |
| 11. ROAD MAINT. | Km | 15 | 40,000 | 600 |
| 12. PREPARATORY WORKS (15%) | | | | 2,898 |
| 13. DIRECT CONSTRUCTION COST | | | | 38,020 |
| 14. E/S & ADMI COST | (10%) | | | 3,802 |
| 15. CONTINGENCIES | (15%) | | | 6,273 |
| 16. TOTAL CONSTRUCTION COST | | | | 48,095 M$ |

## TABLE VII.8 CONSTRUCTION COST FOR MEDAMIT-2 (with pondage)

Damsite : MEDAMIT-2 with pondage
Development Type : RUN-OF-RIVER
Installed Capacity = 4,490 KW Qmax = 7.80 CMS
Dam height, crest length, bottom width (m) : 21, 102, 40
Headrace tunnel = 3,400 m
Penstock length = 130 m

*** CONSTRUCTION COST ( Units : M$,1986 : 1US$=2.6N$ )

| Item | Unit | Q'ty | Unit Cost | Amts(M$'000) |
|---|---|---|---|---|
| 1. INTAKE DAM | | | | |
| a. Excavation | cum | 2,790 | 12 | 33 |
| b. Concrete | cum | 5,080 | 260 | 1,321 |
| c. Gate | ton | 84 | 15,000 | 1,264 |
| | | | Sum+20%= | 3,141 |
| 2. INTAKE | | | | |
| a. Excavation | cum | 1,656 | 20 | 33 |
| b. Concrete | cum | 802 | 370 | 297 |
| c. Reinf. Bar | ton | 32 | 1,600 | 51 |
| d. Gate | ton | 14.1 | 15,000 | 211 |
| | | | Sum+20%= | 731 |
| 3. SAND TRAP BASIN | | | | |
| a. Excavation | cum | 5,601 | 20 | 112 |
| b. Concrete | cum | 1,774 | 370 | 656 |
| c. Reinf. Bar | ton | 89 | 1,600 | 142 |
| d. Gate | ton | 2.1 | 15,000 | 32 |
| | | | Sum+20%= | 1,131 |
| 4. PRESSURE TUNNEL Dia= 2.3 | | | | |
| a. Excavation | cum | 30,390 | 200 | 6,078 |
| b. Concrete | cum | 12,119 | 400 | 4,848 |
| c. Reinf. Bar | ton | 182 | 1,600 | 291 |
| | | | Sum+20%= | 13,460 |
| 5. SURGE TANK | | | | |
| a. Excavation | cum | 2,415 | 120 | 290 |
| b. Concrete | cum | 695 | 400 | 280 |
| c. Reinf. Bar | ton | 35 | 1,600 | 56 |
| | | | Sum+20%= | 750 |
| 6. PENSTOCK LINE Dia= 1.7 | | | | |
| a. Excavation | cum | 3,018 | 25 | 75 |
| b. Concrete | cum | 816 | 400 | 326 |
| c. Reinf. Bar | ton | 8 | 1,600 | 13 |
| d. Penstock | ton | 43.6 | 9,000 | 392 |
| | | | Sum+20%= | 968 |
| 7. POWERHOUSE | | | | |
| a. Excavation | cum | 9,207 | 15 | 138 |
| b. Concrete | cum | 930 | 360 | 335 |
| c. Reinf. Bar | ton | 68 | 1,600 | 109 |
| d. Building | cum | 2,011 | 300 | 604 |
| e. Gate | ton | 3.9 | 15,000 | 59 |
| | | | Sum+20%= | 1,491 |
| 8. GENERATING AND HYDRO-MECHANICAL EQUIPMENT | KW | 4,490 | 1,123 | 5,044 |
| 9. TRANSMISSION LINE | Km | 60 | 160,000 | 9,600 |
| 10. ACCESS ROAD | Km | 1 | 260,000 | 260 |
| 11. ROAD MAINT. | Km | 15 | 40,000 | 600 |
| 12. PREPARATORY WORKS (15%) | | | | 3,248 |
| 13. DIRECT CONSTRUCTION COST | | | | 40,407 |
| 14. ENGINEERING SERVICES AND ADMINISTRATION COST | (10%) | | | 4,041 |
| 15. CONTINGENCIES | (15%) | | | 6,667 |
| 16. TOTAL CONSTRUCTION COST | | | | 51,115 N$ |
| | | | | 19,660 US$ |

# APPENDIX VIII

# DATA ON EXISTING POWER PLANTS AND TRANSMISSION LINE

## LIST OF TABLES



## LIST OF TABLES

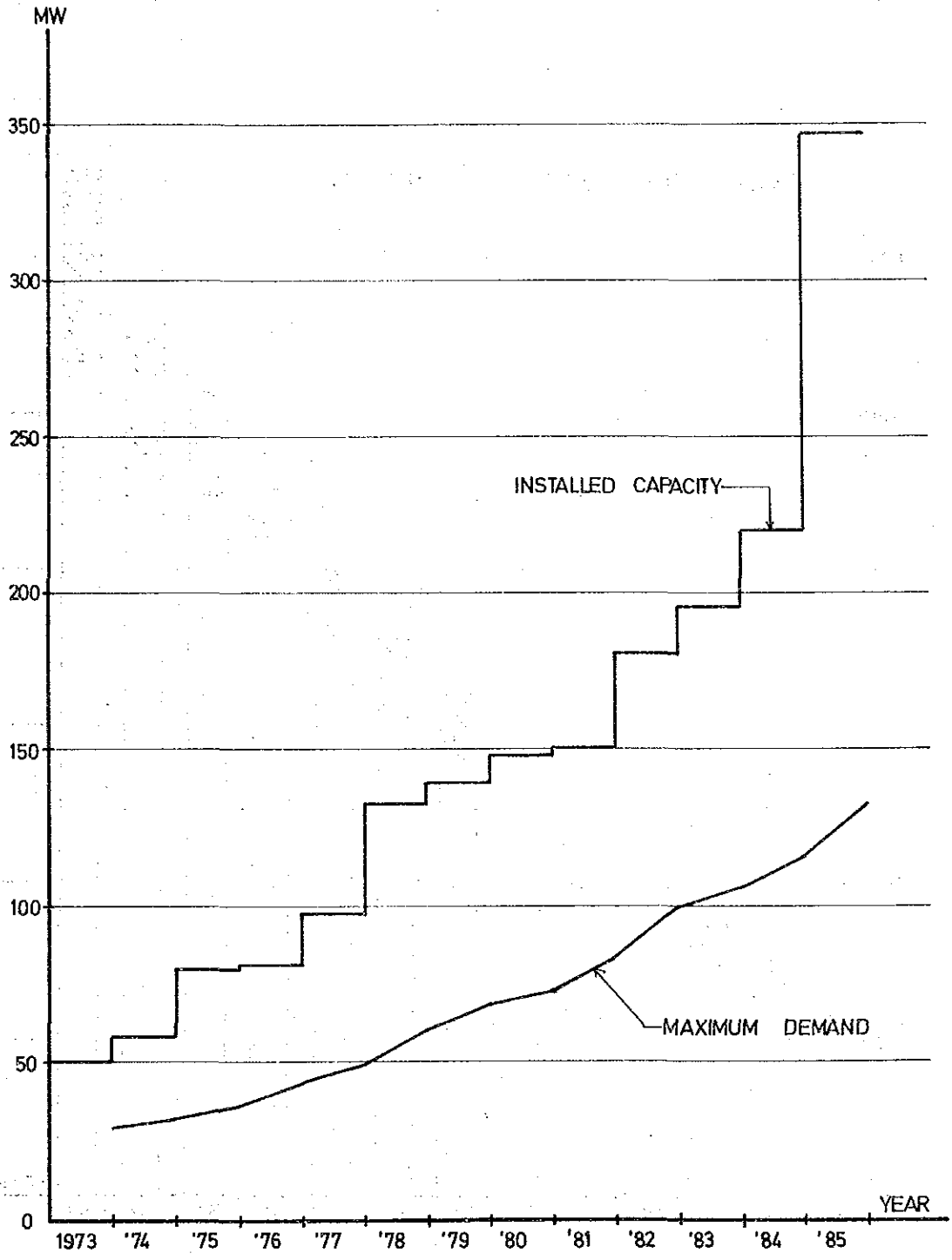



Fig.VIII.1 Installed Capacity and Maximum Demand for Whole Sarawak

GOVERNMENT OF MALAYSIA
FEASIBILITY STUDY
SMALL SCALE HYDROELECTRIC POWER PROJECT IN SARAWAK
JAPAN INTERNATIONAL COOPERATION AGENCY

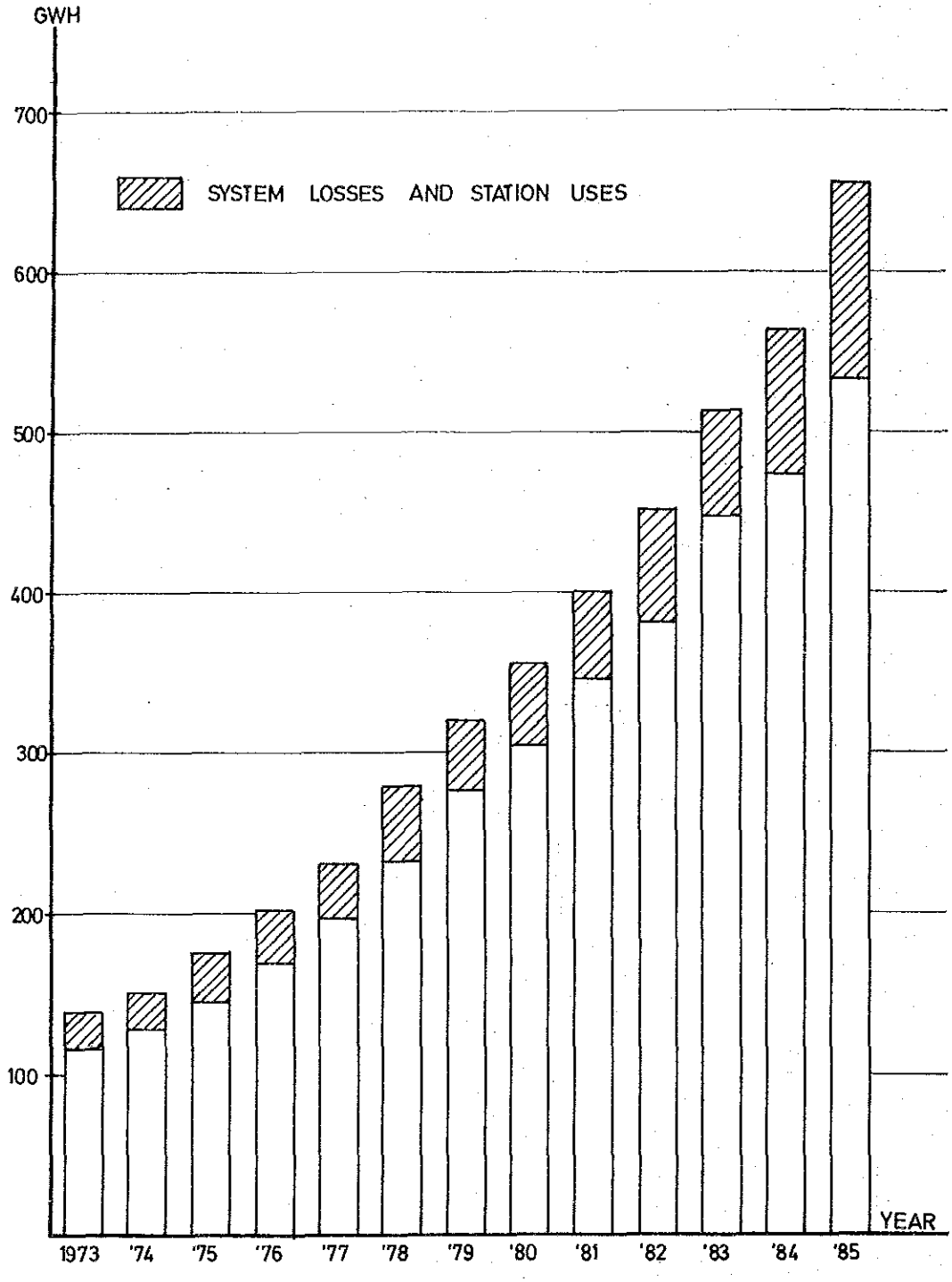
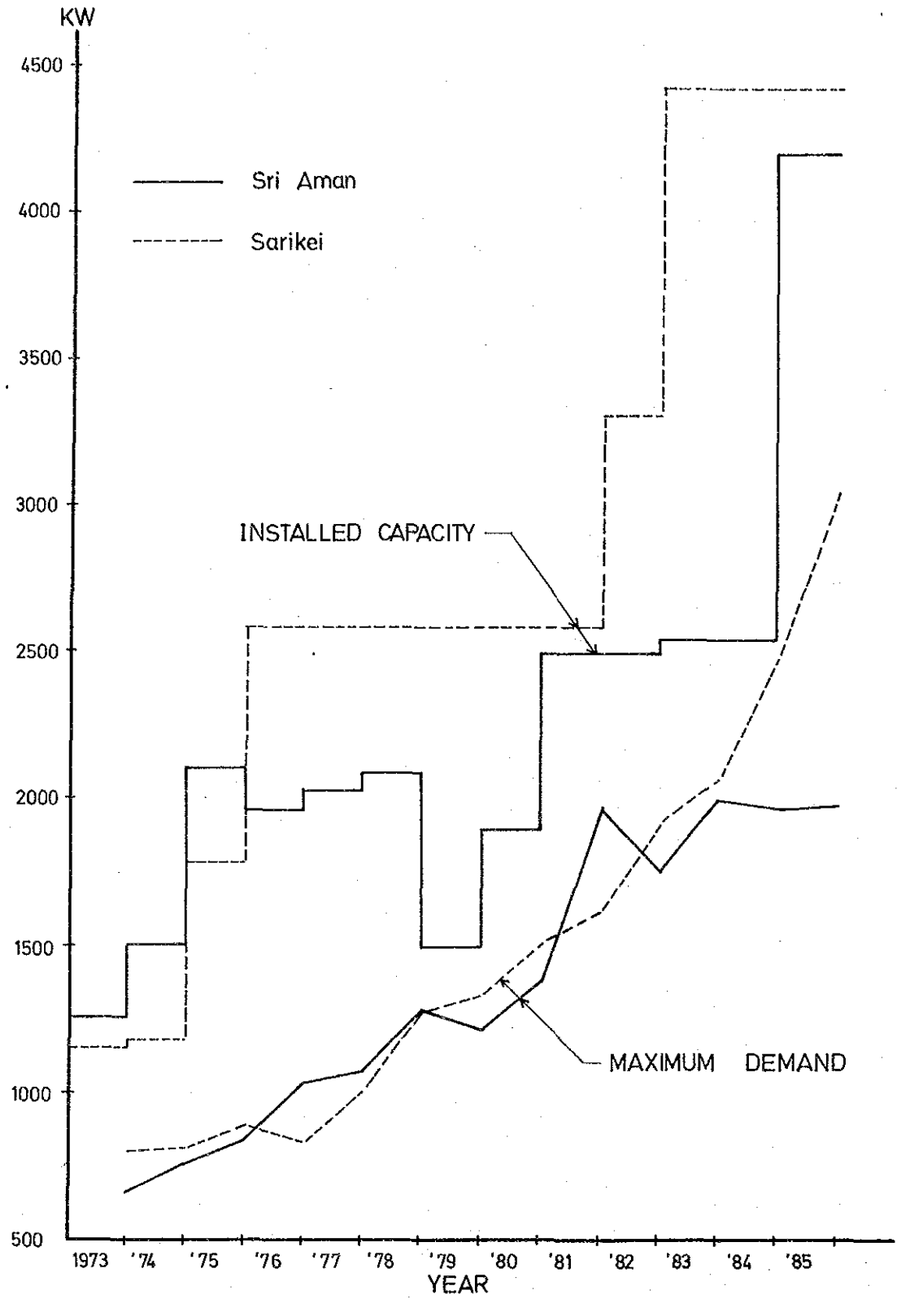



Fig.VIII.2 Energy Generated and Sold for Whole Sarawak

GOVERNMENT OF MALAYSIA
FEASIBILITY STUDY
SMALL SCALE HYDROELECTRIC POWER PROJECT IN SARAWAK
JAPAN INTERNATIONAL COOPERATION AGENCY



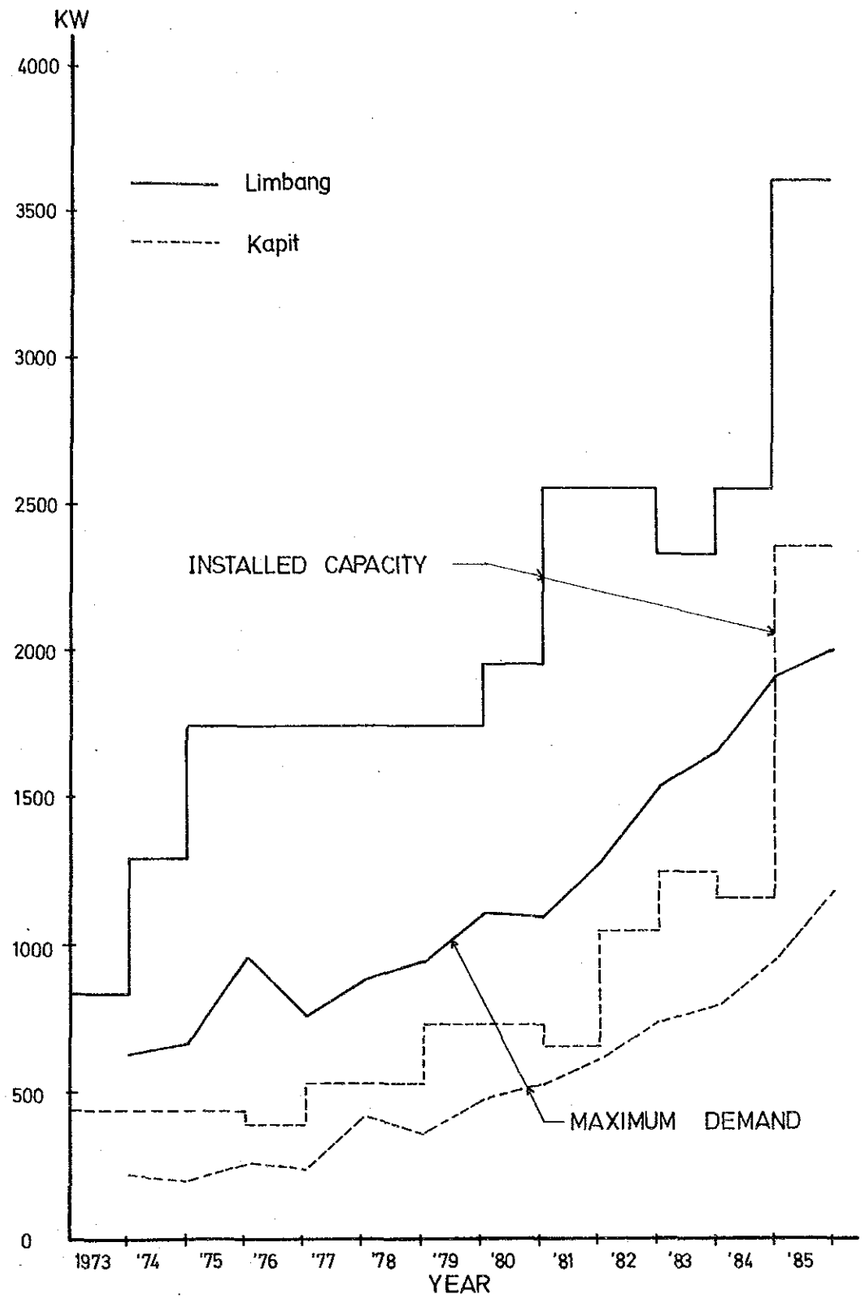




Fig.VIII.3 Installed Capacity and Max. Demand in the Selected 4 Load Centers

GOVERNMENT OF MALAYSIA
FEASIBILITY STUDY
SMALL SCALE HYDROELECTRIC POWER PROJECT IN SARAWAK
JAPAN INTERNATIONAL COOPERATION AGENCY

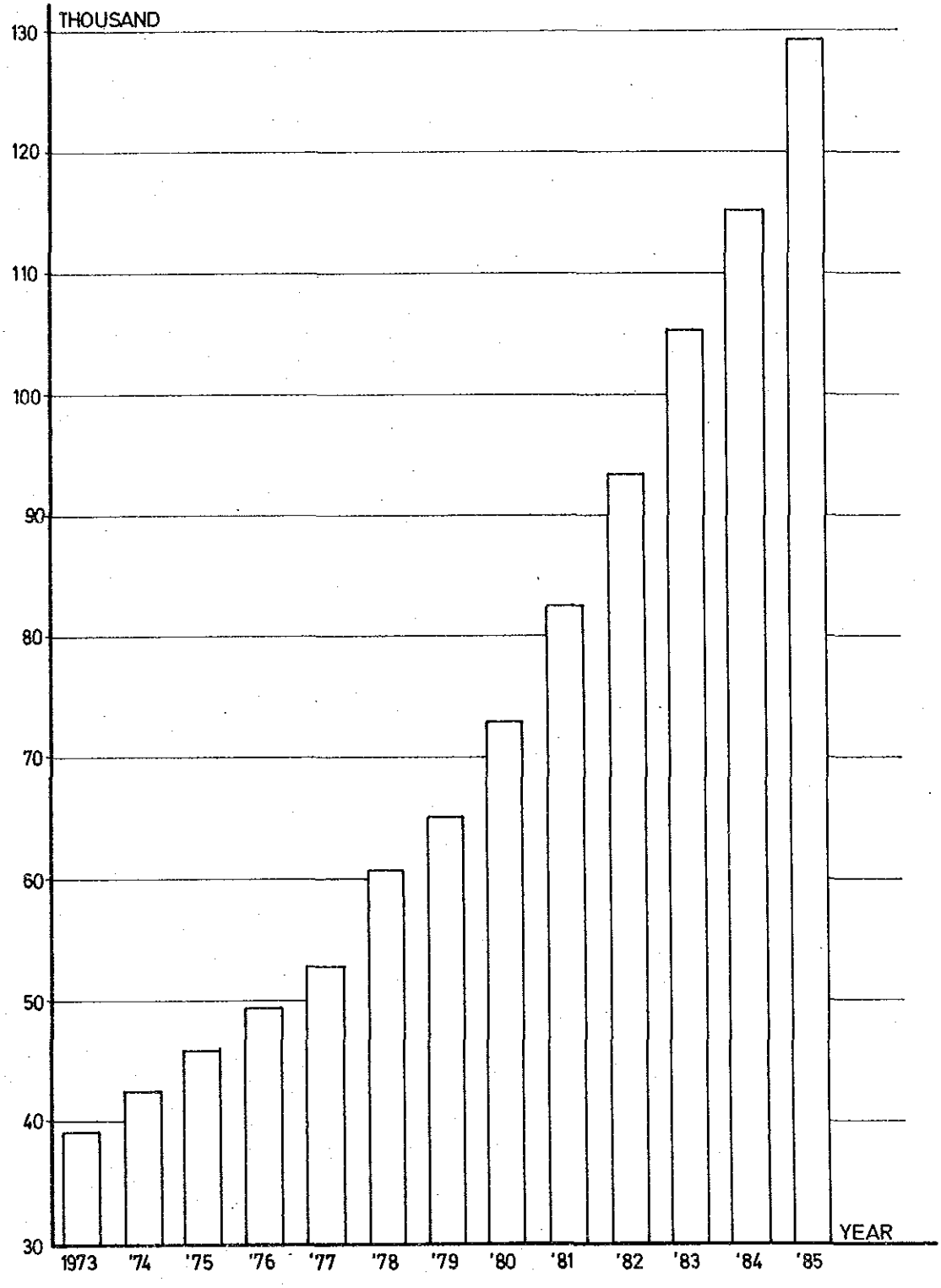



Fig.VIII.4 Number of Consumers for Whole Sarawak

GOVERNMENT OF MALAYSIA
FEASIBILITY STUDY
SMALL SCALE HYDROELECTRIC POWER PROJECT IN SARAWAK
JAPAN INTERNATIONAL COOPERATION AGENCY

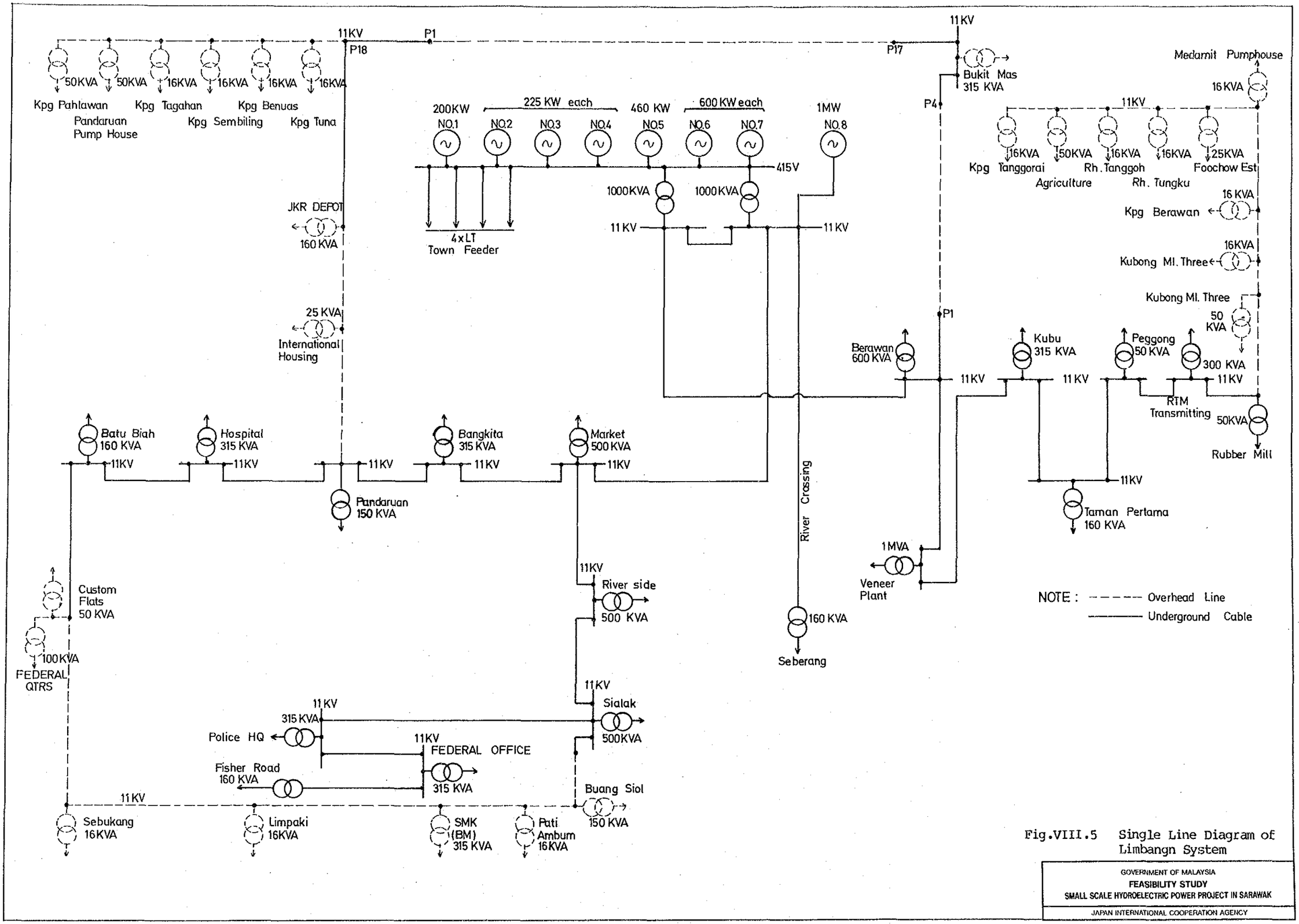



Fig.VIII.5 Single Line Diagram of Limbangn System

GOVERNMENT OF MALAYSIA
FEASIBILITY STUDY
SMALL SCALE HYDROELECTRIC POWER PROJECT IN SARAWAK
JAPAN INTERNATIONAL COOPERATION AGENCY

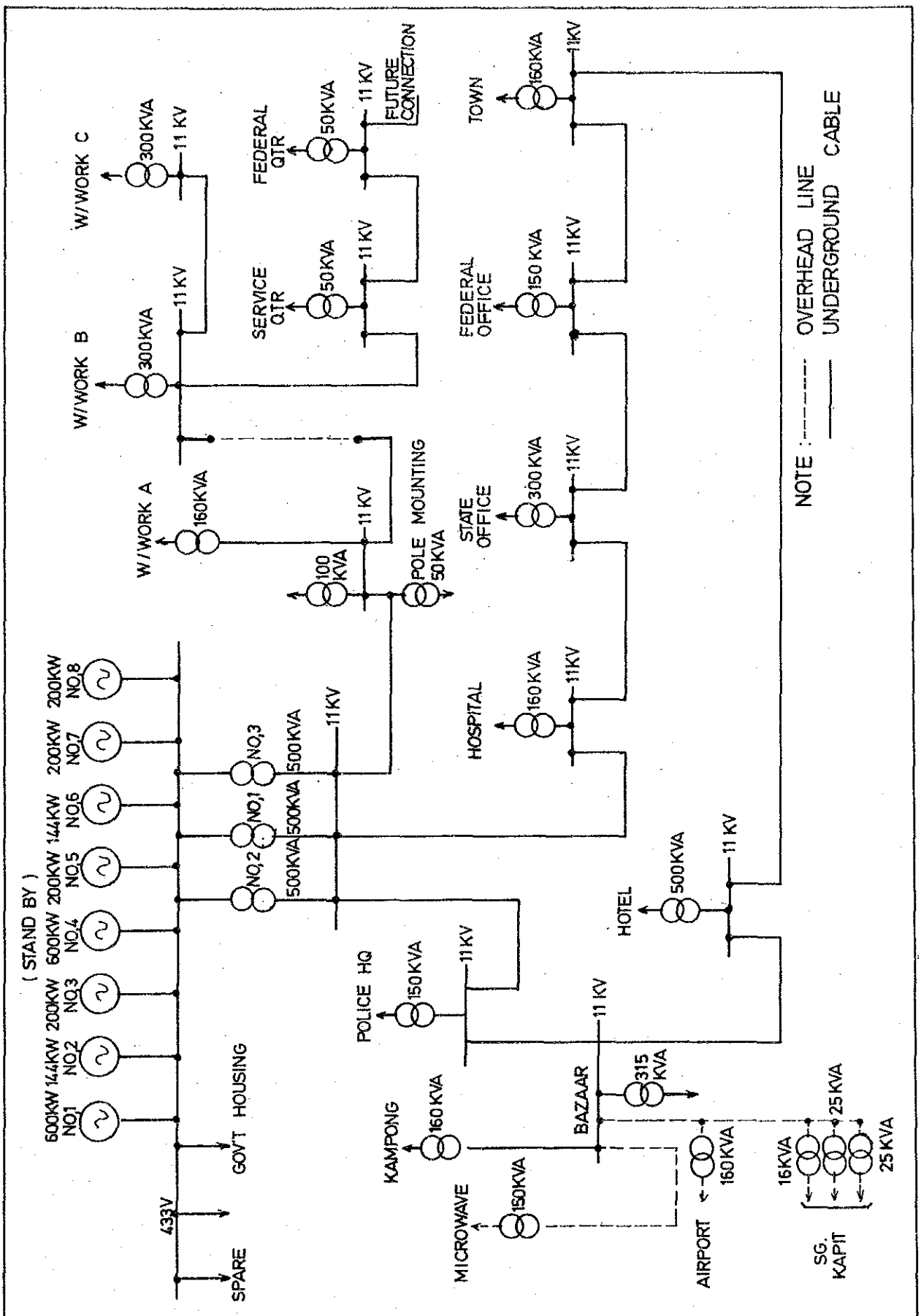



Fig.VIII.6 Single Line Diagram of Kapit

GOVERNMENT OF MALAYSIA
FEASIBILITY STUDY
SMALL SCALE HYDROELECTRIC POWER PROJECT IN SARAWAK
JAPAN INTERNATIONAL COOPERATION AGENCY

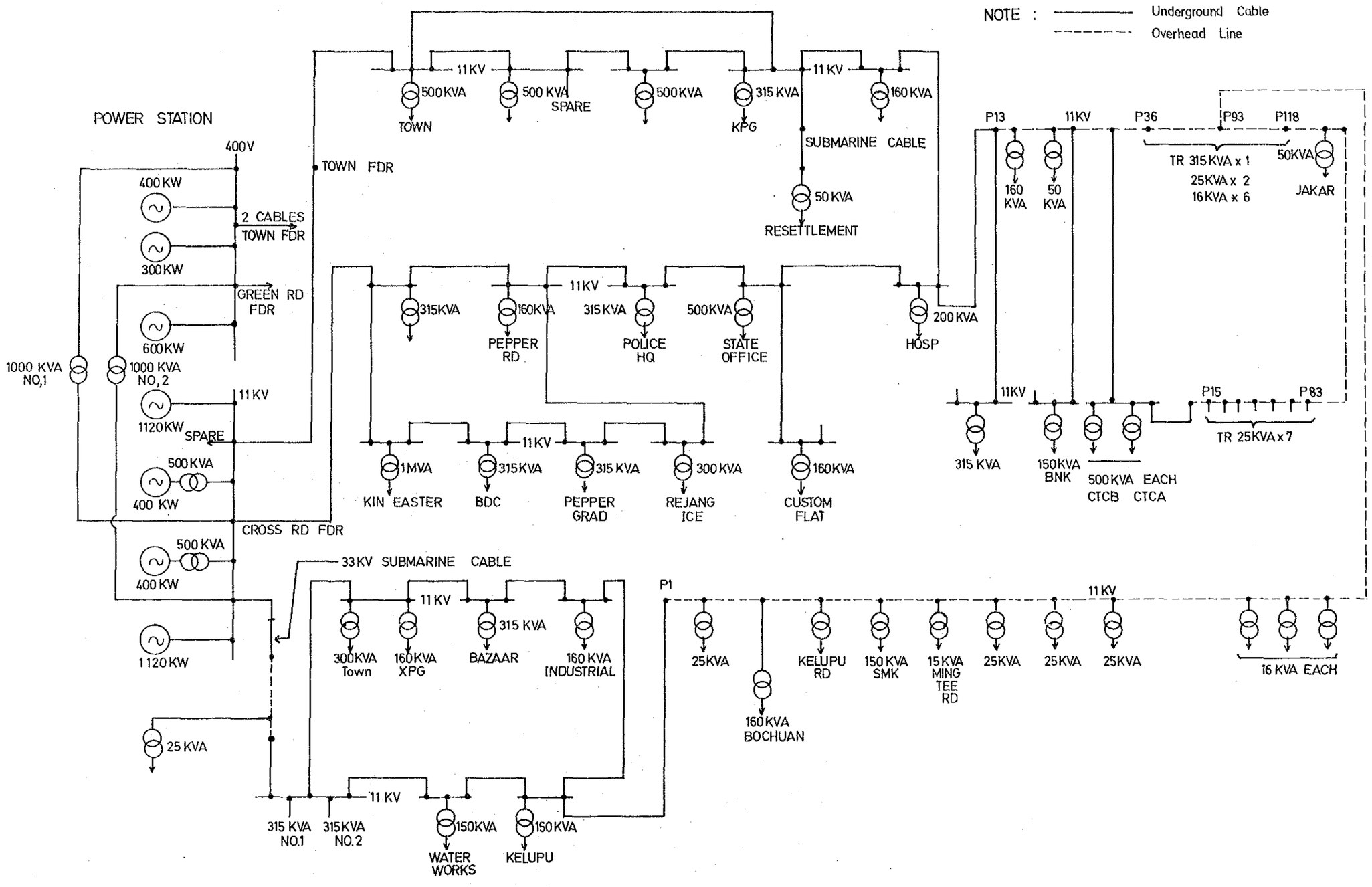



Fig.VIII.7 Single Line Diagram of Sarikei

GOVERNMENT OF MALAYSIA
FEASIBILITY STUDY
SMALL SCALE HYDROELECTRIC POWER PROJECT IN SARAWAK
JAPAN INTERNATIONAL COOPERATION AGENCY

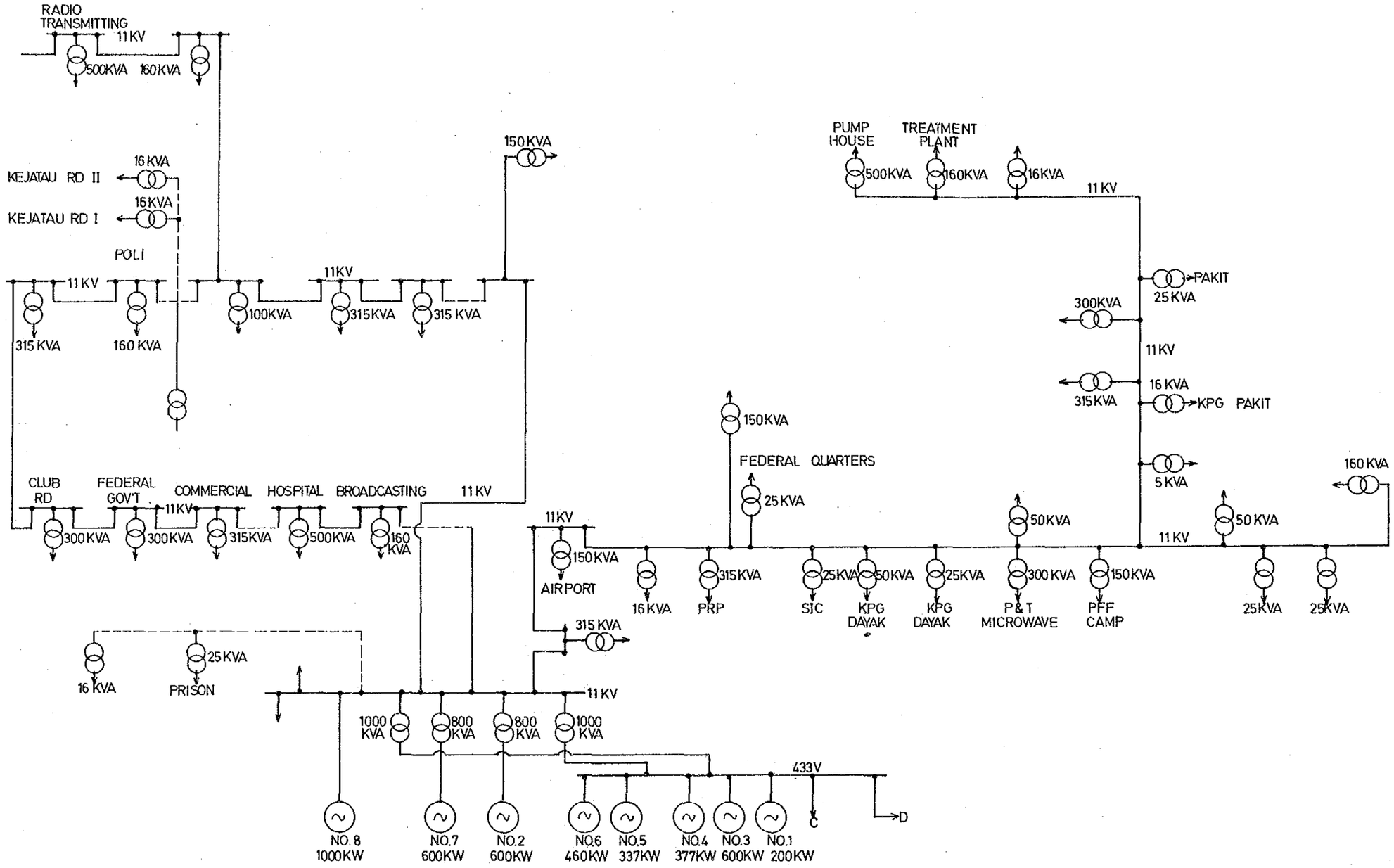



Fig.VIII.8 Single Line Diagram of Sri Aman

GOVERNMENT OF MALAYSIA
FEASIBILITY STUDY
SMALL SCALE HYDROELECTRIC POWER PROJECT IN SARAWAK
JAPAN INTERNATIONAL COOPERATION AGENCY

Fig.VIII.9 Limbang Daily Load Curve

GOVERNMENT OF MALAYSIA
FEASIBILITY STUDY
SMALL SCALE HYDROELECTRIC POWER PROJECT IN SARAWAK
JAPAN INTERNATIONAL COOPERATION AGENCY

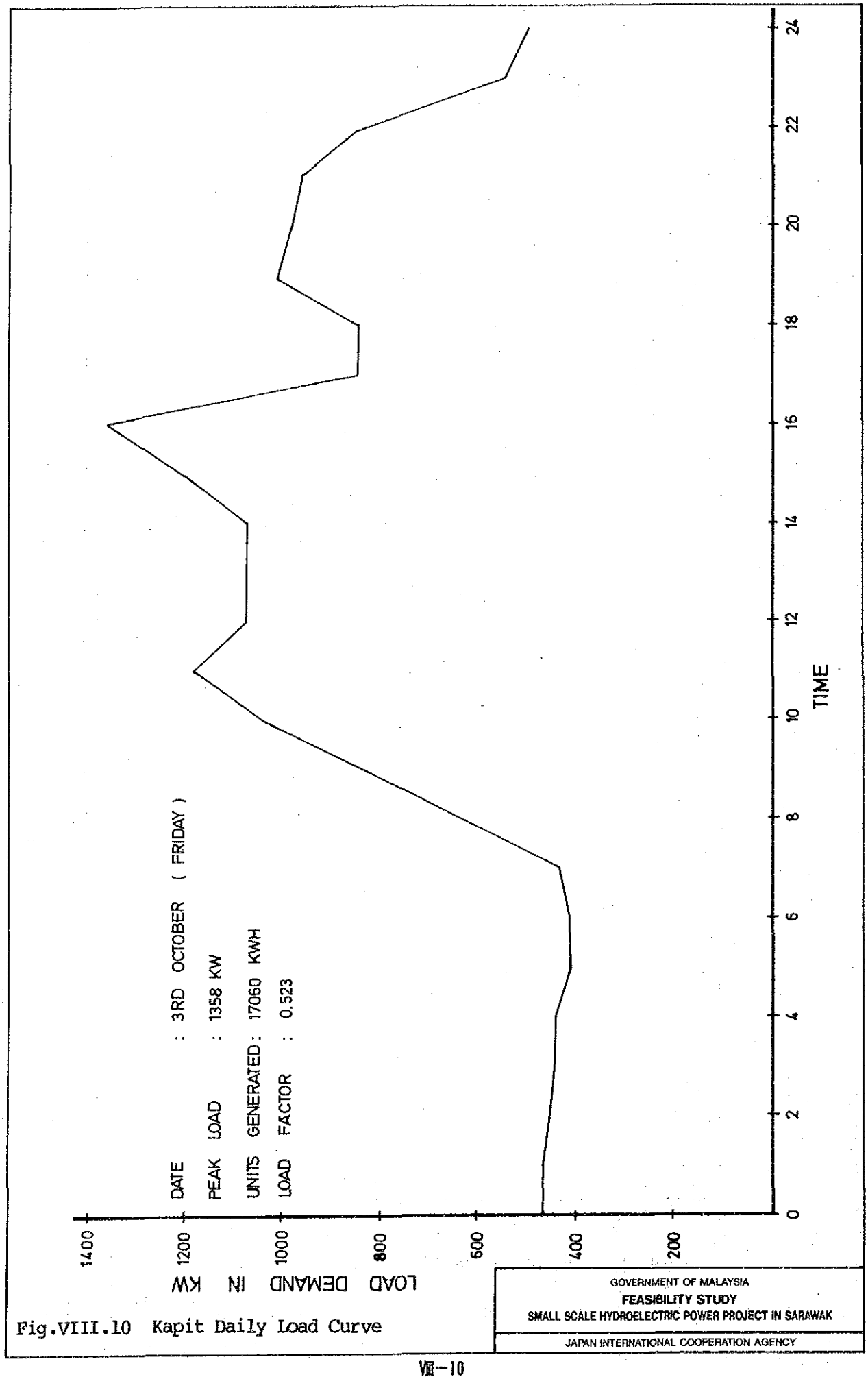



Fig.VIII.10 Kapit Daily Load Curve

GOVERNMENT OF MALAYSIA
FEASIBILITY STUDY
SMALL SCALE HYDROELECTRIC POWER PROJECT IN SARAWAK
JAPAN INTERNATIONAL COOPERATION AGENCY

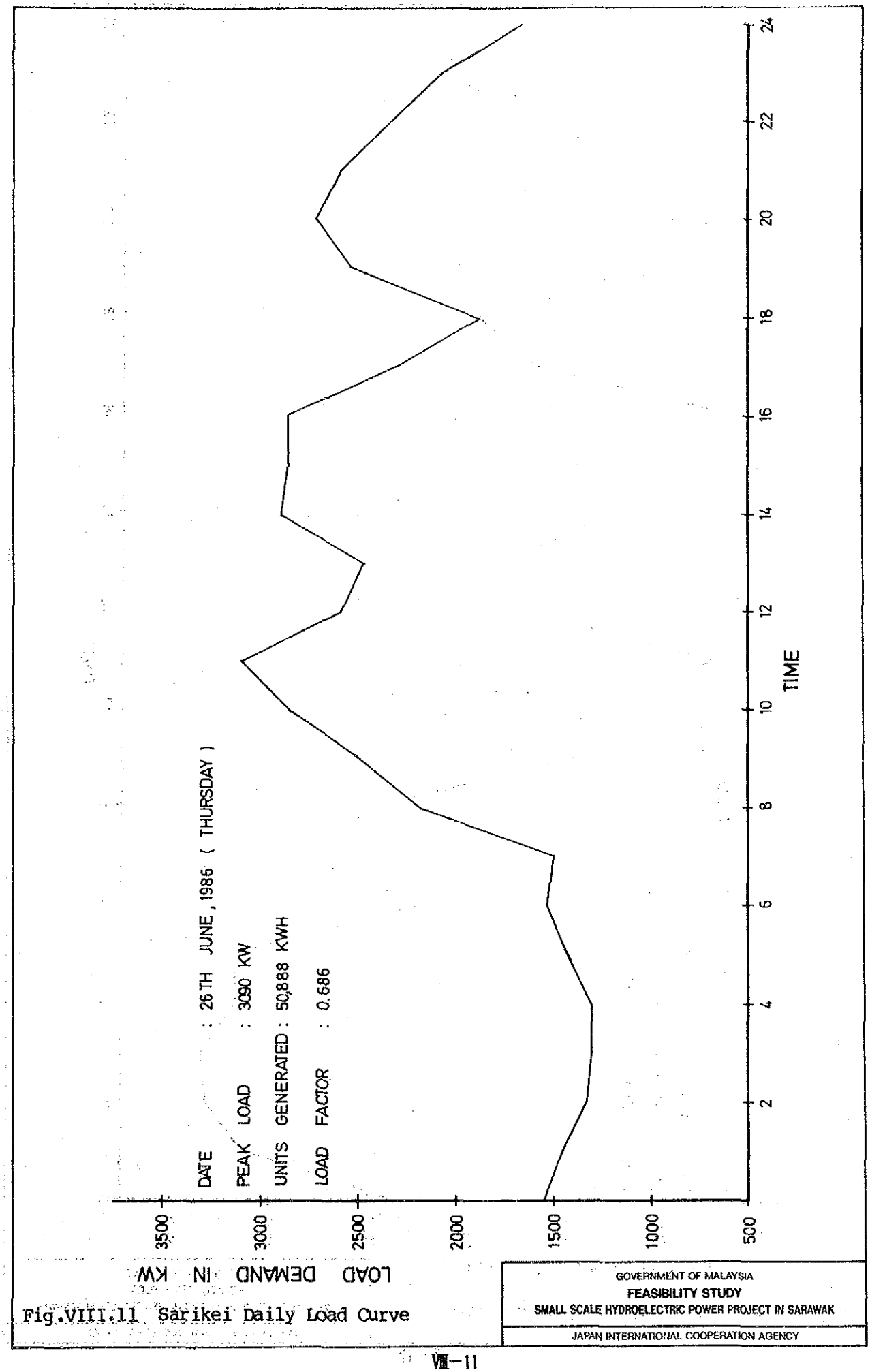



Fig.VIII.11 Sarikei Daily Load Curve

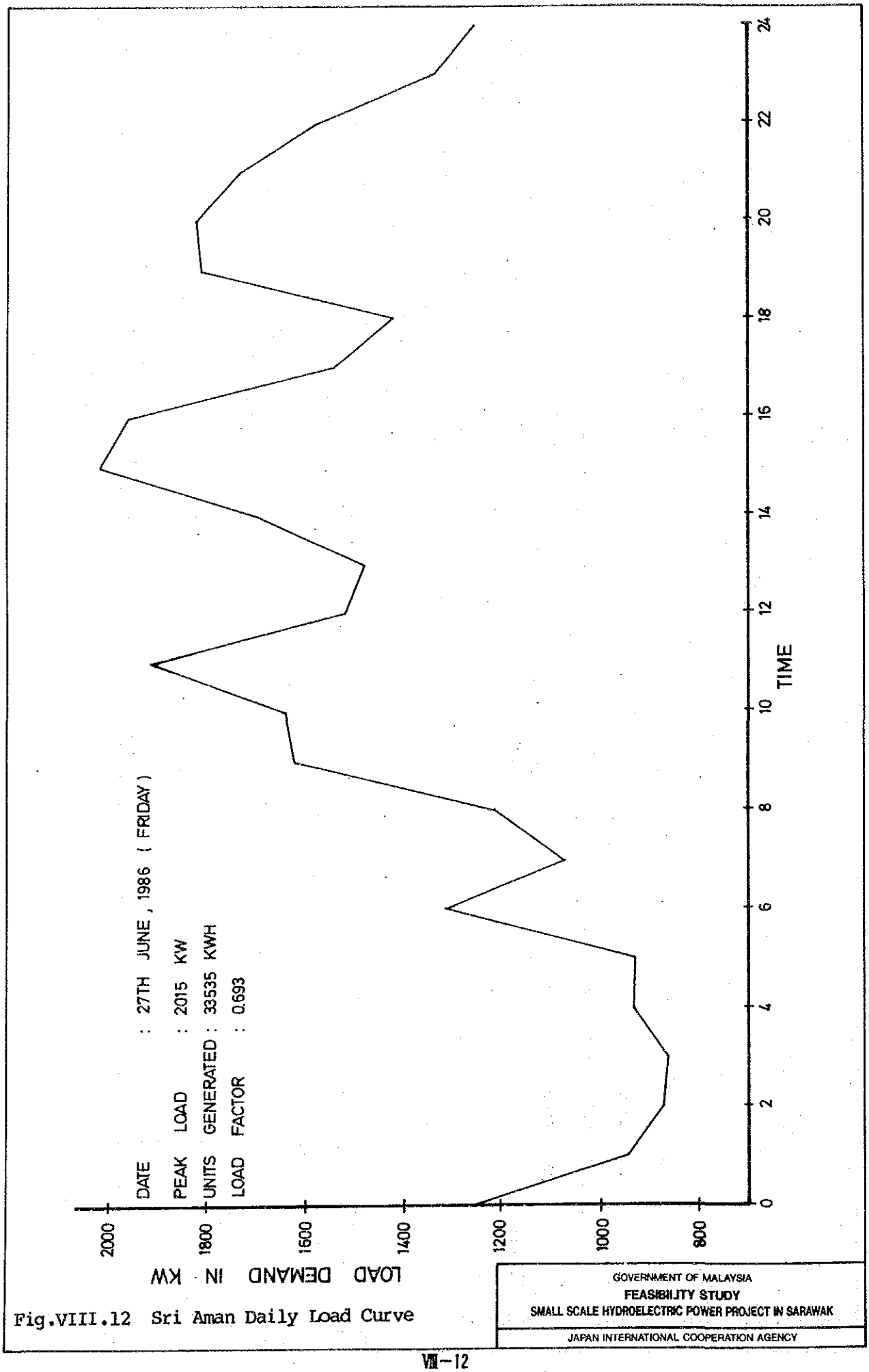



Fig.VIII.12 Sri Aman Daily Load Curve

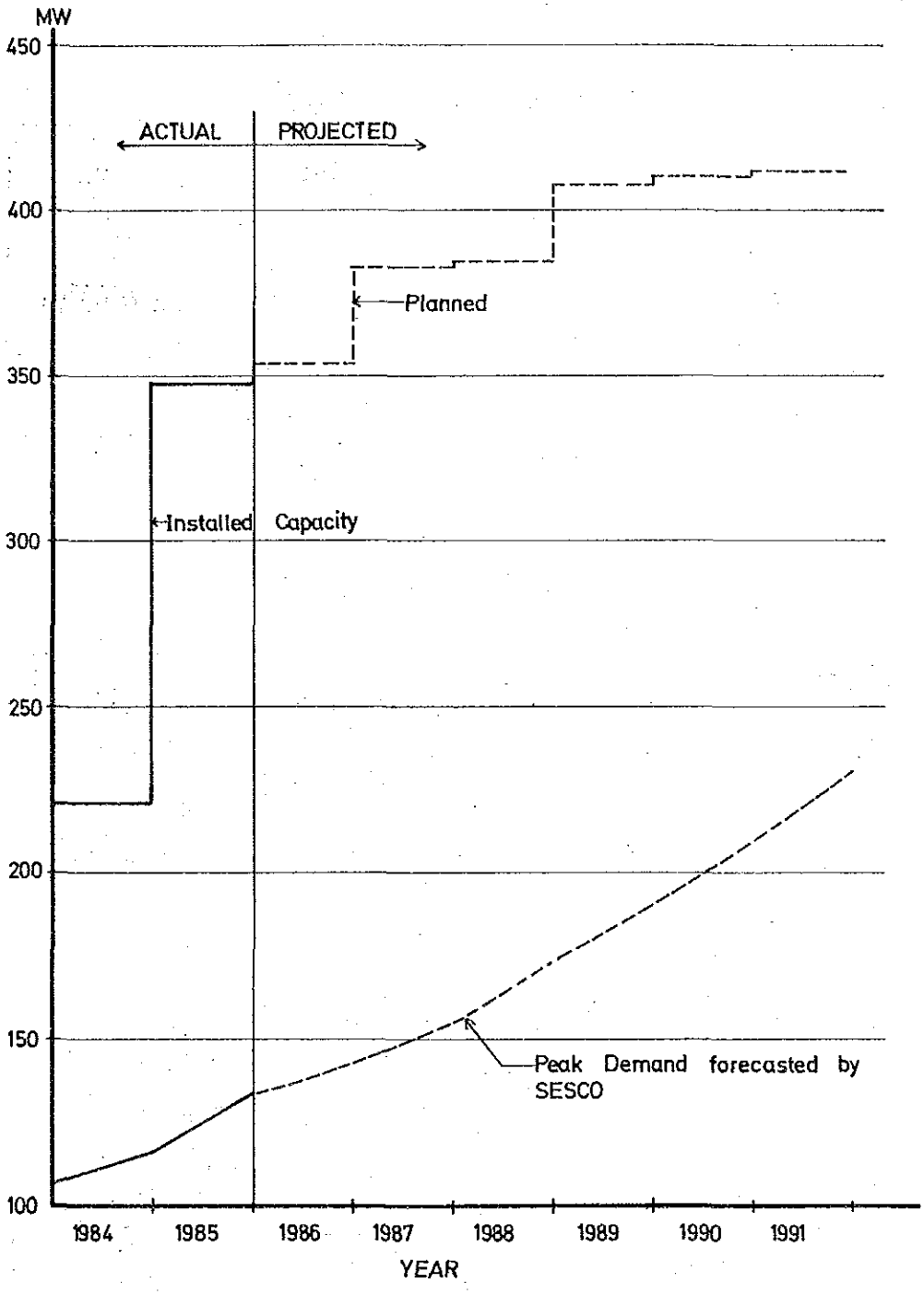



Fig.VIII.13 Relationship between Expansion Program and Forecasted Peak Demand

GOVERNMENT OF MALAYSIA
FEASIBILITY STUDY
SMALL SCALE HYDROELECTRIC POWER PROJECT IN SARAWAK
JAPAN INTERNATIONAL COOPERATION AGENCY

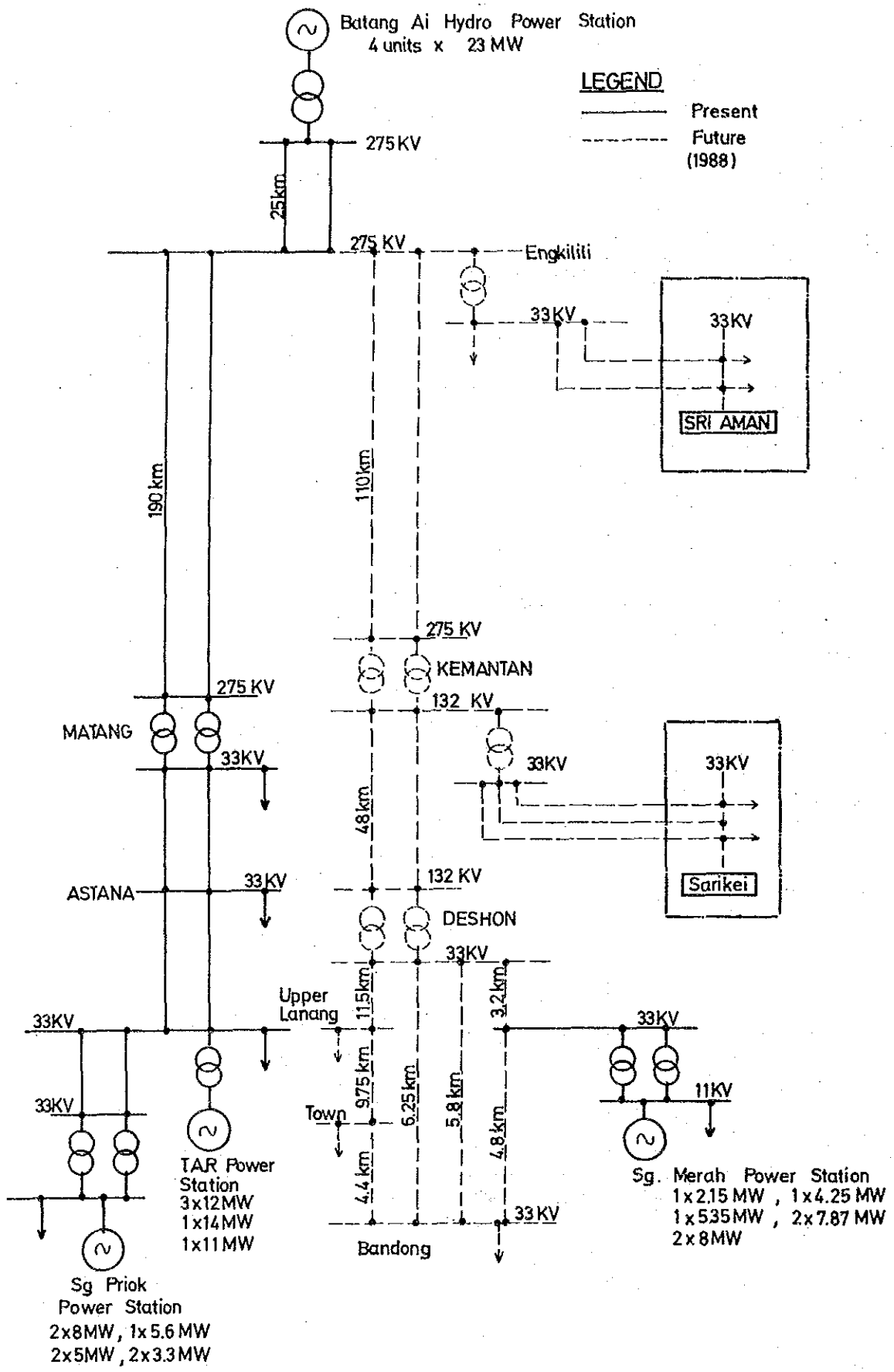



Fig.VIII.14 Kuching/Sibu System Line Diagram

GOVERNMENT OF MALAYSIA
FEASIBILITY STUDY
SMALL SCALE HYDROELECTRIC POWER PROJECT IN SARAWAK
JAPAN INTERNATIONAL COOPERATION AGENCY

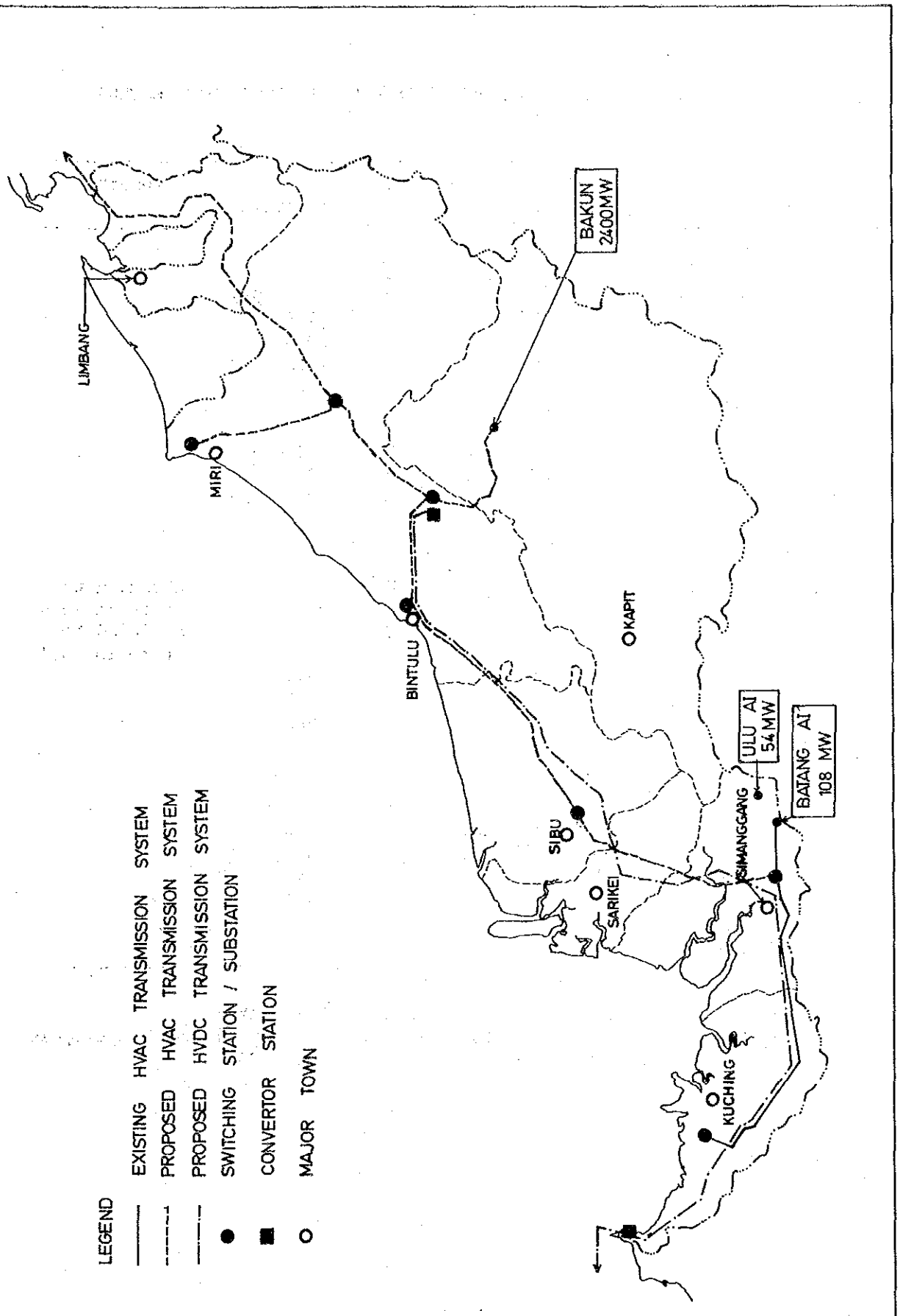



Fig.VIII.15 SESCO Electric Power System

GOVERNMENT OF MALAYSIA
FEASIBILITY STUDY
SMALL SCALE HYDROELECTRIC POWER PROJECT IN SARAWAK
JAPAN INTERNATIONAL COOPERATION AGENCY

TABLE VIII.1 EXISTING POWER FACILITIES IN FOUR LOAD CENTERS

| Load Center | Unit (No.) | kW Rating | Type | Use | Year Installed | Remarks |
|---|---|---|---|---|---|---|
| Sri Aman | 2 | 337 | D | B | - | |
| | 1 | 460 | D | B | - | |
| | 2 | 600 | D | B | 1976,1981 | |
| | 1 | 200 | D | B | 1978 | |
| | 1 | 1,050 | D | B | 1985 | |
| | 1 | 600 | D | P | 1985 | |
| (Total) | 8 | 4,184 | | | | |
| Sarikei | 3 | 400 | D | B | 1974-76 | |
| | 1 | 600 | D | B | 1975 | |
| | 2 | 1,120 | D | B | 1982,1983 | |
| (Total) | 6 | 4,040 | | | | |
| Kapit | 1 | 75 | D | B | - | Scheduled to retire in 1986 |
| | 2 | 144 | D | B | 1977 | Scheduled to retire in 1987 |
| | 4 | 200 | D | B | 1979-82 | |
| | 1 | 600 | D | B | 1985 | |
| | 1 | 600 | D | P | 1985 | |
| (Total) | 9 | 2,363 | | | | |
| Limbang | 3 | 225 | D | B | - | |
| | 1 | 460 | D | B | - | |
| | 2 | 600 | D | B | 1975,1981 | |
| | 1 | 200 | D | B | 1980 | |
| | 1 | 1,050 | D | B | 1985 | |
| (Total) | 8 | 3,585 | | | | |

Note : D : Diesel, B : Base, P : Peak
Source: SESCO, Data and Information on Small-Scale Hydropower Project in Sarawak, September 12, 1986.

# *APPENDIX IX*

## *DATA ON LOAD DEMAND FORECAST*

## LIST OF TABLES



## LIST OF TABLES

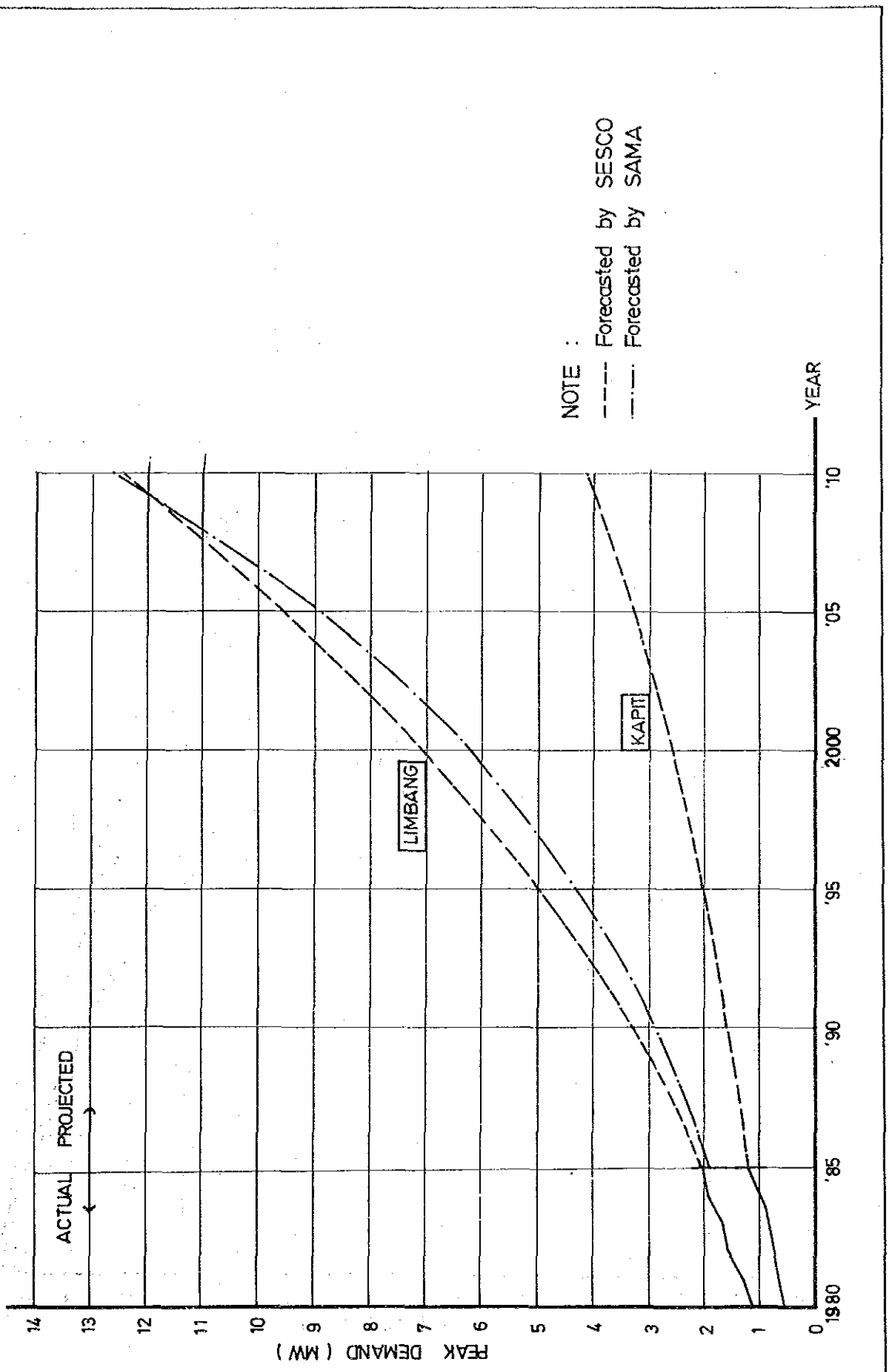



Fig. IX.1 Forecasted Peak Demand upto 2010
Limbang and Kapit

GOVERNMENT OF MALAYSIA
FEASIBILITY STUDY
SMALL SCALE HYDROELECTRIC POWER PROJECT IN SARAWAK
JAPAN INTERNATIONAL COOPERATION AGENCY

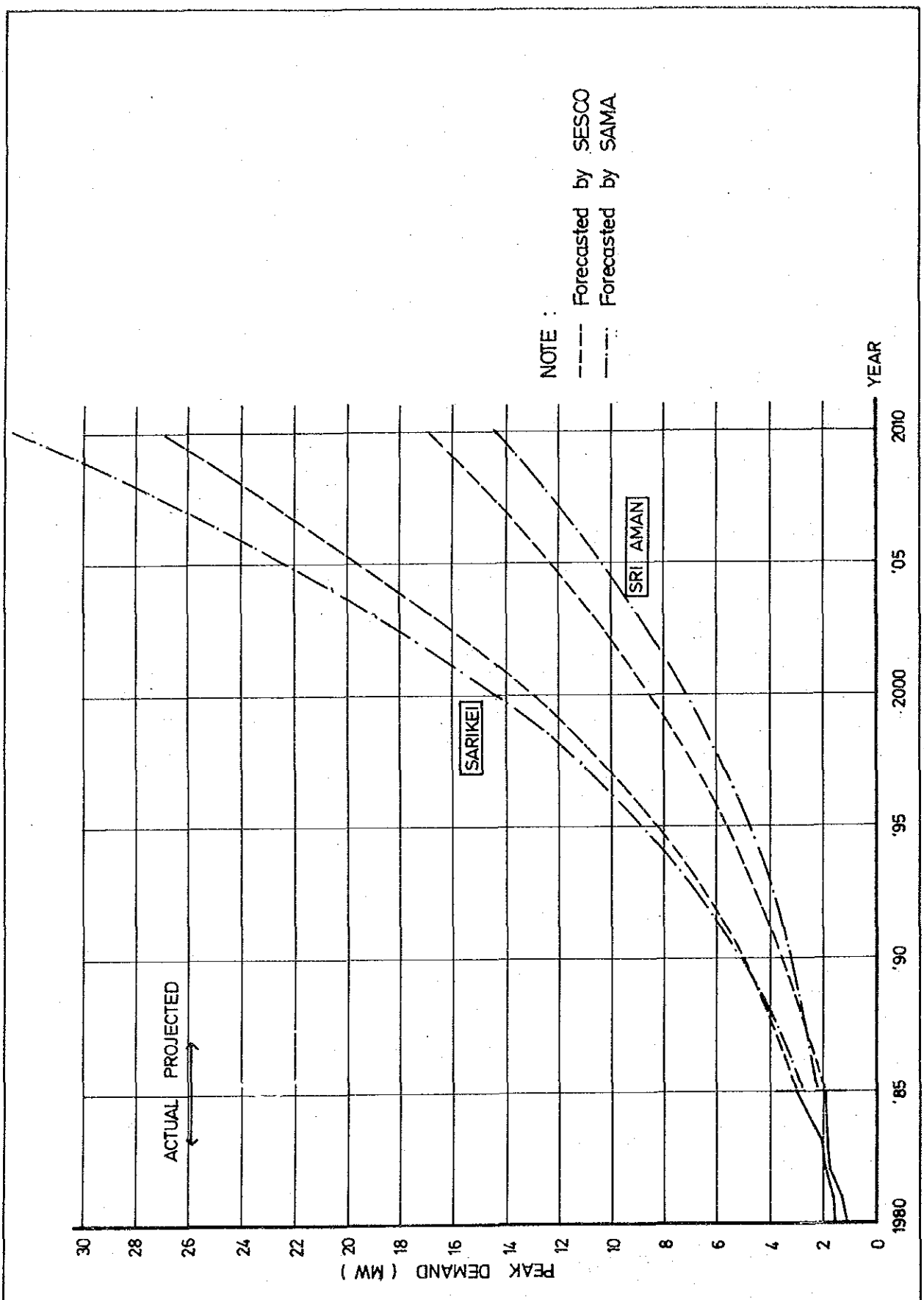



Fig. IX.2 Forecasted Peak Demand upto 2010
Sarikei and Sri Aman

GOVERNMENT OF MALAYSIA
FEASIBILITY STUDY
SMALL SCALE HYDROELECTRIC POWER PROJECT IN SARAWAK
JAPAN INTERNATIONAL COOPERATION AGENCY

TABLE IX.1 FORECASTED AGGREGATE POWER DEMAND (MW)
(SESCO's Forecast)

(Unit : MW)

| Year | Sri Aman | Sarikei | Kapit | Limbang |
|---|---|---|---|---|
| 1986 | 2.2 | 3.3 | 1.27 | 2.3 |
| 1987 | 2.5 | 3.6 | 1.34 | 2.5 |
| 1988 | 2.8 | 4.0 | 1.40 | 2.7 |
| 1989 | 3.1 | 4.5 | 1.47 | 2.9 |
| 1990 | 3.4 | 5.0 | 1.55 | 3.2 |
| 1991 | 3.8 | 5.5 | 1.63 | 3.6 |
| 1992 | 4.3 | 6.1 | 1.71 | 4.0 |
| 1993 | 4.9 | 6.8 | 1.80 | 4.3 |
| 1994 | 5.4 | 7.5 | 1.89 | 4.6 |
| 1995 | 5.9 | 8.2 | 1.98 | 5.0 |
| 2000 | 8.6 | 13.0 | 2.52 | 7.0 |
| 2010 | 16.9 | 27.0 | 4.11 | 12.4 |

Source : SESCO, Data and Information on Small-scale Hydroelectric Power Projects in Sarawak, September 12, 1986.

TABLE IX.2 FORECASTED ENERGY GENERATION (GWh)
(SESCO's Forecast)

(Unit : GWh)

| Year | Sri Aman | Sarikei | Kapit | Limbang |
|---|---|---|---|---|
| 1986 | 11.3 | 15.1 | 5.6 | 11.8 |
| 1987 | 12.4 | 16.6 | 5.9 | 12.7 |
| 1988 | 13.8 | 18.2 | 6.1 | 13.8 |
| 1989 | 15.3 | 20.8 | 6.4 | 15.0 |
| 1990 | 17.1 | 23.0 | 6.8 | 16.5 |
| 1991 | 19.1 | 25.7 | 7.1 | 18.2 |
| 1992 | 21.4 | 28.7 | 7.5 | 20.1 |
| 1993 | 23.7 | 32.0 | 7.9 | 21.7 |
| 1994 | 26.3 | 35.4 | 8.3 | 23.3 |
| 1995 | 29.2 | 39.0 | 8.7 | 25.0 |
| 2000 | 42.4 | 60.0 | 11.0 | 34.9 |
| 2010 | 83.3 | 126.4 | 18.0 | 61.8 |

Source : SESCO, Data and Information on Small-scale Hydroelectric Power Projects in Sarawak, September 12, 1986

Note : See Table 3.10 of Main Report for SESCO's expansion program towards 1991.