Section 3 Promotion of Off-grid Rural Electrification

Chapter 8

Environmental Impact Assessment (EIA)

8-1 Organizations and Legal Framework for EIA

8-1-1 Executing organizations

As for the environmental protection activities in Vietnam, the Ministry of Science, Technology and Environment (MOSTE) is the primarily responsible organization. In each province, the Department of Science, Technology and Environment (DOSTE) of PPC deals with day-to-day issues on environmental protection under the MOSTE. Thus, the MOSTE and DOSTE promote and instruct activities related to environmental conservation. They evaluate proposed projects from the viewpoint of environmental protection and approve them after confirming that the proposed projects satisfy all the requirements of environmental standards.

8-1-2 Legal framework

All the activities to protect the environment in Vietnam are performed based on the Environment Protection Law enacted in 1994. Under the Law, various regulations and guidelines have come into effect for implementation of conservation activities. The MOSTE has already introduced national environmental standards under the Law. In addition to the national standards, each province has its own environmental guidelines that take precedence over the national standards.

8-1-3 Process of EIA

MOSTE categorizes development projects into two groups according to project type and scale defined in "the Guideline on Setting Up and Appraising the Environmental Impact Assessment Report for Investment Project."

Category 1: Large-scale projects affecting the environment substantially. For example, reservoir type hydropower stations with a reservoir capacity of 100 million cubic meters or more, thermal power stations with an installed capacity of 200MW or more, and nuclear power stations come under this category.

Category 2: Other projects

For the implementation of Category 1 projects, project planners shall submit the EIA Report, which clarifies current conditions of development sites, and possible impact(s) on the environment and evaluation, to the authorities for approval. For Category 2 projects, project planners shall assess the environmental impacts by themselves and then apply for "the Registration for Securing Environmental Standards (RSES)" to the authorities.

The MOSTE and DOSTE assess the environmental impacts depending on project scale and significance of impacts. As for hydropower generation, projects with a reservoir of 100 million m^3 or more are reviewed by the MOSTE and smaller projects are reviewed by the DOSTE. The MOSTE at the national level and PPC at the provincial level establish an Appraising Council of experts from related fields. After the Council checks and appraises the proposals based on the environmental standards, the Minister of MOSTE or PPC chairman makes the final decision to approve or to turn down the project.

8-2 EIA for Off-grid Projects

8-2-1 Environmental impacts of off-grid rural electrification

Off-grid rural electrification model plans proposed through this study use clean and renewable energy sources such as hydropower and solar power, which do not emit waste effluents, exhaust gases and other harmful substances. Obviously, electricity generated by renewable energy has far smaller impacts on nature than thermal or diesel power generation. (See Table 8-2-1) It can be said that the proposed off-grid projects will not cause serious environmental damage.

Table 8-2-1 Off-grid rural electrification and its impacts

Scheme	Characteristics	Environmental impacts
Village Hydro	-Utilization of existing irrigation canals for intake facilities and headrace -Small-size facilities	Due to small-scale development, overall impacts are small.
	-Small amount of water use ($Q < 0.2m^3/s$)	Minor changes in river flow and small impact on water utility and aquatic life
	-No change in irrigation water supply	No negative impact on agriculture
	-Buried penstock	No degradation of scenery
Village Solar	-PV panels and battery chargers will be installed at public facilities	Due to small-scale development, overall impacts are small.
	-No distribution lines	No degradation of scenery

8-2-2 EIA process for off-grid rural electrification

According to the MOSTE's regulations, our off-grid model plans fall into Category 2. The formal procedure on EIA, therefore, is to:

i) conduct self-assessment referring to the environmental guidelines,
ii) apply for RSES to the Provincial People's Committee, and
iii) go through a review by the DOSTE.

In reality, however, the necessity of RSES application is decided by PPC based on the scale of project. Many small projects are exempted from the RSES application. In any case, it would be necessary for the project implementers to assess the final project plan and explain the results to the DOSTE to obtain their understanding. The following table shows the environmental items to be considered when planning off-grid projects.

Table 8-2-2 Recommended environmental self-assessment

Potential environmental items to be considered	Impacts to be assessed
Land use	Change in use of project site, etc.
Water system	Change in water flow, route of spillway, etc.
Noise control	Use of heavy machinery near residential area
Forest reserve	Any changes made to preserved nature
Biological reserve	
Ecological reserve	
Preserved outstanding scenery	

8-3 Renewable Electricity and Mitigation of Global Warming

The global warming issue is becoming more and more important in the international community. An agreement to implement the Kyoto Protocol was reached at the COP7 (the 7th Conference of Parties to the Framework Convention on Climate Change) in November 2001 and the preparatory work toward the enactment of the protocol has been accelerated. Power generation based on renewable energy will be promoted from the viewpoint of reducing CO_2 emissions, and hence, mitigating global warming. Vietnam, having abundant renewable energy sources, will be able to take advantage of the Clean Development Mechanism (CDM) scheme that is stipulated in the Kyoto Protocol as a means of accelerating global CO_2 reduction.

The following example shows how much a modest micro hydropower station can save CO_2 emissions. To quantitatively analyze how renewable energy contributes to environmental preservation, fuel consumption of an equivalent thermal power station should be calculated to estimate the possible reduction of CO_2 emissions.

As shown above, compared with a 10kW-class diesel power generator, a 10kW micro hydropower station reduces CO_2 emissions by about 30 tons per year. Thus, rural electrification by using renewable energy sources would have a big impact on global warming. Off-grid rural electrification based on renewable electricity, therefore, is pushed from this viewpoint as well.

Assuming a 10kW diesel power station equivalent to a 10kW micro hydropower station, the annual CO_2 emissions of the diesel power station is calculated as follows.

Conditions: load factor : 40%, thermal efficiency : 30%

- Annual electricity generated by the diesel generator is,

  10kW × 8,760 hr/year × 40% = 35,040kWh

- Annual CO_2 emissions are,
  generated electricity /yr × 860kcal/kWh ÷ thermal efficiency
  × (4.1868 × 10^{-9})TJ/kcal × unit carbon emission by diesel oil
  × coefficient of carbon oxidization rate by diesel × molecular weight of CO_2
  ÷ molecular weight of carbon

  = 35,040 kWh/year × 860 kcal/kWh ÷ 30% × (4.1868 × 10^{-9})TJ/kcal
  × 20.2 t-C/TJ × 0.99 × 44 / 12

  = 30.8 t- CO_2/yr

Source: Intergovernmental Panel on Climate Change Guidelines

Chapter 9

Strategic Recommendations on Off-grid Rural Electrification

9-1 Obstacles in Promoting Off-grid Rural Electrification

So far, very few off-grid rural electrification projects have been actually implemented in Vietnam. The stagnant project undertakings can be attributed to the following points:

1) Systematic inventory survey on potential small hydro sites, which is the starting point of project planning, has not been conducted so far.
2) Organizational structure, from the provincial level to the district and commune level, and financing mechanism for planning and implementing off-grid rural electrification projects, have not been fully developed yet.
3) New technologies for micro hydropower and solar systems are not fully acquired by domestic manufacturers.

Table 9-1-1 summarizes the underlying problems.

Table 9-1-1 Difficulties in off-grid rural electrification

	Planning	Construction	Operation
Finance	Provincial budget is insufficient for survey and design	Using the 135 Program budget for off-grid projects is possible, but there are few cases so far. Financing by overseas donors is under preparation.	Regulated tariff in remote areas Micro-finance is unavailable.
Technology	PPC engineers are not fully aware of the technology.	Domestic technology development is not completed.	Domestic technology development is not completed.
Organization	Collaboration between PPC and EVN is weak.	Difficult to find a reliable and experienced contractor	Training programs for villagers are not developed. Support mechanism from outside is not developed.

In this study, after reviewing these problems and the socio-economic conditions of rural Vietnam in depth, a strategic plan for off-grid rural electrification by renewable energy resources is to be formulated. We have completed the creation of an un-electrified commune database and the formulation of off-grid model plans. Now we step forward to discuss how to smoothly implement off-grid projects.

The off-grid model plans we proposed include some new technologies, but Vietnam has a good technological base. Domestic manufacturers and contractors can quickly master necessary technologies for Village Hydro and Village Solar.

Financing small-scale off-grid projects requires only $10,000 to $20,000 in project costs. The villagers who benefit from off-grid power systems will pay some money for the electricity supply service, which can cover the operational costs at least. The GOV needs to provide a subsidy to buy down the capital cost. The balance of capital cost is to be borne by the villagers. This financial arrangement is quite feasible as long as rural development programs, such as the 135 Program, are applied. In addition, financial assistance from overseas donors will help to accelerate off-grid projects. We discussed with the JBIC and other relevant organizations to gain understanding on off-grid projects and to help materialize a workable financing scheme, which is strongly requested by the GOV. However, since the required budget is small, the GOV can start with their own programs without waiting for donors' assistance.

Based on these ideas, we strongly recommend that the GOV push small-scale off-grid projects, which we think fit the conditions of rural areas in northern Vietnam. Potential problems to be considered are related to human resources. We need to target PPC engineers, key players in off-grid rural electrification, in developing the strategic plan to accelerate off-grid projects. Also, the local villagers are underutilized. If adequate training is given, they can do a lot of work to take care of off-grid power systems. After commissioning, they need to manage the systems on their own anyway.

9-2 Strategy for Off-grid Rural Electrification

In order to promote off-grid renewable projects based on our model plans and to achieve the goal of off-grid rural electrification in northern Vietnam, it is recommended that the GOV and PPCs take actions as follows.

2002-2003 (Preparatory Stage)

Conduct pilot projects to train PPC engineers and develop the technical capability of domestic industries

Identify candidate communes and formulate development plans including design and financing

2004- (Implementation Stage)

Develop off-grid projects based on the formulated plans using funds from various sources. By doing this, PPC engineers can gain more experience and know-how on off-grid development.

Disseminate the off-grid technologies to help local people develop off-grid plans

It is unlikely that private companies will get into the off-grid market quickly because the expected investment is too large to recover quickly. Electricity tariffs in rural areas are virtually regulated even in the case of off-grid systems. Hence, the public sector is expected to play a key role for some time until the income level of rural farmers goes up. In this regard, PPC is responsible for implementing off-grid projects based on our model plans taking the local conditions and resources into consideration. Also, what we proposed in this report requires the strong commitment and hard work of local people. A lot of field work to convince and motivate the local leaders will be required to implement off-grid projects, but it will be rewarding in the long-run.

9-2-1 Financial arrangement

The recommended model plans are very small in terms of initial investment., which will range from $10,000 to $20,000. Therefore, the first choice of a financial source would be the 135 Program. There may be an approach to build a micro-hydro plant whenever an irrigation channel is constructed. Also, it would be possible to get financial assistance from the World Bank or JBIC in the future. The GOV is expected to accelerate the discussions on these financing programs and to set out a guideline on financial assistance for individual off-grid projects as soon as possible. The local communities need some subsidy to implement off-grid projects.

The appropriate rate of subsidy will be defined based on the estimation of revenue and expenses. The proposed scenario of rural people receiving a 50% subsidy and paying back the balance over 20 years would be achievable as long as the investment cost is reduced and the quality of system components is improved.

Also, the GOV needs to establish a micro-finance system to help those who cannot afford the one-time costs of electrification such as the connection charge or the purchase of electrical equipment or batteries. This will significantly improve the household electrification rate in remote areas.

9-2-2 Technology development

Technologies for off-grid rural electrification should be basic and simple, and developed from the existing technological base in Vietnam. The simple but robust design is the key to long-term sustainability. Of course, Vietnam lacks some new technologies that will be required for easy operation and maintenance of off-grid systems. Given the high technological potential in Vietnam, it would be quite possible that domestic manufacturers digest these new technologies and develop their own products.

As a first step, it is recommended to undertake pilot projects to demonstrate and disseminate technology. In these pilot projects, some leading manufacturers and contractors will be involved so that they can learn the required technologies quickly. Also, it is important to develop O&M manuals and related training programs so that off-grid system users can easily master the necessary know-how to run off-grid systems.

9-2-3 Organizational development

It is urgent to strengthen the planning capability of PPC engineers regarding off-grid rural electrification. Conducting pilot projects would help a lot in this regard. On the state level, it is expected that the Project Management Board of MOI, which was already established to promote off-grid rural electrification, and many provinces will tie up for strong collaboration. Manufacturers and contractors in Vietnam have a good potential to grow in the course of off-grid projects and, in future, will play an important role. The GOV needs to take necessary measures to help these enterprises improve their services from the viewpoint of securing higher sustainability. For example, it is recommended that the GOV direct them to provide training to the villagers and also provide regularly scheduled checking after the construction work is completed.

On the user side, developing a CEU will proceed without difficulty owing to the fact that such organizations have been common in remote areas. However, some of the CEU's assignments are new and complicated to the villagers. It is, therefore, important to give them a well-coordinated training to ensure their daily work is conducted smoothly.

9-2-4 Recommended actions

In summary, it is recommended that the GOV take the initiative to undertake the following measures to promote off-grid rural electrification in a timely manner.

1) Securing fund

Acceleration of negotiation with overseas donors

Develop a rule of financial assistance for off-grid projects

Establishment of micro-finance program

2) Technology development

Implementation of pilot projects

Development of technical manuals

Quality improvement of off-grid equipment

3) Organizational development

Capacity building of local PPC engineers

Strengthening the relationship between the GOV and PPCs

Backup support from EVN and PCs

Development of operation and management manuals for CEUs

Appendix

Attachment List

Database of Un-electrified Communes

1.Inventory of communes not to be connected to the EVN power grid after 2005
2.Micro Hydro Potential Data
3.Application—Selecting target communes by the database

Village Hydro—Micro-hydropower development

1.Village Hydro Basic Design Data
2.Village Hydro Sample model 10kw class
    (1) Specification
    (2) Site layout
    (3) Design drawings (Profile, Intake, Head-tank, Powerhouse)
    (4) Cost estimation
        cf: 5kW
3. Model communes surveyed by JICA for micro-hydro development

Village Solar—Photovoltaic power development

1.Average sunshine hours in Northern Part of Vietnam
2.Village Solar Basic Technical Instructions

INVENTORY OF COMMUNES NOT TO BE CONNECTED TO THE EVN POWER GRID AFTER YEAR 2005

As of March, 2001

Note: ~ Average   # Number of   ^ Maximum   C: Car   M: Motorbike   W: Walking   Trans: transportation   Dist: distance   Y: Yes N: No   MHP: Micro hydro power   Winter: from January to March

Total No	No.	Province	District	Commune name	Lon	Lat	Basic Data: Population	Basic Data: #households	Ethnic structure: 1st group Name	1st group %	2nd group Name	2nd group %	Income Data: ~income (10^6 VND)	Area of rice fields (ha)	Harvest time (times/year)	Yield (t/year)	Price for sale (VND/kg)	Village Data: #Villages	~Dist between villages (Km)	^Dist between villages (Km)	Develop-ment of 135 program: Road (Y/N)	Develop-ment of 135 program: Irrigation (Y/N)	Data of Infrastructure: Trans in Dry sea-son	Trans in Rainy sea-son	Perennial road (Y/N)	^River crossing without bridge (m)	Health centre (Y/N)	School (Y/N)	Market (Y/N)	Electrification Data: Dist from MV grid (Km)	#Pico-hydro machin	MHP potential (Y/N)	SUN Shine in Winter (hour/day)
1	1	Ha Giang	Dong Van	Sinh Lung	105.28	23.22	2590	494	H'Mong	80	Lao	20	1.000	0	1	325	1400	9	3.4	5.0	Y	Y	C	C	Y	25	Y	Y	N	24.0	0	N	3.0
2	2	Ha Giang	Dong Van	Ta Lung	105.37	23.22	2392	442	H'Mong	100			1.000	2	2	433	1400	13	3.1	5.7	Y	Y	C	C	Y	25	Y	Y	N	12.0	0	N	3.0
3	3	Ha Giang	Dong Van	Sang Tung	105.23	23.20	2723	481	H'Mong	100			0.800	0	1	351	1400	16	3.2	4.5	Y	Y	C	C	Y	25	Y	Y	N	12.0	0	N	3.0
4	4	Ha Giang	Dong Van	Ho Quang Phin	105.25	23.15	2397	410	H'Mong	89	Dao	2	0.900	0	1	309	1400	9	5.3	7.5	Y	Y	C	C	Y	25	Y	Y	N	6.0	0	N	3.0
5	5	Ha Giang	Dong Van	Thai Phin Tung	105.32	23.25	2513	453	H'Mong	100			1.000	1	2	455	1400	10	3.1	4.5	Y	Y	C	C	Y	25	Y	Y	N	3.0	0	N	3.0
6	6	Ha Giang	Dong Van	Ta Phin	105.32	23.20	2433	463	H'Mong	100			0.900	3	2	440	1400	10	4.7	5.5	Y	Y	C	C	Y	25	Y	Y	N	7.0	0	N	3.0
7	7	Ha Giang	Dong Van	Lung Thau	105.17	23.18	1723	315	H'Mong	100			0.800	0	1	222	1400	6	4.0	5.0	Y	Y	C	C	Y	25	Y	Y	N	10.0	0	N	3.0
8	8	Ha Giang	Dong Van	Van Chai	105.22	23.13	2682	474	H'Mong	100			0.800	0	1	346	1400	13	3.3	4.5	Y	Y	C	C	Y	25	Y	Y	N	7.0	0	N	3.0
9	9	Ha Giang	Meo Vac	Lung Chinh	105.32	23.12	2799	507	H'Mong	88	Dao	9	1.003	23	2	507	1400	7	4.0	6.2	Y	Y	C	C	Y	25	Y	Y	N	5.0	3		3.0
10	10	Ha Giang	Meo Vac	Lung Pu	105.50	23.10	3089	242	H'Mong	99	Other	1	1.000	0	2	398	1400	6	3.9	7.0	Y	Y	C	M	N	25	Y	Y	N	10.5	0	Y	3.0
11	11	Ha Giang	Meo Vac	Can Chu Phin	105.45	23.13	3296	601	H'Mong	100			0.900	0	2	425	1400	14	4.1	7.5	Y	Y	C	M	N	25	Y	Y	N	6.0	0		3.0
12	12	Ha Giang	Meo Vac	Giang Chu Phin	105.45	23.17	3338	550	H'Mong	99	Other	1	0.900	5	3	604	1400	12	3.0	6.2	Y	Y	C	C	Y	25	Y	Y	N	5.0	0		3.0
13	13	Ha Giang	Yen Minh	Mau Due	105.27	23.05	4664	903	Tay	43	H'Mong	39	0.300	963	2	844	1400	15	2.0	4.0	Y	Y	C	C	Y	25	Y	Y	N	0.5	0	Y	3.0
14	14	Ha Giang	Yen Minh	Du Gia	105.20	22.92	4212	759	H'Mong	70	Tay	24	0.300	202	4	762	1400	14	3.0	7.2	Y	Y	C	C	Y	25	Y	Y	Y	9.0	0	Y	2.5
15	15	Ha Giang	Yen Minh	Sung Thai	105.13	23.17	4695	848	H'Mong	100			2.000	10	2	850	1400	19	10.0	15.0	Y	Y	C	C	Y	25	Y	Y	N	14.0	0	N	3.0
16	16	Ha Giang	Yen Minh	Huu Vinh	105.14	23.08	2819	560	H'Mong	32	Tay	27	1.800	90	4	510	1400	13	5.0	6.0	Y	Y	C	C	Y	25	Y	Y	N	0.3	40	N	3.0
17	17	Ha Giang	Yen Minh	Dong Minh	105.16	23.16	2170	396	Giay	80	Xuong	14	1.700	93	2	393	1400	16	5.0	7.0	Y	Y	C	C	Y	25	Y	Y	N	12.0	63	N	3.0
18	18	Ha Giang	Hoang Su Phi	Thang Tin	104.63	22.80	1569	271	H'Mong	67	Tay	14	0.900	140	2	284	1400	3	4.0	2.5	Y	Y	C	M	N	25	Y	Y	N	10.5	35	N	3.0
19	19	Ha Giang	Hoang Su Phi	Then Chu Phin	104.70	22.80	1313	232	H'Mong	80	Nung	20	0.930	84	2	238	1400	4	3.7	5.2	Y	Y	C	M	N	25	Y	Y	N	14.0	33	N	3.0
20	20	Ha Giang	Hoang Su Phi	Ban Nhung	104.75	22.70	1990	368	Nung	90	Tay	10	0.400	121	4	360	1400	8	4.1	5.7	Y	Y	C	M	N	25	Y	Y	N	8.0	251	Y	3.0
21	21	Ha Giang	Hoang Su Phi	Ban Dan Van	104.72	22.77	1618	295	Nung	98	H'Mong	2	0.400	125	2	293	1400	8	2.0	5.0	Y	Y	C	M	N	25	Y	Y	N	6.0	37	Y	3.0
22	22	Ha Giang	Hoang Su Phi	Ban Peo	104.73	22.63	1233	196	H'Mong	55	Dao	42	0.800	85	2	223	1400	4	5.0	6.0	Y	Y	C	C	Y	25	Y	Y	N	5.0	160		3.0
23	23	Ha Giang	Hoang Su Phi	Nam Khoa	104.67	22.57	2717	415	Dao	68	Nung	32	0.800	284	2	492	1400	7	5.0	7.0	Y	Y	C	M	N	25	Y	Y	N	11.0	306	Y	3.0
24	24	Ha Giang	Hoang Su Phi	Xuan Minh	104.75	22.50	1930	328	Dao	78	Pa Then	22	0.800	141	2	349	1400	10	6.0	7.0	Y	Y	C	C	Y	25	Y	Y	N	7.0	158		2.5
25	25	Ha Giang	Hoang Su Phi	Ban Phung	104.74	22.70	2149	332	La Chi	97	Tay	2	0.310	86	2	389	1400	8	9.0	12.0	Y	Y	C	C	N	25	Y	Y	N	14.0	0		3.0
26	26	Ha Giang	Xin Mau	Ngan Chien	104.52	22.68	2991	525	Nung	91	H'Mong	6	1.692	181	3	541	1400	10	4.6	6.2	Y	Y	C	M	N	25	Y	Y	Y	11.0	116		3.0
27	27	Ha Giang	Xin Mau	Thu Ta	104.55	22.65	1919	367	Nung	83	H'Mong	17	1.428	195	3	347	1400	14	3.3	4.5	Y	Y	C	M	N	25	Y	Y	N	12.0	164	Y	3.0
28	28	Ha Giang	Xin Mau	Che La	104.52	22.62	2255	407	Nung	55	H'Mong	45	1.788	187	3	408	1400	13	3.3	4.7	Y	Y	C	M	N	25	Y	Y	N	8.0	133		3.0
29	29	Ha Giang	Xin Mau	Ban Ngo	104.43	22.63	555	118	Nung	53	H'Mong	43	1.848	184	2	100	1400	5	3.3	5.5	Y	Y	C	M	N	25	Y	Y	N	5.0	22		3.0
30	30	Ha Giang	Xin Mau	Tan Nam	104.58	22.50	2460	450	Tay	56	Dao	28	2.004	145	2	445	1400	12	3.0	5.0	Y	Y	C	M	N	25	Y	Y	N	9.0	387	Y	3.0
31	31	Ha Giang	Xin Mau	Theng Phan	104.47	22.64	3272	575	Nung	83	H'Mong	16	1.728	100	4	592	1400	11	4.0	5.0	Y	Y	C	M	N	25	Y	Y	N	5.5	189		3.0
32	32	Ha Giang	Xin Mau	Ban Diu	104.55	22.73	3583	646	La Chi	69	Tay	12	1.608	150	4	648	1400	8	4.0	6.0	Y	Y	C	M	N	25	Y	Y	N	12.0	183	Y	3.0
33	33	Ha Giang	Bac Quang	Yen Thanh	104.70	22.32	2577	459	Tay	29	Pa Thi	26	1.750	136	4	798	1400	8	5.0	6.0	Y	Y	C	M	N	25	Y	Y	Y	0.2	159		2.5
34	34	Ha Giang	Quan Ba	Lung Tam	105.07	23.05	2670	445	H'Mong	100			1.000	0	2	483	1400	15	2.9	3.7	Y	Y	C	M	Y	25	Y	Y	N	9.0	0		3.0
35	35	Ha Giang	Quan Ba	Ta Van	104.85	23.00	1633	297	H'Mong	100			1.000	37	2	296	1400	8	4.2	5.5	Y	Y	C	W	N	25	Y	Y	N	15.0	0	Y	3.0
36	36	Ha Giang	Bac Me	Giap Trung	105.30	22.80	3781	565	H'Mong	38	Dao	37	1.000	347	4	684	1400	11	5.0	8.5	Y	Y	M	W	N	25	Y	Y	N	9.0	0	Y	2.0
37	37	Ha Giang	Bac Me	Phu Nam	105.47	22.73	2049	359	Tay	44	Dao	23	1.500	119	4	371	1400	4	3.0	5.0	Y	Y	M	W	N	25	Y	Y	N	12.0	210	Y	2.0
38	38	Ha Giang	Bac Me	Thuong Tam	105.27	22.68	1643	214	H'Mong	66	Tay	20	0.930	104	4	297	1400	6	4.0	6.0	Y	Y	M	W	N	25	Y	Y	N	1.7	110		2.0
39	39	Ha Giang	Bac Me	Yen Phong	105.40	22.75	1825	303	Tay	60	Dao	25	1.300	207	4	330	1400	7	3.7	5.5	Y	Y	C	C	Y	25	Y	Y	N	6.0	180		2.0
40	40	Ha Giang	Bac Me	Yen Cuong	105.37	22.68	4801	733	H'Mong	30	Dao	30	1.100	353	4	869	1400	14	4.0	5.5	Y	Y	C	C	Y	25	Y	Y	N	6.0	400	Y	2.0
41	1	Cao Bang	Hoa An	Duc Xuan	106.25	22.78	424	73	H'Mong	81	Nung	19	0.950	10	3	89	1400	4	4.0	5.0	Y	Y	M	M	Y	20	N	Y	N	16.0	0		2.0
42	2	Cao Bang	Hoa An	Cong Trung	106.03	22.7	1100	162	Dao	63	Tay	31	0.900	16	2	230	1400	5	5.0	6.0	Y	Y	C	C	Y	20	Y	Y	N	7.0	6	Y	2.0
43	3	Cao Bang	Hoa An	Truong Luong	106.08	22.73	2515	483	Tay	68	Nung	29	0.900	142	2	562	1400	18	3.5	5.0	Y	Y	C	C	Y	20	Y	Y	Y	13.0	56		2.0
44	4	Cao Bang	Ha Quang	Si Hai	106.20	22.87	1278	209	Nung	93	H'Mong	7	1.290	0	1	199	1400	14	2.0	6.0	Y	Y	C	M	N	20	Y	Y	N	10.0	0		2.5
45	5	Cao Bang	Ha Quang	Ma Ba	106.22	22.85	1218	204	Nung	93	H'Mong	17	1.400	0	1	190	1400	12	2.0	5.5	Y	Y	C	M	N	20	Y	Y	N	9.0	0	N	2.0
46	6	Cao Bang	Ha Quang	Ha Thon	106.20	22.80	794	137	H'Mong	64	Nung	36	0.900	0	1	124	1400	8	2.0	5.0	Y	Y	C	M	N	20	Y	Y	N	10.0	0	N	2.0
47	7	Cao Bang	Trung Khanh	Ngoc Chung	106.47	22.88	920	174	Nung	89	Tay	11	1.500	40	3	192	1400	8	2.0	4.5	Y	Y	C	M	N	20	Y	Y	N	4.3	10		2.5
48	8	Cao Bang	Nguyen Binh	Mai Long	105.78	22.63	2862	456	Dao	53	Nung	27	0.360	76	2	598	1400	14	3.0	4.0	Y	Y	M	W	N	20	Y	Y	N	20.0	0	Y	2.0
49	9	Cao Bang	Nguyen Binh	Trieu Nguyen	105.90	22.72	1212	172	Dao	59	Nung	35	0.150	30	2	253	1400	10	7.0	9.0	Y	Y	M	W	N	20	N	N	Y	17.0	0		2.0
50	10	Cao Bang	Nguyen Binh	Thanh Cong	105.88	22.55	2452	422	Dao	70	Tay	15	0.465	130	2	512	1400	18	4.8	7.2	Y	Y	C	M	N	20	Y	Y	N	35.0	0	Y	2.0

INVENTORY OF COMMUNES NOT TO BE CONNECTED TO THE EVN POWER GRID AFTER YEAR 2005

As of March, 2001

Note: ~ Average   # Number of   ^ Maximum   C: Car   M: Motorbike   W: Walking   Trans: transportation   Dist: distance   Y: Yes N: No   MHP: Micro hydro power   Winter: from January to March

Total No	No.	Province	District	Commune name	Lon	Lat	Basic Data: Population	#households	Ethnic structure: 1st group Name	%	2nd group Name	%	Income Data: ~income	Area of rice fields	Harvest time	Yield	Price for sale	Village Data: #Villages	~Dist between villages	^Dist between villages	Data of Infrastructure: Development of 135 program: Road	Irrigation	Trans in Dry sea-son	Trans in Rainy sea-son	Perennial road	^River crossing without bridge	Health centre	School	Market	Electrification Data: Dist from MV grid	#Pico-hydro machin	MHP potential	SUN Shine in Winter
													(10^6 VND)	(ha)	(times/year)	(t/year)	(VND/kg)		(Km)	(Km)	(Y/N)	(Y/N)			(Y/N)	(m)	(Y/N)	(Y/N)	(Y/N)	(Km)		(Y/N)	(hour/day)
51	11	Cao Bang	Bao Lam	Nam Quang	105.43	22.93	5160	750	Tay	60	Dao	30	1.290	127	3	1087	1400	12	5.6	8.2	Y	Y	M	W	N	20	Y	Y	N	26.0	0		2.5
52	12	Cao Bang	Bao Lam	Yen Tho	105.53	22.68	3938	602	Tay	70	Dao	15	1.355	165	3	823	1400	10	7.6	11.2	Y	Y	M	W	N	20	Y	Y	N	34.0	0		2.0
53	13	Cao Bang	Bao Lac	Son Lo	105.68	22.75	4371	673	Tay	54	Dao	24	0.900	116	2	913	1400	14	3.2	4.5	Y	Y	M	W	N	20	Y	Y	Y	21.0	246		2.0
54	14	Cao Bang	Bao Lac	Hong An	105.83	22.83	675	99	H'Mong	78	Dao	20	0.900	0	2	141	1400	4	5.1	9.0	Y	Y	C	W	N	20	Y	Y	N	21.0	0		2.0
55	1	Lang Son	Dinh Lap	Dong Thang			494	91	Tay	43	SanChay	28	1.372					7	4.6	6.5					N		Y	Y	N	15.5		Y	
56	1	Quang Ninh	Hoanh Bo	Dong Son	106.97	21.15	2091	360	Dao	98	Kinh	2	1.500	86	4	575	1400	5	1.5	4.0	Y	Y	C	M	N	20	Y	Y	Y	35.0	2		2.0
57	2	Quang Ninh	Hoanh Bo	Ky Thuong	107.15	21.18	489	77	Dao	100			1.000	30	4	134	1400	4	0.5	2.0	Y	Y	M	W	N	20	Y	Y	N	30.0	0		2.0
58	3	Quang Ninh	Hoanh Bo	Hoa Binh	107.18	21.08	821	152	Dao	77	Diu	13	1.700	52	4	226	1400	2	3.6	6.0	Y	Y	C	C	N	20	Y	Y	N	2.0	0		2.0
59	4	Quang Ninh	Ba Che	Luong Mong	107.00	21.27	1041	214	Tay	57	Dao	40	1.260	48	3	286	1400	8	3.0	6.0	Y	Y	C	M	N	20	Y	Y	Y	22.0	3	Y	2.0
60	5	Quang Ninh	Ba Che	Minh Cam	107.07	21.23	410	76	Tay	68	Dao	30	1.152	20	3	113	1400	4	4.0	5.5	Y	Y	C	M	Y	20	Y	Y	N	14.0	3	Y	2.0
61	6	Quang Ninh	Quang Ha	Quang Thinh	107.70	21.45	2242	489	Dao	65	Tay	30	1.200	238	3	617	1400	7	2.5	5.5	Y	Y	C	M	Y	20	Y	Y	N	6.0	0	Y	2.0
62	7	Quang Ninh	Quang Ha	Quang Son	107.62	21.55	2610	387	Dao	55	Tay	25	1.200	150	3	718	1400	6	3.8	4.2	Y	Y	C	M	Y	20	Y	Y	N	18.0	0		2.0
63	1	Bac Can	Ba Be	Dong Phuc	105.75	22.30	2714	410	Tay	60	Nung	20	1.407	176	3	730	1400	6	4.7	8.5	Y	Y	C	W	N	20	Y	Y	N	16.0		Y	2.0
64	2	Bac Can	Ba Be	Hoang Tri	105.67	22.30	1290	200	Tay	75	Dao	10	1.372	54	3	334	1400	4	4.3	7.0	Y	Y	C	W	N	20	Y	Y	N	16.7		Y	2.0
65	3	Bac Can	Ba Be	Quang Khe	105.72	22.37	2993	498	Nung	70	Dao	20	1.533	142	3	775	1400	7	4.7	9.5	Y	Y	C	W	N	20	Y	Y	N	8.5		Y	2.0
66	4	Bac Can	Ba Be	An Thang	105.75	22.58	1175	181	Tay	75	Nung	15	1.309	49	3	304	1400	2	3.6	5.5	Y	Y	C	W	N	20	Y	Y	N	10.0		Y	2.0
67	5	Bac Can	Ba Be	Co Linh	105.63	22.57	2328	423	Tay	72	Nung	20	1.329	102	3	603	1400	6	2.0	3.0	Y	Y	C	W	N	20	Y	Y	N	16.0		Y	2.0
68	6	Bac Can	Ba Be	Cao Tan	105.63	22.52	2250	375	Nung	65	Tay	30	1.345	103	3	583	1400	5	2.2	3.0	Y	Y	C	W	N	20	Y	Y	N	5.0			2.0
69	7	Bac Can	Bach Thong	Cao Son	105.97	22.17	718	120	Tay	80	Dao	10	1.325	39	2	186	1400	2	7.9	8.7	Y	Y	C	W	Y	20	Y	Y	N	15.0			1.5
70	1	Yen Bai	Tram Tau	Lang Nhi	104.52	20.97	1293	157	H'Mong	100			2.230	137	2	303	1400	6	3.8	6.2	Y	Y	M	W	N	20	Y	Y	N	12.0	18	Y	4.5
71	2	Yen Bai	Tram Tau	Ta Si Lang	104.63	20.95	1126	158	H'Mong	100			2.237	100	2	263	1400	5	8.0	10.0	Y	Y	M	W	N	20	Y	Y	N	13.0	20	Y	4.0
72	3	Yen Bai	Mu Cang Chai	Che Tao	104.05	21.74	1515	209	H'Mong	100			1.032	80	2	355	1400	7	10.0	12.0	Y	Y	M	W	N	20	Y	Y	N	40.0	300	Y	5.5
73	4	Yen Bai	Van Yen	Mo Vang	104.63	21.50	3110	526	Dao	64	H'Mong	25	1.900	93	2	728	1400	11	10.0	12.0	Y	Y	C	W	N	20	Y	Y	N	10.0	368	Y	3.0
74	5	Yen Bai	Van Yen	Na Hau	104.55	21.50	1240	260	H'Mong	92	Dao	8	0.300	55	2	290	1400	6	12.0	13.0	Y	Y	C	W	N	20	Y	Y	N	20.0	100	Y	3.5
75	6	Yen Bai	Van Yen	Xuan Tam	104.52	21.72	2247	350	Dao	96	Kinh	4	1.800	50	3	526	1400	8	6.0	8.0	Y	Y	C	W	N	20	Y	Y	N	18.0	300		3.5
76	7	Yen Bai	Van Chau	An Luong	104.62	21.32	2790	454	Tay	40	H'Mong	30	0.801	166	3	904	1400	12	10.0	12.0	Y	Y	M	W	N	20	Y	Y	N	18.0	155		3.5
77	1	Phu Tho	Thanh Son	Tan Lap	105.20	21.00	4456	852	Nung	65	Nung	30	1.800	177	2	891	1400	9	2.0	4.5	Y	Y	C	C	Y	20	Y	Y	N	13.0			2.0
78	2	Phu Tho	Thanh Son	Yen Luong	105.08	21.15	3828	721	Nung	70	Nung	20	1.820	208	2	766	1400	8	1.5	3.0	Y	Y	C	C	Y	20	Y	Y	N	18.0		Y	2.0
79	3	Phu Tho	Thanh Son	Yen Lang	105.23	20.98	3472	644	Dao	75	Dao	15	1.800	183	3	694	1400	9	1.5	3.5	Y	Y	C	C	Y	20	Y	Y	N	19.0			2.0
80	4	Phu Tho	Thanh Son	Thu Ngac	105.05	21.25	4948	829	Nung	70	Nung	25	1.800	190	2	990	1400	9	2.0	3.0	Y	Y	C	C	Y	20	Y	Y	N	7.0			2.0
81	5	Phu Tho	Thanh Son	Xuan Dai	105.00	21.15	5043	943	Dao	60	Dao	35	1.800	163	2	1010	1400	11	2.0	6.0	Y	Y	C	C	Y	20	Y	Y	N	17.0		Y	2.0
82	6	Phu Tho	Thanh Son	Kim Thuong	105.00	21.07	6062	1093	Nung	55	Dao	30	1.800	213	3	1210	1400	10	3.9	7.0	Y	Y	C	C	Y	20	Y	Y	Y	19.0		Y	2.0
83	7	Phu Tho	Thanh Son	Lai Dong	104.92	21.22	3260	620	Nung	50	Dao	25	1.800	116	3	650	1400	9	3.0	4.0	Y	Y	C	C	Y	20	Y	Y	N	20.0		Y	2.0
84	8	Phu Tho	Thanh Son	Kiet Son	104.95	21.23	3062	587	Nung	60	Dao	20	1.800	131	2	612	1400	8	3.0	5.0	Y	Y	C	C	Y	20	Y	Y	N	8.0			2.0
85	9	Phu Tho	Thanh Son	Tan Son	104.93	21.18	3631	623	Nung	75	Dao	15	1.800	148	3	726	1400	10	3.7	5.7	Y	Y	C	C	Y	20	Y	Y	N	20.0			2.0
86	10	Phu Tho	Thanh Son	Dong Son	104.88	21.18	2987	538	Nung	55	Dao	40	1.800	109	2	597	1400	7	5.5	8.7	Y	Y	C	C	Y	20	Y	Y	N	25.0		Y	2.5
87	11	Phu Tho	Thanh Son	Dong Cuu	105.08	21.02	2701	492	Nung	60	Kinh	25	1.800	109	3	548	1400	10	5.0	8.0	Y	Y	C	C	Y	20	Y	Y	N	18.0		Y	2.0
88	12	Phu Tho	Thanh Son	Thuong Cuu	105.12	20.98	2473	397	Nung	70	Dao	25	1.800	62	2	495	1400	9	4.0	5.0	Y	Y	C	C	Y	20	Y	Y	N	17.0		Y	2.0
89	13	Phu Tho	Thanh Son	Vinh Tien	105.07	21.07	1064	199	Dao	60	Kinh	20	1.800	20	3	213	1400	6	5.0	8.7	Y	Y	C	C	Y	20	Y	Y	Y	7.0		Y	2.0
90	14	Phu Tho	Thanh Son	Xuan Son	104.93	21.15	1071	194	Nung	75	Dao	20	1.800	51	2	210	1400	2	4.9	6.5	Y	Y	M	M	N	20	Y	Y	N	20.0			2.5
91	15	Phu Tho	Thanh Son	Yen Son	105.28	20.95	5910	1477	Dao	65	Kinh	10	1.745	281	2	1180	1400	9	3.0	3.2	Y	Y	C	C	Y	20	Y	Y	Y	15.0			2.0
92	16	Phu Tho	Thanh Son	Luong Nha	105.30	21.00	3858	964	Dao	70	Kinh	10	1.660	121	3	770	1400	4	3.0	4.0	Y	Y	C	C	Y	20	Y	Y	N	12.0			2.0
93	17	Phu Tho	Thanh Son	Long Coc	105.05	21.12	2627	656	Nung	60	Dao	30	1.528	128	2	525	1400	3	3.8	4.0	Y	Y	C	C	Y	20	Y	Y	N	3.0			2.0
94	18	Phu Tho	Thanh Son	Tam Thanh	105.10	21.08	2130	532	Nung	70	Dao	25	1.758	77	3	426	1400	4	2.7	3.0	Y	Y	C	C	Y	20	Y	Y	N	7.0			2.0
95	19	Phu Tho	Thanh Son	Minh Dai	105.03	21.17	5259	1314	Nung	70	Dao	20	1.870	105	3	1050	1400	7	2.2	3.0	Y	Y	C	C	Y	20	Y	Y	Y	5.0		Y	2.0
96	20	Phu Tho	Thanh Son	Kha Cuu	105.13	21.03	3676	919	Nung	60	Kinh	20	1.502	120	3	735	1400	6	4.5	6.0	Y	Y	C	C	Y	20	Y	Y	Y	15.0			2.0
97	21	Phu Tho	Thanh Son	Tan Phu	105.00	21.20	3672	923	Nung	65	Dao	30	1.728	132	2	738	1400	6	5.5	7.0	Y	Y	C	C	Y	20	Y	Y	N	6.0			2.0
98	22	Phu Tho	Thanh Son	Thach Kiet	104.97	21.28	3496	874	Nung	65	Dao	25	1.809	111	2	670	1400	5	4.0	5.2	Y	Y	C	C	Y	20	Y	Y	Y	12.0		Y	2.0
99	23	Phu Tho	Thanh Son	My Thuan	105.05	21.20	6611	1952	Nung	80	Dao	15	1.633	196	3	1320	1400	8	5.1	7.2	Y	Y	C	C	Y	20	Y	Y	Y	3.0		Y	2.0
100	24	Phu Tho	Thanh Son	Van Mieu	105.13	21.10	6475	1040	Dao	55	Kinh	30	1.860	150	3	1300	1400	8	3.0	3.5	Y	Y	C	C	Y	20	Y	Y	N	6.0		Y	2.0
101	25	Phu Tho	Thanh Son	Cu Dong	105.23	21.10	4050	1012	Dao	65	Kinh	20	1.860	256	2	810	1400	6			Y	Y	C	C	Y	20							2.0

INVENTORY OF COMMUNES NOT TO BE CONNECTED TO THE EVN POWER GRID AFTER YEAR 2005

As of March, 2001

Note: ~ Average # Number of ^ Maximum C: Car M: Motorbike W: Walking Trans: transportation Dist: distance Y: Yes N: No MHP: Micro hydro power Winter: from January to March

Total No	No.	Province	District	Commune name	Lon	Lat	Basic Data: Population	Basic Data: #households	Ethnic structure: 1st group Name	1st group %	2nd group Name	2nd group %	Income Data: ~income (10^6 VND)	Area of rice fields (ha)	Harvest time (times/year)	Yield (t/year)	Price for sale (VND/kg)	Village Data: #Villages	~Dist between villages (Km)	^Dist between villages (Km)	Develop-ment of 135 program: Road (Y/N)	Develop-ment of 135 program: Irrigation (Y/N)	Data of Infrastructure: Trans in Dry sea-son	Trans in Rainy sea-son	Perennial road (Y/N)	^River crossing without bridge (m)	Health centre (Y/N)	School (Y/N)	Market (Y/N)	Electrification Data: Dist from MV grid (Km)	#Pico-hydro machin	MHP potential (Y/N)	SUN Shine in Winter (hour/day)
102	1	Hoa Binh	Tan Lac	Nam Son	105.17	20.55	1153	229	Muong	100			1.300	0	2	220	1400	6	3.0	3.5	Y	Y	C	C	Y	30	Y	Y	N	13.0	0		2.0
103	2	Hoa Binh	Tan Lac	Bac Son	105.13	20.58	1186	239	Muong	58	Tay	42	1.200	0	2	227	1400	5	2.1	2.5	Y	Y	C	C	Y	30	N	Y	N	19.0	0		2.5
104	3	Hoa Binh	Lac Son	Ngoc Son	105.30	20.45	2004	340	Muong	99	Other	1	1.198	77	3	383	1400	9	2.7	4.0	Y	Y	C	C	Y	30	Y	Y	N	7.5	5	N	1.5
105	4	Hoa Binh	Lac Son	Ngoc Lau	105.43	20.40	2433	141	Muong	99	Other	1	1.100	63	3	465	1400	13	3.4	6.0	Y	Y	C	M	N	30	Y	Y	Y	9.5	8	N	1.5
106	5	Hoa Binh	Lac Son	Tu Do	105.35	20.40	2257	438	Muong	99	Other		1.200	140	3	431	1400	11	3.2	3.7	Y	Y	C	C	Y	30	Y	Y	N	12.0	50	Y	1.5
107	6	Hoa Binh	Lac Son	Mien Doi	105.42	20.58	3797	707	Muong	99	Other	1	1.000	324	3	725	1400	12	3.0	4.2	Y	Y	C	C	Y	30	Y	Y	N	8.5	532	Y	1.5
108	7	Hoa Binh	Kim Boi	Thuong Tien	105.43	20.65	1120	219	Muong	100			1.035	93	3	214	1400	5	2.5	5.0	Y	y	C	M	N	30	Y	Y	N	10.0	111	Y	2.0
109	8	Hoa Binh	Mai Chau	Tan Mai	105.07	20.78	1725	320	Thai	85	Muong	10	1.000	101	2	329	1400	7	3.9	5.0	Y	Y	C	M	N	30	Y	Y	N	5.0			2.5
110	9	Hoa Binh	Lac Thuy	Dong Mon	105.70	20.48	1174	230	Muong	100			1.695	49	3	224	1400	7	3.7	4.5	Y	Y	C	M	N	30	Y	Y	N	8.0			1.5
111	10	Hoa Binh	Yen Thuy	Lac Sy	105.57	20.52	1840	330	Muong	100			1.456	166	2	351	1400	8	4.2	5.2	Y	Y	C	C	Y	30	Y	Y	N	13.0			1.5
112	11	Hoa Binh	Da Bac	Tan Dan	105.03	20.82	1943	354	Thai	80	Muong	15	1.617	18	2	371	1400	8	3.2	3.7	Y	Y	C	M	N	30	Y	Y	N	10.0	108		2.5
113	12	Hoa Binh	Ky Son	Doc Lap	105.40	20.82	1521	277	Muong	100			1.614	81	2	290	1400	7	3.5	3.7	Y	Y	C	M	N	30	Y	Y	N	5.0			2.0
114	13	Hoa Binh	Ky Son	Yen Thuong	105.38	20.61	2297	463	Muong	100			0.929	353	3	440	1400	12	2.0	5.0	Y	Y	C	C	Y	30	Y	Y	N		74	Y	2.0
115	1	Son La	Quynh Nhai	Nam Ca Nang	103.55	21.95	5061	1071	Thai	86	Dao	6	2.200	148	7	660	1400	13	4.5	5.0	Y	Y	C	M	N	20	Y	Y	N	14.0	270		4.5
116	2	Son La	Quynh Nhai	Chieng Khay	103.65	21.87	4330	1108	Thai	66	H'Mong	11	2.200	443	7	567	1400	10	7.0	9.0	Y	Y	C	M	N	20	Y	Y	N	18.0	170		4.5
117	3	Son La	Song Ma	Chieng En	103.50	21.18	4464	628	Thai	72	H'Mong	12	0.870	472	4	585	1400	15	5.0	6.7	Y	Y	C	M	N	20	Y	Y	N	33.0	0		5.0
118	4	Son La	Song Ma	Muong Leo	103.35	20.90	1788	254	Thai	38	H'Mong	32	0.570	182	2	234	1400	10	6.0	10.0	Y	Y	M	W	N	20	Y	Y	N	80.0	50	Y	5.0
119	5	Son La	Song Ma	Muong Va	103.62	20.87	7705	1223	Thai	55	Kho Mu	10	0.860	249	4	1010	1400	27	4.0	8.0	Y	Y	C	C	Y	20	Y	Y	N	40.0	1	Y	5.0
120	6	Son La	Song Ma	Muong Lan	104.00	20.97	6338	990	Thai	37	H'Mong	27	0.960	644	4	830	1400	16	5.0	7.5	Y	Y	C	M	N	20	Y	Y	N	60.0	1		5.0
121	7	Son La	Song Ma	Bo Sinh	103.45	21.30	3402	480	Thai	81	Khang	11	0.670	344	4	446	1400	13	4.5	4.5	Y	Y	M	W	N	20	Y	Y	N	50.0	0		5.5
122	8	Son La	Song Ma	Chieng Phung	103.60	21.25	3807	541	Thai	91	H'Mong	9	0.696	200	2	499	1400	20	5.0	6.0	Y	Y	M	W	N	20	Y	Y	N	45.0	60		5.0
123	9	Son La	Song Ma	Sam Kha	103.75	21	1587	235	H'Mong	86	Thai	14	0.540	283	2	208	1400	9	5.5	8.0	Y	Y	M	W	N	20	Y	Y	N	70.0	40		5.0
124	10	Son La	Song Ma	Pung Banh	103.40	21.03	5860	900	Thai	97	H'Mong	3	0.860	252	2	768	1400	16	5.0	6.0	Y	Y	C	M	N	20	Y	Y	N	46.0	1		5.0
125	11	Son La	Song Ma	Muong Cai	103.75	20.90	3264	505	H'Mong	56	Thai	31	0.860	378	4	428	1400	19	5.0	7.0	Y	Y	M	W	N	20	Y	Y	N	16.0	0		5.0
126	12	Son La	Thuan Chau	Long He	103.50	21.40	2759	406	H'Mong	77	Thai	13	1.300	857	2	361	1400	20	8.0	9.0	Y	Y	C	C	Y	20	Y	Y	N	50.0	30	Y	5.5
127	13	Son La	Thuan Chau	Muong Bam	103.37	21.40	6656	857	Thai	72	H'Mong	22	1.400	1027	3	872	1400	22	3.0	5.7	Y	Y	M	W	N	20	Y	Y	N	19.0	40	Y	5.5
128	14	Son La	Thuan Chau	Liep Muoi	103.70	21.57	3183	473	Thai	86	La Ha	14	1.450	165	3	417	1400	11	4.0	6.0	Y	Y	C	C	Y	20	Y	Y	N	3.0	30	Y	5.5
129	15	Son La	Thuan Chau	Ban Lam	103.75	21.59	2962	431	Thai	82	H'Mong	18	1.530	341	3	388	1400	15	3.0	5.0	Y	Y	C	C	Y	20	Y	Y	N	14.0	0	Y	5.0
130	16	Son La	Thuan Chau	Bo Muoi	103.90	21.43	5515	778	Thai	99	Kinh	1	1.400	350	4	722	1400	16	6.0	8.0	Y	Y	M	W	N	20	Y	Y	N	14.0	0	Y	5.0
131	17	Son La	Thuan Chau	E Tong	103.47	21.45	2442	296	H'Mong	100			1.250	263	3	280	1400	18	7.0	9.0	Y	Y	M	W	N	20	Y	Y	N	58.0	25	Y	5.5
132	18	Son La	Thuan Chau	Co Ma	103.53	21.35	4162	575	H'Mong	84	Thai	16	1.300	537	2	545	1400	22	6.0	9.0	Y	Y	C	C	Y	20	Y	Y	Y	43.0	25	Y	5.5
133	19	Son La	Thuan Chau	Pa Long	103.53	21.25	2175	320	H'Mong	94	Thai	6	1.250	265	2	285	1400	8	6.0	8.0	Y	Y	C	M	N	20	Y	Y	N	53.0	25	Y	5.5
134	20	Son La	Thuan Chau	Co Tong	103.5	21.28	1932	275	Thai	55	H'Mong	27	1.250	187	2	253	1400	11	6.0	9.0	Y	Y	C	M	N	20	Y	Y	N	50.0	30	Y	5.5
135	21	Son La	Muong La	Ngoc Chien	104.25	21.62	6669	965	Thai	60	H'Mong	30	1.282	276	3	874	1400	18	5.0	8.7	Y	Y	C	M	Y	20	Y	Y	Y	47.0		Y	5.0
136	22	Son La	Muong La	Chieng Cong	104.25	21.43	2705	469	H'Mong	70	Thai	25	1.339	253	3	354	1400	15	2.7	4.7	Y	Y	M	W	N	20	Y	Y	N	35.0			4.5
137	23	Son La	Muong La	Chieng An	104.17	21.50	1452	211	H'Mong	75	Thai	15	1.290	161	3	190	1400	7	6.3	9.5	Y	Y	M	W	N	20	Y	Y	Y	33.0			5.0
138	24	Son La	Muong La	Chieng Muon	104.13	21.53	941	143	Thai	80	Dao	10	1.259	100	3	123	1400	4	3.3	5.0	Y	Y	M	W	N	20	Y	Y	N	32.0		Y	5.0
139	25	Son La	Muong La	Muong Trai	103.77	21.58	3847	641	Thai	70	Dao	15	1.413	189	3	504	1400	14	3.9	5.0	Y	Y	M	W	N	20	Y	Y	N	14.0		Y	5.0
140	26	Son La	Muong La	Chieng Lao	103.90	21.63	6907	952	Thai	72	H'Mong	20	1.222	407	3	905	1400	20	3.6	5.2	Y	Y	M	W	N	20	Y	Y	N	21.0			5.0
141	27	Son La	Muong La	Hua Trai	104.00	21.63	2934	415	H'Mong	90	Thai	10	1.227	133	3	384	1400	15	4.0	4.5	Y	Y	M	W	N	20	Y	Y	Y	14.0			5.5
142	28	Son La	Mai Son	Chieng Noi	103.82	21.13	8013	1100	H'Mong	80	Thai	15	1.219	126	3	1050	1400	20	1.6	2.0	Y	Y	M	W	N	20	Y	Y	Y	10.0			5.0
143	29	Son La	Mai Son	Phieng Cam	104.02	21.05	3348	478	H'Mong	85	Thai	15	1.790	103	3	438	1400	16	3.9	4.5	Y	Y	C	W	Y	20	Y	Y	N	28.0			5.0
144	30	Son La	Moc Chau	Chieng Yen	104.95	20.77	3960	783	Thai	42	Dao	29	1.563	165	3	519	1400	14	7.0	15.0	Y	Y	C	C	Y	20			N	1.0	405		3.0
145	31	Son La	Moc Chau	Muong Men	104.92	20.83	1667	300	Thai	65	Dao	20	1.614	256	3	218	1400	13	5.3	6.2	Y	Y	M	W	N	20			N	5.0		Y	3.0
146	32	Son La	Moc Chau	Suoi Bang	104.82	21.00	2102	365	Thai	60	Dao	25	1.409	124	3	287	1400	12	4.5	6.7	Y	Y	M	W	N	20			N	24.0			3.0
147	33	Son La	Moc Chau	Chieng Khua	104.48	20.87	2059	343	Thai	50	Dao	30	1.460	174	3	270	1400	14	2.9	3.2	Y	Y	M	W	N	20	Y	Y	N	18.0		Y	4.5
148	34	Son La	Bac Yen	Phieng Kon	104.45	21.08	1478	223	Dao	74	H'Mong	26	1.395	191	2	194	1400	6	9.0	11.0	Y	Y	M	W	N	20	Y	Y	Y	10.5	89	Y	4.5
149	35	Son La	Bac Yen	Hang Chu	104.30	21.35	2422	338	H'Mong	100			1.400	625	2	317	1400	10	12.0	14.0	Y	Y	M	W	N	20	Y	Y	N	21.0	135	Y	4.5
150	36	Son La	Bac Yen	Xim Vang	104.38	21.35	1746	258	H'Mong	100			1.320	242	2	229	1400	7	7.0	10.0	Y	Y	M	W	N	20	Y	Y	N	14.0	85	Y	4.5
151	37	Son La	Phu Yen	Kim Bon	104.62	21.12	2917	363	H'Mong	100			1.103	673	3	382	1400	8	5.5	7.5	Y	Y	M	W	N	20	Y	Y	N	16.0			3.5
152	38	Son La	Phu Yen	Sap Xa	104.55	21.15	2118	326	H'Mong	100			1.376	108	3	277	1400	8	2.8	3.5	Y	Y	M	W	N	20	Y	Y	N	18.0			4.0

INVENTORY OF COMMUNES NOT TO BE CONNECTED TO THE EVN POWER GRID AFTER YEAR 2005

As of March, 2001

Note: ~ Average # Number of ^ Maximum C: Car M: Motorbike W: Walking Trans: transportation Dist: distance Y: Yes N: No MHP: Micro hydro power Winter: from January to March

Total No	No.	Province	District	Commune name	Lon	Lat	Basic Data: Popula-tion	#house-holds	Ethnic structure: 1st group Name	%	2nd group Name	%	Income Data: ~income (10^6 VND)	Area of rice fields (ha)	Har-vest time (times/year)	Yield (t/year)	Price for sale (VND/kg)	Village Data: #Vil-lages	~Dist be-tween vil-lages (Km)	^Dist be-tween vil-lages (Km)	Data of Infrastructure: Develop-ment of 135 program: Road (Y/N)	Irriga-tion (Y/N)	Trans in Dry sea-son	Trans in Rainy sea-son	Peren-nial road (Y/N)	^River crossing without bridge (m)	Health centre (Y/N)	School (Y/N)	Mar-ket (Y/N)	Electrification Data: Dist from MV grid (Km)	#Pico-hydro machin	MHP poten-tial (Y/N)	SUN Shine in Winter (hour/day)
153	1	Lai Chau	Tuan Giao	Ta Ma	103.55	21.66	2791	432	H'Mong	100			0.890	340	4	578	1400	7	5.1	8.2	Y	Y	C	M	N	20	Y	Y	N	22.0	39		5.0
154	2	Lai Chau	Tua Chua	Huoi so	103.38	22.10	1932	219	Dao	79	H'Mong	21	1.200	310	2	400	1400	9	9.0	11.0	Y	Y	C	M	N	20	Y	Y	N	50.0	105	Y	5.5
155	3	Lai Chau	Tua Chua	Tua Thang	103.45	21.98	3830	575	H'Mong	85	Thai	15	0.525	390	3	793	1400	8	4.8	7.2	Y	Y	C	C	Y	20	Y	Y	N	12.5	0	Y	5.0
156	4	Lai Chau	Tua Chua	Lao Xa Phinh	103.35	22.00	1722	243	H'Mong	81	Hoa	19	1.100	57	2	356	1400	6	3.8	5.7	Y	Y	C	C	Y	20	Y	Y	N	42.0	2	Y	5.5
157	5	Lai Chau	Tua Chua	Xin Chai	103.32	22.08	3866	501	H'Mong	100			0.600	810	1	800	1400	12	10.0	12.0	Y	Y	C	C	Y	20	Y	Y	N	46.0	6	Y	5.5
158	6	Lai Chau	Sin Ho	Nam Ban	103.05	22.38	1822	300	H'Mong	50	Ha Nhi	7	0.446	143	2	377	1400	10	10.0	19.0	Y	Y	M	W	N	20	Y	Y	N	70.0	0	Y	5.5
159	7	Lai Chau	Sin Ho	Pu Sam Cap	103.45	22.27	856	121	H'Mong	90	Kinh	9	0.504	75	2	177	1400	4	6.0	7.0	Y	Y	C	M	N	20	Y	Y	N	70.0	0	Y	5.5
160	8	Lai Chau	Sin Ho	Noong Heo	103.48	22.20	5267	757	Thai	95	Kinh	5	0.976	1207	3	1090	1400	14	6.0	8.7	Y	Y	C	M	N	20	Y	Y	N	63.0	0	Y	5.5
161	9	Lai Chau	Sin Ho	Nam Ma	103.35	22.17	1658	236	Thai	96	Kinh	4	1.010	205	2	343	1400	5	3.0	7.7	Y	Y	C	M	N	20	Y	Y	N	65.0	0	Y	5.5
162	10	Lai Chau	Sin Ho	Tua Sin Chai	103.27	22.12	2774	389	H'Mong	97	Kinh	2	0.560	176	2	574	1400	12	10.0	12.0	Y	Y	C	M	N	20	Y	Y	N	33.0	0	Y	5.5
163	11	Lai Chau	Sin Ho	Nam Tam	103.37	22.25	2760	402	Thai	90	Dao	8	0.700	218	3	570	1400	13	10.0	12.0	Y	Y	C	M	N	20	Y	Y	N	50.0	0	Y	5.5
164	12	Lai Chau	Sin Ho	Nam Cha	103.37	22.20	2923	473	Dao	85	H'Mong	10	0.950	460	2	605	1400	11	5.0	8.0	Y	Y	C	M	N	20	Y	Y	N	60.0	0	Y	5.5
165	13	Lai Chau	Sin Ho	Can Co	103.45	22.13	2635	419	Dao	98	Kinh	2	0.878	381	3	545	1400	9	15.0	18.0	Y	Y	C	M	N	20	Y	Y	N	43.0	0	Y	5.5
166	14	Lai Chau	Sin Ho	Nam Cuoi	103.53	22.08	3047	358	Thai	92	H'Mong	6	0.920	370	3	630	1400	8	10.0	12.0	Y	Y	C	M	N	20	Y	Y	N	70.0	0	Y	5.0
167	15	Lai Chau	Sin Ho	Nam Han	103.47	22.05	3569	590	Dao	40	Thai	39	0.600	395	2	739	1400	14	10.0	12.0	Y	Y	M	W		20	Y	Y	N	90.0	0	Y	5.0
168	16	Lai Chau	Muong Lay	Sa Tong	103.20	22.00	3468	458	H'Mong	99	Kinh	1	1.500	372	2	718	1400	11	10.0	15.0	Y	Y	M	W	N	20	Y	Y	N	8.0	0	Y	5.0
169	17	Lai Chau	Muong Lay	Nam Hang	103.00	22.18	4454	706	Thai	50	H'Mong	30	0.800	403	4	922	1400	14	15.0	18.0	Y	Y	C	C	Y	20	Y	Y	N	80.0	120	Y	5.0
170	18	Lai Chau	Muong Lay	Pu Dao	103.10	22.18	761	103	H'Mong	100			0.900	135	2	157	1400	4	6.0	7.0	Y	Y	M	M	Y	20	Y	N	N	15.0	0	Y	5.0
171	19	Lai Chau	Muong Lay	Hua Ngai	103.23	21.87	3925	574	H'Mong	92	Thai	8	3.000	366	3	812	1400	13	6.0	10.0	Y	Y	C	M	N	20	Y	Y	N	13.5	33	Y	5.0
172	20	Lai Chau	Muong Lay	Muong Tung	103.05	21.93	3121	528	Thai	56	H'Mong	39	0.419	504	2	646	1400	15	15.0	20.0	Y	Y	C	C	Y	20	Y	Y	N	12.0	0	Y	5.0
173	21	Lai Chau	Muong Te	Muong Nhe	102.45	22.12	2052	410	Thai	32	Ha Nhi	24	0.200	382	2	297	1400	12	4.6	6.7	Y	Y	C	W	Y	20	Y	Y	Y	18.0	0	Y	5.5
174	22	Lai Chau	Muong Te	Sin Thau	102.30	22.42	1558	224	Ha Nhi	100			0.210	218	2	226	1400	4	3.2	4.7	Y	Y	C	W	Y	20	Y	Y	N	52.5	4	Y	5.5
175	23	Lai Chau	Muong Te	Thu Lum	102.45	22.72	1849	260	Ha Nhi	89	Dao	10	0.200	203	2	268	1400	5	3.9	6.0	Y	Y	M	W	N	20	Y	Y	N	48.5	5	Y	5.5
176	24	Lai Chau	Muong Te	Chung Trai	102.32	22.25	797	159	Thai	65	Ha Nhi	15	0.200	76	2	116	1400	4	4.8	6.5	Y	Y	C	W	Y	20	Y	Y	N	52.0	5	Y	5.5
177	25	Lai Chau	Muong Te	Pa U	102.67	22.60	2463	366	La Hu	100			0.380	203	2	357	1400	13	2.2	6.0	Y	Y	M	W	N	20	Y	Y	N	28.0	5	Y	5.5
178	26	Lai Chau	Muong Te	Can Ho	102.73	22.27	1590	318	Thai	72	Ha Nhi	10	0.300	164	2	230	1400	14	3.6	6.2	Y	Y	C	W	Y	20	Y	Y	N	10.0	0	Y	5.5
179	27	Lai Chau	Muong Te	Muong Te	102.58	22.55	2332	400	Thai	90	Ha Nhi	5	0.370	213	2	338	1400	6	3.2	5.0	Y	Y	C	W	Y	20	Y	Y	N	30.0	0	Y	5.5
180	28	Lai Chau	Muong Te	Mu Ca	102.50	22.43	1702	256	Ha Nhi	100			0.300	221	2	247	1400	6	2.5	3.5	Y	Y	C	W	Y	20	Y	Y	N	32.0	0	Y	5.5
181	29	Lai Chau	Muong Te	Nam Khao	102.72	22.47	927	185	Thai	60	Ha Nhi	30	0.300	100	2	134	1400	5	4.5	7.7	Y	Y	C	W	Y	20	Y	Y	N	12.5	0	Y	5.5
182	30	Lai Chau	Muong Te	Ka Lang	102.37	22.63	2727	545	Ha Nhi	65	La Hu	34	0.230	173	2	395	1400	12	3.8	7.5	Y	Y	C	W	Y	20	Y	Y	Y	40.0	6	Y	5.5
183	31	Lai Chau	Muong Te	Muong Mo	102.87	22.17	3337	667	Thai	65	Ha Nhi	25	0.400	305	2	484	1400	15	3.3	4.7	Y	Y	C	W	Y	20	Y	Y	Y	23.5	0	Y	5.0
184	32	Lai Chau	Muong Te	Ta Tong	102.58	22.32	3733	747	Thai	70	Ha Nhi	15	0.300	453	2	541	1400	16	3.5	4.5	Y	Y	M	W	N	20	Y	Y	Y	25.0	0	Y	5.5
185	33	Lai Chau	Muong Te	Pa Ve Su	102.85	22.50	1685	255	La Hu	95	H'Mong	4	0.230	202	2	244	1400	17	1.8	4.0	Y	Y	C	W	N	20	Y	Y	N	60.0	6	Y	5.5
186	34	Lai Chau	Muong Te	TT Muong Te	102.80	22.37	2846	450	Thai	75	Ha Nhi	10	1.500		2	413	1400		3.6	5.7	Y	Y	C	C	Y	20	Y	Y	Y	50.0		Y	5.5
187	35	Lai Chau	Phong Tho	Si Lo Lau	103.32	22.77	2800	410	H'Mong	80	Thai	15	1.000	99	2	580	1400	14	4.5	6.0	Y	Y	C	W	N	20	Y	Y	Y	25.0		Y	5.0
188	36	Lai Chau	Phong Tho	Mai Li Chai	103.28	22.72	1525	235	H'Mong	85	Thai	15	1.000	62	2	316	1400	7	4.7	5.2	Y	Y	C	W	N	20	Y	Y	N	20.0		Y	5.5
189	37	Lai Chau	Phong Tho	Tung Qua Lin	103.38	22.67	1385	220	H'Mong	90	Ha Nhi	10	1.000	63	2	287	1400	6	0.1	1.5	Y	Y	C	W	N	20	Y	Y	N	4.5	39	Y	5.5
190	38	Lai Chau	Phong Tho	Mu Sang	103.27	22.63	1490	237	H'Mong	85	Ha Nhi	10	1.200	116	2	308	1400	6	2.7	4.5	Y	Y	C	W	N	20	Y	Y	N	12.5		Y	5.5
191	39	Lai Chau	Phong Tho	Sin Suoi Ho	103.52	22.57	1638	270	H'Mong	100			1.200	171	2	340	1400	7	3.8	6.0	Y	Y	C	W	N	20	Y	Y	N	17.5		Y	5.5
192	40	Lai Chau	Phong Tho	Khun Ha	103.60	22.22	3234	361	H'Mong	96	Thai	4	0.560	194	2	670	1400	13	10.0	12.0	Y	Y	C	W	N	20	Y	Y	Y	20.0	175	Y	5.0
193	41	Lai Chau	Phong Tho	Vang Ma Chai	103.30	22.68	1873	284	H'Mong	100			1.000	66	2	388	1400	9	4.9	10.0	Y	Y	C	W	N	20	Y	Y	N	17.0		Y	5.5
194	42	Lai Chau	Phong Tho	Pa Vay Su	103.38	22.70	1213	221	H'Mong	100			1.400	62	2	251	1400	8	5.5	9.0	Y	Y	C	W	N	20	Y	Y	N	20.0		Y	5.5
195	43	Lai Chau	Phong Tho	Mo Si San	103.38	22.75	1626	270	H'Mong	100			1.200	104	2	337	1400	10	5.2	8.5	Y	Y	C	W	N	20	Y	Y	N	25.0		Y	5.0
196	44	Lai Chau	Dien Bien	Na U	102.93	21.20	1107	176	H'Mong	100			1.000	137	2	229	1400	6	2.9	4.0	Y	Y	C	W	N	20	Y	Y	N	40.0	10	Y	5.5
197	45	Lai Chau	Dien Bien	Muong Nha	103.05	21.08	5692	890	Thai	41	H'Mong	40	1.200	259	2	1178	1400	19	6.0	7.0	Y	Y	C	W	N	20	Y	Y	N	35.0	50	Y	5.5
198	46	Lai Chau	Dien Bien	Muong Loi	103.15	20.93	3008	440	Kho Mu	39	Lao	37	1.500	371	2	623	1400	13	5.0	6.2	Y	Y	C	W	N	20	Y	Y	N	70.0	40	Y	5.5
199	47	Lai Chau	Dien Bien	Pa Thom	102.88	21.30	1006	127	H'Mong	80	Thai	10	1.000	188	2	308	1400	5	4.3	5.0	Y	Y	C	W	N	20	Y	Y	Y	13.0		Y	5.5
200	48	Lai Chau	Dien Bien Dong	Hang Lia	103.32	21.12	4535	514	H'Mong	94	Thai	6	0.300	354	1	657	1400	19	3.0	10.7	Y	Y	C	W	N	20	Y	N	N	20.0	20	Y	5.5
201	49	Lai Chau	Dien Bien Dong	Luan Gioi	103.42	21.18	4085	550	Thai	100			0.320	593	2	592	1400	16	3.5	9.7	Y	Y	C	C	Y	20	Y	Y	N	27.0	120	Y	5.5
202	50	Lai Chau	Dien Bien Dong	Chieng So	103.37	21.30	3764	468	Thai	59	Lao	5	0.300	507	3	546	1400	14	2.0	8.7	Y	Y	C	W	N	20	Y	Y	N	27.0	50	Y	5.5
203	51	Lai Chau	Dien Bien Dong	Phinh Giang	103.23	21.17	5776	794	H'Mong	68	Thai	10	0.430	803	2	838	1400	25	2.0	4.0	Y	Y	C	C	Y	20	Y	Y	N	20.0	0	Y	5.5
204	52	Lai Chau	Dien Bien Dong	Sa Dung	103.28	21.37	4426	795	H'Mong	85	Thai	15	0.250	746	2	647	#####	18	4.4	9.0	Y	Y	C	W	N	20	Y	Y	N	15.0	30	Y	5.5

INVENTORY OF COMMUNES NOT TO BE CONNECTED TO THE EVN POWER GRID AFTER YEAR 2005

As of March, 2001

Note: *~ Average* *# Number of* *^ Maximum* *C: Car* *M: Motorbike* *W: Walking* *Trans: transportation* *Dist: distance* *Y: Yes N: No* *MHP: Micro hydro power* *Winter: from January to March*

Total No	No.	Province	District	Commune name	Lon	Lat	Basic Data: Popula-tion	Basic Data: #house-holds	Ethnic structure: 1st group Name	1st group %	2nd group Name	2nd group %	Income Data: ~income (10^6 VND)	Area of rice fields (ha)	Har-vest time (times/year)	Yield (t/year)	Price for sale (VND/kg)	Village Data: #Vil-lages	~Dist be-tween vil-lages (Km)	^Dist be-tween vil-lages (Km)	Data of Infrastructure: Develop-ment of 135 program: Road (Y/N)	Develop-ment of 135 program: Irriga-tion (Y/N)	Trans in Dry sea-son	Trans in Rainy sea-son	Peren-nial road (Y/N)	^River crossing without bridge (m)	Health centre (Y/N)	School (Y/N)	Mar-ket (Y/N)	Electrification Data: Dist from MV grid (Km)	#Pico-hydro machin	MHP poten-tial (Y/N)	SUN Shine in Winter (hour/day)
205	1	Lao Cai	Bat Xat	Trung Leng Ho	103.67	22.45	1520	236	H'Mong	100			1.200	51	4	292	1400	5	2.0		Y	Y	C	W	N	20	Y	Y	N	30.0	100	Y	5.0
206	2	Lao Cai	Bat Xat	Nam Pung	103.77	22.45	1261	206	Dao	100			1.200	97	4	242	1400	4	2.5		Y	Y	C	W	N	20	Y	Y	N	35.0	80	Y	4.5
207	3	Lao Cai	Bat Xat	Y Ty	103.65	22.62	3450	508	Ha Nhi	54	H'Mong	33	1.000	67	4	622	1400	11	3.5	5.2	Y	Y	C	W	N	20	Y	Y	N	45.0	350	Y	4.5
208	4	Lao Cai	Bat Xat	Ngai Thau	103.65	22.67	1494	222	H'Mong	100			1.100	50	4	287	1400	5	2.0	5.3	Y	Y	C	W	N	20	Y	Y	N	52.0	20	Y	4.5
209	5	Lao Cai	Bat Xat	A Lu	103.65	22.7	1485	258	Dao	46	Ha Nhi	29	1.200	90	4	285	1400	6	2.5	3.0	Y	Y	M	W	N	20	Y	Y	N	60.0	150	Y	4.5
210	6	Lao Cai	Bat Xat	A Mu Xung	103.68	22.73	1612	249	Dao	58	H'Mong	27	1.100	70	4	310	1400	6	2.5	3.5	Y	Y	M	W	N	20	Y	Y	N	50.0	50	Y	4.5
211	7	Lao Cai	Bat Xat	Sang Ma Sao	103.68	22.53	3096	422	H'Mong	100			1.200	147	4	594	1400	7	3.0	4.5	Y	Y	C	C	Y	20	Y	Y	N	40.0	280	Y	4.5
212	8	Lao Cai	Bac Ha	Ban Lien	104.33	22.52	1828	243	Tay	48	H'Mong	43	1.100	119	1	350	1400	9	4.0	5.0	Y	Y	M	W	N	20	N	Y	Y	25.0	10	Y	3.0
213	9	Lao Cai	Bac Ha	Ta Cu Ty	104.37	22.60	1598	251	Tay	39	Dao	38	1.400	141	2	305	1400	7	8.0	10.0	Y	Y	M	W	N	20	Y	Y	N	16.8	12	Y	3.0
214	10	Lao Cai	Bac Ha	Ban Cai	104.32	22.38	1018	174	Dao	60	H'Mong	39	1.250	79	2	195	1400	8	4.0	5.0	Y	Y	C	C	Y	20	Y	Y	N	18.0	0	Y	3.0
215	11	Lao Cai	Bac Ha	Coc Ly	104.31	22.41	3773	676	Tay	57	Nung	23	1.000	170	2	724	1400	15	7.0	10.0	Y	Y	C	C	Y	20	Y	Y	N	16.0	0	Y	3.0
216	12	Lao Cai	Si Ma Cai	Nam Xin	104.17	22.60	1322	196	H'Mong	100			0.800	102	2	254	1400	7	2.0	5.0	Y	Y	C	C	Y	20	Y	Y	N	19.0	0	Y	3.0
217	13	Lao Cai	Si Ma Cai	Xin Cheng	104.22	22.65	3206	468	H'Mong	94	Nung	5	1.300	183	2	616	1400	7	2.0	4.5	Y	Y	C	C	Y	20	Y	Y	N	7.0	0	Y	3.0
218	14	Lao Cai	Si Ma Cai	Thao Chu Phin	104.15	22.70	1740	301	H'Mong	79	Thu Lao	20	0.850	73	2	334	1400	5	3.0	4.0	Y	Y	C	C	Y	20	Y	Y	N	13.0	6	Y	3.0
219	15	Lao Cai	Si Ma Cai	Ban Me	104.18	22.68	1675	294	Nung	66	H'Mong	30	0.900	51	2	322	1400	7	2.0	4.0	Y	Y	C	C	Y	20	Y	Y	N	15.0	10	Y	3.0
220	16	Lao Cai	Van Ban	Nam Tha	104.33	21.97	1520	217	H'Mong	100			1.000	161	2	292	1400	7	4.0	5.5	Y	Y	C	M	N	20	Y	Y	N	19.2		Y	4.0
221	17	Lao Cai	Van Ban	Nam Chay	104.02	22.10	1818	268	H'Mong	100			1.000	113	2	349	1400	8	5.0	7.0	Y	Y	C	C	Y	20	Y	Y	N	14.0	92	Y	4.5
222	18	Lao Cai	Van Ban	Nam Xe	104.05	21.93	620	83	H'Mong	100			1.100	46	2	119	1400	3	2.4	3.7	Y	Y	C	M	N	20	Y	Y	Y	25.0		Y	5.5
223	19	Lao Cai	Sa Pa	Nam Cang	104.03	22.18	1136	177	Dao	56	H'Mong	42	1.150	84	2	218	1400	2	3.0	4.0	Y	Y	C	M	N	20	Y	Y	N	20.0	90	Y	4.0
224	20	Lao Cai	Sa Pa	Suoi Thau	104.03	22.25	1539	216	Dao	89	H'Mong	9	1.100	81	2	295	1400	4	7.0	10.0	Y	Y	C	M	N	20	Y	Y	N	15.0	170	Y	4.0
225	21	Lao Cai	Sa Pa	Ban Ho	103.95	22.18	1835	297	Dao	49	Tay	34	1.114	100	2	353	1400	5	8.0	10.0	Y	Y	C	M	N	20	Y	Y	Y	9.0	70	Y	4.0
226	22	Lao Cai	Sa Pa	Ta Giang Phinh	103.80	22.43	2181	364	H'Mong	98	Kinh	2	1.100	96	2	419	1400	6	2.9	5.5	Y	Y	C	M	N	20	Y	Y	N	16.0	50	Y	4.5
227	23	Lao Cai	Sa Pa	Ban Phung	104.00	22.32	1366	191	Dao	79	H'Mong	18	0.971	74	2	263	1400	6	5.1	6.5	Y	Y	C	M	N	20	Y	Y	N	16.0	20	Y	3.5
228	24	Lao Cai	Bao Yen	Tan Tien	104.37	22.47	1820	316	Dao	60	H'Mong	29	1.200	223	1	349	1400	13	2.5		Y	Y	C	M	N	20	Y	N	N	45.0	210	Y	3.0
229	25	Lao Cai	Bao Yen	Cam Con	104.22	22.22	3906	730	Dao	41	Kinh	36	1.300	194	3	750	1400	15	1.5		Y	Y	M	W	N	20	Y	Y	N	15.0	200	Y	3.5
230	26	Lao Cai	Muong Khuong	La Pan Tan	104.12	22.58	1933	292	H'Mong	86	Dao	13	1.240	50	2	371	1400	9	6.5	8.0	Y	Y	C	M	N	20	Y	Y	N	3.0	9	Y	3.0
231	27	Lao Cai	Muong Khuong	Ta Thang	104.17	22.55	1643	261	H'Mong	99	Kinh	1	1.124	77	2	315	1400	9	6.0	7.0	Y	Y	C	M	N	20	Y	Y	N	12.0	13	Y	3.0
232	28	Lao Cai	Muong Khuong	Ta Gia Khau	104.20	22.73	1715	312	H'Mong	52	Phu La	45	1.146	56	2	329	1400	10	7.0	8.0	Y	Y	C	M	N	20	Y	Y	N	20.0	4	Y	3.0
233	29	Lao Cai	Than Uyen	Pha Mu	103.77	21.90	2831	420	Thai	83	H'Mong	11	0.600	320	3	543	1400	13	6.0	7.0	Y	Y	M	W	N	20	Y	Y	N	20.0	31	Y	4.5
234	30	Lao Cai	Than Uyen	Nam So	103.65	22.08	4517	656	Thai	72	H'Mong	21	0.550	707	3	867	1400	19	4.4	5.0	Y	Y	M	W	N	20	Y	Y	N	32.0	75	Y	5.0
235	31	Lao Cai	Than Uyen	Ho Mit	103.93	22.12	2071	306	H'Mong	96	Thai	4	0.500	294	2	398	1400	7	9.0	12.0	Y	Y	C	M	N	20	Y	Y	N	5.0	38	Y	4.5
236	1	Thanh Hoa	Nhu Xuan	Thanh Quan	105.32	19.71	4455	758	Thai	99	Kinh	1	0.360	196	2	962	1400	11	2.0	4.0	Y	Y	C	M	N	20	Y	Y	N	34.0	26		2.0
237	2	Thanh Hoa	Nhu Xuan	Thanh Son	105.25	19.68	2282	423	Thai	99	Kinh	1	0.372	64	3	493	1400	10	2.5	4.7	Y	Y	C	M	N	20	Y	Y	N	28.0	21		2.0
238	3	Thanh Hoa	Thuong Xuan	Yen Nhan	105.13	20.03	3852	680	Thai	99	Kinh	1	1.200	125	3	832	1400	6	5.0	6.0	Y	Y	C	C	Y	20	Y	Y	N	50.0	0	Y	2.5
239	4	Thanh Hoa	Thuong Xuan	Bat Mot	105.00	20.00	2983	497	Thai	100			1.100	169	3	644	1400	9	5.0	7.7	Y	Y	C	C	Y	20	Y	Y	Y	60.0	0	Y	2.5
240	5	Thanh Hoa	Thuong Xuan	Xuan Loc	105.28	19.78	3352	659	Thai	98	Kinh	2	1.200	131	3	724	1400	5	4.0	2.5	Y	Y	M	W	N	20	Y	Y	N	30.0	0		2.0
241	6	Thanh Hoa	Thuong Xuan	Xuan Chinh	105.22	19.75	2568	444	Thai	99	Kinh	1	1.200	144	3	555	1400	7	4.0	6.0	Y	Y	C	M	N	20	Y	Y	N	30.0	0		2.0
242	7	Thanh Hoa	Thuong Xuan	Xuan Le	105.17	19.80	2520	546	Thai	99	Kinh	1	1.200	195	3	544	1400	9	2.9	3.2	Y	Y	M	W	N	20	Y	Y	N	40.0	0		2.0
243	8	Thanh Hoa	Lang Chanh	Yen Khuong	105.03	20.18	4040	652	Thai	85	Muong	10	1.490	145	3	873	1400	9	4.1	6.2	Y	Y	M	W	N	20	Y	Y		21.0		Y	2.5
244	9	Thanh Hoa	Lang Chanh	Yen Thang	105.10	20.12	4652	737	Thai	90	Muong	5	1.464	112	3	1005	1400	10	3.6	5.7	Y	Y	M	W	N	20	Y	Y		21.0			2.5
245	10	Thanh Hoa	Ba Thuoc	Lung Cao	105.13	20.52	5323	1027	Thai	94	Muong	4	0.700	239	3	1150	1400	12	2.5	5.0	Y	Y	C	M	N	20	Y	Y	N	17.0	84	Y	2.5
246	11	Thanh Hoa	Ba Thuoc	Co Lung	105.25	20.43	3884	821	Thai	96	Kinh	3	0.700	178	2	839	1400	12	2.5	6.7	Y	Y	C	M	N	10	Y	Y	N	15.0	120	Y	2.0
247	12	Thanh Hoa	Ba Thuoc	Lung Niem	105.17	20.45	3140	648	Thai	85	Kinh	8	0.720	116	2	678	1400	10	0.5	3.7	Y	Y	C	M	N	20	Y	Y	Y	12.0	230	Y	2.0
248	13	Thanh Hoa	Quan Hoa	Thanh Son	104.95	20.60	2017	405	Thai	51	Muong	49	2.900	278	4	447	1400	8	3.0	5.2	Y	Y	M	W	N	20	Y	Y	N	52.0	165	Y	3.0
249	14	Thanh Hoa	Quan Hoa	Trung Son	104.80	20.60	2358	447	Thai	88	Muong	13	0.900	492	2	509	1400	7	7.1	10.5	Y	Y	M	W	N	20	Y	N	N	54.0	0		3.5
250	15	Thanh Hoa	Quan Hoa	Trung Thanh	104.90	20.54	2536	471	Thai	66	Muong	32	1.900	219	2	548	1400	10	10.0	12.0	Y	Y	M	W	N	20	Y	N	N	55.0	250		3.0
251	16	Thanh Hoa	Muong Lat	Muong Ly	104.75	20.50	4701	746	H'Mong	78	Thai	16	0.720	240	4	1015	1400	15	7.0	9.0	Y	Y	M	W	N	20	Y	Y	N	85.0	0	Y	3.5
252	17	Thanh Hoa	Muong Lat	Quang Chieu	104.75	20.58	4307	803	Thai	91	Dao	5	0.780	531	4	930	1400	13	3.5		Y	Y	C	W	N	20	Y	Y	N	124.0	120	Y	3.5
253	18	Thanh Hoa	Muong Lat	Muong Chanh	104.64	20.5	2783	456	Thai	93	Kho Mu	7	0.750	183	4	601	1400	9	2.8		Y	Y	C	W	N	20	Y	Y	N	140.0	91	Y	4.0
254	19	Thanh Hoa	Quan Son	Tam Thanh	104.96	20.22	2925	529	Thai	98	Kinh	1	0.900	163	5	632	1400	9	3.0		Y	Y	C	C	Y	20	Y	Y	Y	12.0	400	Y	2.5
255	20	Thanh Hoa	Quan Son	Tam Lu	104.87	20.18	2499	471	Thai	100			0.950	148	5	540	1400	5	6.0	7.0	Y	Y	C	M	N	20	Y	Y	N	6.0	112	Y	3.0
256	21	Thanh Hoa	Ngoc Lac	Van Am	105.30	20.02	6867	1039	Muong	96	Kinh	2	0.480	291	2	1438	1400	17	4.0	7.0	Y	Y	M	W	N	20	Y	Y	N	12.0	0		2.0

INVENTORY OF COMMUNES NOT TO BE CONNECTED TO THE EVN POWER GRID AFTER YEAR 2005

As of March, 2001

Note: ~ Average   # Number of   ^ Maximum   C: Car   M: Motorbike   W: Walking   Trans: transportation   Dist: distance   Y: Yes N: No   MHP: Micro hydro power   Winter: from January to March

Total No	No.	Province	District	Commune name	Lon	Lat	Basic Data: Popula-tion	#house-holds	Ethnic structure: 1st group Name	1st group %	2nd group Name	2nd group %	Income Data: ~income (10^6 VND)	Area of rice fields (ha)	Har-vest time (times/year)	Yield (t/year)	Price for sale (VND/kg)	Village Data: #Vil-lages	~Dist be-tween vil-lages (Km)	^Dist be-tween vil-lages (Km)	Data of Infrastructure: Develop-ment of 135 program Road (Y/N)	Develop-ment of 135 program Irriga-tion (Y/N)	Trans in Dry sea-son	Trans in Rainy sea-son	Peren-nial road (Y/N)	^River crossing without bridge (m)	Health centre (Y/N)	School (Y/N)	Mar-ket (Y/N)	Electrification Data: Dist from MV grid (Km)	#Pico-hydro machin	MHP poten-tial (Y/N)	SUN Shine in Winter (hour/day)
257	1	Nghe An	Con Cuong	Binh Chuan	104.95	19.25	3507	587	Thai	99	Kinh	1	0.300	15	3	582	1400	7	2.0	6.0	Y	Y	C	M	N	20	Y	Y	N	35.0	70	Y	2.5
258	2	Nghe An	Tuong Duong	Kim Tien	104.60	19.40	2538	424	Thai	85	Kho Mu	10	1.542	0	2	421	1400	6	4.0	7.0	Y	Y	C	M	Y	20	Y	Y	N	22.0		Y	3.0
259	3	Nghe An	Tuong Duong	Mai Son	104.47	19.45	1645	245	Thai	70	Kho Mu	15	1.327	18	3	273	1400	4	3.5	4.5	Y	Y	M	W	N	20	Y	Y	N	30.0			3.0
260	4	Nghe An	Tuong Duong	Nhon Mai	104.5	19.6	1988	293	Thai	90	H'Mong	5	1.362	15	3	330	1400	5	2.5	4.0	Y	Y	M	W	N	20	Y	Y	Y	25.0		Y	3.0
261	5	Nghe An	Ky Son	Keng Du	104.08	19.63	2934	397	Kho Mu	96	Thai	3	1.100	0	2	489	1400	9	13.0	15.0	Y	Y	M	M	Y	20	Y	Y	N	60.0	0	Y	3.5
262	6	Nghe An	Ky Son	Bac Ly	104.22	19.62	3001	392	Kho Mu	80	H'Mong	12	1.120	0	2	498	1400	13	3.4	5.0	Y	Y	M	M	Y	20	Y	Y	N	26.0	0		3.5
263	7	Nghe An	Ky Son	My Ly	104.37	19.63	4696	721	Thai	77	H'Mong	16	1.430	0	2	780	1400	13	12.0	14.0	Y	Y	M	M	Y	20	Y	Y	N	51.0	0	Y	3.5
264	8	Nghe An	Ky Son	Dooc May	104.15	19.57	1869	260	H'Mong	99	Kinh	1	1.240	0	2	310	1400	6	11.0	12.0	Y	Y	M	M	Y	20	Y	Y	N	57.0	0	Y	3.5
265	9	Nghe An	Ky Son	Na Loi	104.17	19.50	1372	206	Thai	58	Kho Mu	41	1.300	24	2	228	1400	6	10.0	13.0	Y	Y	C	C	Y	20	Y	Y	N	45.0	0		3.5
266	10	Nghe An	Ky Son	Huoi Tu	104.30	19.52	3904	606	H'Mong	94	Thai	4	1.450	0	2	648	1400	12	3.4	4.7	Y	Y	C	C	Y	20	Y	Y	Y	20.0	0		3.5
267	11	Nghe An	Ky Son	Muong Long	104.40	19.45	4105	605	H'Mong	99	Other	1	1.450	0	2	681	1400	15	9.0	11.0	Y	Y	C	C	Y	20	Y	Y	Y	41.0	0		3.0
268	12	Nghe An	Ky Son	Nam Can	104.25	19.15	1504	189	H'Mong	99	Kinh	1	1.180	0	2	250	1400	5	18.0	21.0	Y	Y	C	C	Y	20	Y	Y	N	17.0	0		3.0
269	13	Nghe An	Ky Son	Huu Lap	104.23	19.37	2286	353	Thai	83	Kho Mu	16	1.450	20	3	379	1400	6	7.0	8.0	Y	Y	C	C	Y	20	Y	Y	N	5.0	0		3.5
270	14	Nghe An	Ky Son	Bao Thang	104.40	19.38	1276	164	Kho Mu	99	Other	1	1.100	0	1	212	1400	5	12.0	14.0	Y	Y	M	W	N	20	Y	Y	N	33.0	0		3.0
271	15	Nghe An	Ky Son	Tay Son	104.12	19.33	1209	160	H'Mong	99	Kinh	1	1.240	0	2	201	1400	7	12.0	15.0	Y	Y	C	M	N	20	Y	Y	N	30.0	0		3.5
272	16	Nghe An	Ky Son	Muong Ai	103.95	19.28	1579	213	Kho Mu	61	Thai	21	1.100	7	2	262	1400	6	12.0	15.0	Y	Y	M	W	N	20	Y	Y	N	37.0	0	Y	3.5
273	17	Nghe An	Ky Son	Na Ngoi	104.20	19.25	4675	601	Muong	85	Thai	14	1.100	87	2	776	1400	16	12.0	15.0	Y	Y	M	W	N	20	Y	Y	N	25.0	0	Y	3.0
274	18	Nghe An	Que Phong	Thong Thu	104.93	19.93	3656	706	Thai	100			0.400	129	3	607	1400	12	7.0	9.0	Y	Y	C	M	N	20	Y	Y	N	50.0	120	Y	2.5
275	19	Nghe An	Que Phong	Nam Giai	104.80	19.67	1524	260	Thai	85	H'Mong	14	0.600	125	2	253	1400	6	2.1	6.5	Y	Y	M	W	N	20	Y	Y	N	17.0	45	Y	2.5
276	20	Nghe An	Que Phong	Tri Le	104.70	19.60	7295	1127	Thai	66	H'Mong	25	0.720	291	2	1210	1400	30	1.0	5.2	Y	Y	C	C	Y	20	Y	Y	Y	18.0	450	Y	3.0
277	21	Nghe An	Que Phong	Nam Nhoong	104.72	19.53	1740	305	H'Mong	96	Kinh	2	0.650	57	2	289	1400	7	3.0	6.0	Y	Y	C	M	N	20	Y	Y	N	30.0	120	Y	2.5

Micro Hydro Potential Data

Note: # Number of

Total No	No.	Province	District	Commune name	Lon	Lat	The First Site									The Second Site									Existing Hydro Site (not Working)								
							Site No.	Catchment Area (km2)	Discharge (m3/s)	Head (m)	Hydro Power (kW)	Channel Length (m)	Lon	Lat	Map No. (1:50,000)	Site No.	Catchment Area (km2)	Discharge (m3/s)	Head (m)	Hydro Power (kW)	Channel Length (m)	Lon	Lat	Map No. (1:50,000)	Site No.	Catchment Area (km2)	Discharge (m3/s)	Head (m)	Hydro Power (kW)	Channel Length (m)	Lon	Lat	Map No. (1:50,000)
1	1	Ha Giang	Dong Van	Sinh Lung	105.28	23.22												0.00		0							0.00		0				
2	2	Ha Giang	Dong Van	Ta Lung	105.37	23.22												0.00		0							0.00		0				
3	3	Ha Giang	Dong Van	Sang Tung	105.23	23.20												0.00		0							0.00		0				
4	4	Ha Giang	Dong Van	Ho Quang Phin	105.25	23.15												0.00		0							0.00		0				
5	5	Ha Giang	Dong Van	Thai Phin Tung	105.32	23.25												0.00		0							0.00		0				
6	6	Ha Giang	Dong Van	Ta Phin	105.32	23.20												0.00		0							0.00		0				
7	7	Ha Giang	Dong Van	Lung Thau	105.17	23.18												0.00		0							0.00		0				
8	8	Ha Giang	Dong Van	Van Chai	105.22	23.13												0.00		0							0.00		0				
9	9	Ha Giang	Meo Vac	Lung Chinh	105.32	23.12												0.00		0							0.00		0				
10	10	Ha Giang	Meo Vac	Lung Pu	105.50	23.10		86	0.60	240	1000		106	23				0.00		0							0.00		0				
11	11	Ha Giang	Meo Vac	Can Chu Phin	105.45	23.13			0.00		0							0.00		0							0.00		0				
12	12	Ha Giang	Meo Vac	Giang Chu Phin	105.45	23.17			0.00		0							0.00		0							0.00		0				
13	13	Ha Giang	Yen Minh	Mau Due	105.27	23.05			0.10	40	30		105.27	23.05				0.20	52	84		105.30	23.03				0.00		0				
14	14	Ha Giang	Yen Minh	Du Gia	105.20	22.92			0.00									0.00		0							0.00		0				
15	15	Ha Giang	Yen Minh	Sung Thai	105.13	23.17			0.00									0.00		0							0.00		0				
16	16	Ha Giang	Yen Minh	Huu Vinh					0.00									0.00		0							0.00		0				
17	17	Ha Giang	Yen Minh	Dong Minh					0.00									0.00		0							0.00		0				
18	18	Ha Giang	Hoang Su Phi	Thang Tin	104.63	22.80			0.00									0.00		0							0.00		0				
19	19	Ha Giang	Hoang Su Phi	Then Chu Phin	104.70	22.80			0.00									0.00		0							0.00		0				
20	20	Ha Giang	Hoang Su Phi	Ban Nhung	104.75	22.70				40	30							0.00		0							0.00		0				
21	21	Ha Giang	Hoang Su Phi	Ban Dan Van	104.72	22.77			0.30		100		104.68	22.73				0.00		0							0.00		0				
22	22	Ha Giang	Hoang Su Phi	Ban Peo	104.73	22.63			0.00		0							0.00		0							0.00		0				
23	23	Ha Giang	Hoang Su Phi	Nam Khoa	104.67	22.57			0.40	17	44		104.68	22.57				0.00		0							0.00		0				
24	24	Ha Giang	Hoang Su Phi	Xuan Minh	104.75	22.50			0.00		0							0.00		0							0.00		0				
25	25	Ha Giang	Hoang Su Phi	Ban Phung					0.00		0							0.00		0							0.00		0				
26	26	Ha Giang	Xin Mau	Ngan Chien	104.52	22.68			0.00		0							0.00		0							0.00		0				
27	27	Ha Giang	Xin Mau	Thu Ta	104.55	22.65					10							0.00		0							0.00		0				
28	28	Ha Giang	Xin Mau	Che La	104.52	22.62			0.00									0.00		0							0.00		0				
29	29	Ha Giang	Xin Mau	Ban Ngo	104.43	22.63			0.00									0.00		0							0.00		0				
30	30	Ha Giang	Xin Mau	Tan Nam	104.58	22.50					50							0.00		0							0.00		0				
31	31	Ha Giang	Xin Mau	Theng Phan	104.45	22.53			0.00									0.00		0							0.00		0				
32	32	Ha Giang	Xin Mau	Ban Diu	104.45	22.53					6							0.00		0							0.00		0				
33	33	Ha Giang	Bac Quang	Yen Thanh					0.00		0							0.00		0							0.00		0				
34	34	Ha Giang	Quan Ba	Lung Tam	105.07	23.05			0.00		0							0.00		0							0.00		0				
35	35	Ha Giang	Quan Ba	Ta Van	104.85	23.00			0.05	34	12		104.85	23.0				0.00		0							0.00		0				
36	36	Ha Giang	Bac Me	Giap Trung	105.30	22.80			0.10	17	12		105.30	22.80				0.00		0							0.00		0				
37	37	Ha Giang	Bac Me	Phu Nam	105.47	22.73			0.30	13	30		105.47	22.75				0.00		0							0.00		0				
38	38	Ha Giang	Bac Me	Thuong Tam	105.27	22.68			0.00		0							0.00		0							0.00		0				
39	39	Ha Giang	Bac Me	Yen Phong	105.40	22.75			0.00		0							0.00		0							0.00		0				
40	40	Ha Giang	Bac Me	Yen Cuong	105.37	22.68			0.20	20	30		105.37	22.56				0.00		0							0.00		0				
41	1	Cao Bang	Hoa An	Duc Xuan	106.25	22.78			0.00		0							0.00		0							0.00		0				
42	2	Cao Bang	Hoa An	Cong Trung	106.03	22.7			1.00	4	22							0.00		0							0.00		0				
43	3	Cao Bang	Hoa An	Truong Luong	106.08	22.73			0.00		0							0.00		0							0.00		0				
44	4	Cao Bang	Ha Quang	Si Hai	106.20	22.87			0.00		0							0.00		0							0.00		0				
45	5	Cao Bang	Ha Quang	Ma Ba	106.22	22.85			0.00		0							0.00		0							0.00		0				
46	6	Cao Bang	Ha Quang	Ha Thon	106.20	22.80			0.00		0							0.00		0							0.00		0				
47	7	Cao Bang	Trung Khanh	Ngoc Chung	106.47	22.88			0.00		0							0.00		0							0.00		0				
48	8	Cao Bang	Nguyen Binh	Mai Long	105.78	22.63			0.00		0							0.00		0							0.00		0				
49	9	Cao Bang	Nguyen Binh	Trieu Nguyen	105.90	22.72			0.00		0							0.00		0							0.00		0				
50	10	Cao Bang	Nguyen Binh	Thanh Cong	105.88	22.55			0.00		0							0.00		0							0.10	60	20		105.88	22.55	

Micro Hydro Potential Data

Note: # Number of

Total No	No.	Province	District	Commune name	Lon	Lat	The First Site									The Second Site									Existing Hydro Site (not Working)								
							Site No.	Catchment Area (km2)	Discharge (m3/s)	Head (m)	Hydro Power (kW)	Channel Length (m)	Lon	Lat	Map No. (1:50,000)	Site No.	Catchment Area (km2)	Discharge (m3/s)	Head (m)	Hydro Power (kW)	Channel Length (m)	Lon	Lat	Map No. (1:50,000)	Site No.	Catchment Area (km2)	Discharge (m3/s)	Head (m)	Hydro Power (kW)	Channel Length (m)	Lon	Lat	Map No. (1:50,000)
51	11	Cao Bang	Bao Lam	Nam Quang	105.43	22.93			0.00		0							0.00		0							0.00		0				
52	12	Cao Bang	Bao Lam	Yen Tho	105.53	22.68			0.00		0							0.00		0							0.00		0				
53	13	Cao Bang	Bao Lac	Son Lo	105.68	22.75			0.00		0							0.00		0							0.00		0				
54	14	Cao Bang	Bao Lac	Hong An	105.83	22.83			0.00		0							0.00		0							0.00		0				
55	1	Lang Son	Dinh Lap	Dong Thang					0.20	10	11																						
56	1	Quang Ninh	Hoanh Bo	Dong Son	106.97	21.15			0.00		0							0.00		0							0.00		0				
57	2	Quang Ninh	Hoanh Bo	Ky Thuong	107.15	21.18			0.00		0							0.00		0							0.00		0				
58	3	Quang Ninh	Hoanh Bo	Hoa Binh	107.18	21.08			0.00		0							0.00		0							0.00		0				
59	4	Quang Ninh	Ba Che	Luong Mong	107.00	21.27			0.50	3	5		107.00	21.27				0.00		0							0.00		0				
60	5	Quang Ninh	Ba Che	Minh Cam	107.07	21.23			0.50	4	10		107.07	21.23				0.00		0							0.00		0				
61	6	Quang Ninh	Quang Ha	Quang Thinh	107.70	21.45					0							0.00		0							0.29	6	12		107.7	21.45	
62	7	Quang Ninh	Quang Ha	Quang Son	107.62	21.55					0							0.00		0							0.00		0				
63	1	Bac Can	Ba Be	Dong Phuc	105.75	22.30					25		105.75	22.30				0.00		0							0.00		0				
64	2	Bac Can	Ba Be	Hoang Tri	105.67	22.30			0.30	8	25		105.67	22.30				0.00		0							0.00		0				
65	3	Bac Can	Ba Be	Quang Khe	105.72	22.37			0.30	8	25		105.72	22.37				0.00		0							0.00		0				
66	4	Bac Can	Ba Be	An Thang	105.75	22.58					15		105.75	22.58				0.00		0							0.00		0				
67	5	Bac Can	Ba Be	Co Linh	105.63	22.57					15		105.63	22.57				0.00		0							0.00		0				
68	6	Bac Can	Ba Be	Cao Tan	105.63	22.52			0.00		0							0.00		0							0.00		0				
69	7	Bac Can	Bach Thong	Cao Son	105.97	22.17			0.00		0							0.00		0							0.00		0				
70	1	Yen Bai	Tram Tau	Lang Nhi	104.52	20.97					10		104.50	20.97				0.00		0							0.00		0				
71	2	Yen Bai	Tram Tau	Ta Si Lang	104.63	20.95					20		104.63	20.95				0.00		0							0.00		0				
72	3	Yen Bai	Mu Cang Chai	Che Tao							120							0.00		0							0.00		0				
73	4	Yen Bai	Van Yen	Mo Vang	104.63	21.50			0.50	60	165							0.00		0							0.00		0				
74	5	Yen Bai	Van Yen	Na Hau	104.55	21.50			1.60	102	1242		104.55	21.50				0.00		0							0.00		0				
75	6	Yen Bai	Van Yen	Xuan Tam	104.52	21.72			0.00		0							0.00		0							0.00		0				
76	7	Yen Bai	Van Chau	An Luong	104.62	21.32			0.00		0							0.00		0							0.00		0				
77	1	Phu Tho	Thanh Son	Tan Lap	105.20	21.00			0.00		0							0.00		0							0.00		0				
78	2	Phu Tho	Thanh Son	Yen Luong					0.83	6	40							0.00		0									20				
79	3	Phu Tho	Thanh Son	Yen Lang	105.23	20.98			0.00		0							0.00		0							0.00		0				
80	4	Phu Tho	Thanh Son	Thu Ngac	105.05	21.25			0.00		0							0.00		0							0.00		0				
81	5	Phu Tho	Thanh Son	Xuan Dai	105.00	21.15			0.20	4	30							0.00		0							0.00		0				
82	6	Phu Tho	Thanh Son	Kim Thuong	105.00	21.07			0.50	5	15							0.00		0							0.00		0				
83	7	Phu Tho	Thanh Son	Lai Dong	104.92	21.22			5.00	7	200							0.00		0									5		104.92	21.22	
84	8	Phu Tho	Thanh Son	Kiet Son	104.95	21.23			0.00		0							0.00		0							0.00		0				
85	9	Phu Tho	Thanh Son	Tan Son	104.93	21.18			0.00		0							0.00		0							0.00		0				
86	10	Phu Tho	Thanh Son	Dong Son	104.88	21.18			0.50	5	15							0.00		0							0.00		0				
87	11	Phu Tho	Thanh Son	Dong Cuu	105.08	21.02			0.45	6	15							0.00		0							0.00		0				
88	12	Phu Tho	Thanh Son	Thuong Cuu	105.12	20.98			0.60	25	100							0.00		0							0.00		0				
89	13	Phu Tho	Thanh Son	Vinh Tien	105.07	21.07			0.50	5	15							0.00		0							0.00		0				
90	14	Phu Tho	Thanh Son	Xuan Son	104.93	21.15			0.00		0							0.00		0							0.00		0				
91	15	Phu Tho	Thanh Son	Yen Son	105.28	20.95			0.00		0							0.00		0							0.00		0				
92	16	Phu Tho	Thanh Son	Luong Nha	105.30	21.00			0.00		0							0.00		0							0.00		0				
93	17	Phu Tho	Thanh Son	Long Coc	105.05	21.12			0.00		0							0.00		0							0.00		0				
94	18	Phu Tho	Thanh Son	Tam Thanh	105.10	21.08			0.00		0							0.00		0							0.00		0				
95	19	Phu Tho	Thanh Son	Minh Dai	105.03	21.17			11.00	15	1300							150.00	7	180							0.00		0				
96	20	Phu Tho	Thanh Son	Kha Cuu	105.13	21.03			0.00		0							0.00		0							0.00		0				
97	21	Phu Tho	Thanh Son	Tan Phu	105.00	21.20			0.00		0							0.00		0							0.00		0				
98	22	Phu Tho	Thanh Son	Thach Kiet	104.97	21.28			5.00	15	500							0.00		0							0.00		0				
99	23	Phu Tho	Thanh Son	My Thuan	105.05	21.20			0.50	15	45							0.00		0							0.00		0				
100	24	Phu Tho	Thanh Son	Van Mieu					11.00	30	260							0.00		0							0.00		0				
101	25	Phu Tho	Thanh Son	Cu Dong					0.00		0							0.00		0							0.00		0				

Micro Hydro Potential Data

Note: # Number of

Total No	No.	Province	District	Commune name	Lon	Lat	The First Site: Site No.	Catchment Area (km2)	Discharge (m3/s)	Head (m)	Hydro Power (kW)	Channel Length (m)	Lon	Lat	Map No. (1:50,000)	The Second Site: Site No.	Catchment Area (km2)	Discharge (m3/s)	Head (m)	Hydro Power (kW)	Channel Length (m)	Lon	Lat	Map No. (1:50,000)	Existing Hydro Site (not Working): Site No.	Catchment Area (km2)	Discharge (m3/s)	Head (m)	Hydro Power (kW)	Channel Length (m)	Lon	Lat	Map No. (1:50,000)
102	1	Hoa Binh	Tan Lac	Nam Son	105.17	20.55			0.00		0							0.00		0							0.00		0				
103	2	Hoa Binh	Tan Lac	Bac Son	105.13	20.58			0.00		0							0.00		0							0.00		0				
104	3	Hoa Binh	Lac Son	Ngoc Son	105.30	20.45			0.00		0							0.00		0							0.00		0				
105	4	Hoa Binh	Lac Son	Ngoc Lau	105.43	20.40			0.00		0							0.00		0							0.00		0				
106	5	Hoa Binh	Lac Son	Tu Do	105.35	20.40			0.22	150	166	2300	105.37	20.41				0.21	140	148	300	105.37	20.37				0.00		0				
107	6	Hoa Binh	Lac Son	Mien Doi	105.42	20.58		10	0.15	100	75	500	105.42	20.56			16	0.20	80	80	600	105.42	20.55				0.00		0				
108	7	Hoa Binh	Kim Boi	Thuong Tien	105.43	20.65		9	0.09	100	45	600	105.43	20.65			25	0.20	10	10	500	105.45	20.66				0.00		0				
109	8	Hoa Binh	Mai Chau	Tan Mai	105.07	20.78			0.00		0							0.00		0							0.00		0				
110	9	Hoa Binh	Lac Thuy	Dong Mon	105.70	20.48			0.00		0							0.00		0							0.00		0				
111	10	Hoa Binh	Yen Thuy	Lac Sy	105.57	20.52			0.00		0							0.00		0							0.00		0				
112	11	Hoa Binh	Da Bac	Tan Dan	105.03	20.82			0.00		0							0.00		0							0.00		0				
113	12	Hoa Binh	Ky Son	Doc Lap	105.40	20.82			0.00		0							0.00		0							0.00		0				
114	13	Hoa Binh	Ky Son	Yen Thuong				14	0.03	60	9	200	105.36	20.60				0.00		0							0.00		0				
115	1	Son La	Quynh Nhai	Nam Ca Nang	103.55	21.95			0.00		0							0.00		0							0.00		0				
116	2	Son La	Quynh Nhai	Chieng Khay	103.65	21.87			0.00		0							0.00		0							0.00		0				
117	3	Son La	Song Ma	Chieng En	103.50	21.18			0.00		0							0.00		0							0.00		0				
118	4	Son La	Song Ma	Muong Leo	103.35	20.90			1.80	2.8	30							0.00		0							0.00		0				
119	5	Son La	Song Ma	Muong Va	103.62	20.87			0.00		0							0.00		0									5				
120	6	Son La	Song Ma	Muong Lan	104.00	20.97			0.00		0							0.00		0							0.00		0				
121	7	Son La	Song Ma	Bo Sinh	103.45	21.30			0.00		0							0.00		0							0.00		0				
122	8	Son La	Song Ma	Chieng Phung	103.60	21.25			0.00		0							0.00		0							0.00		0				
123	9	Son La	Song Ma	Sam Kha					0.00		0							0.00		0							0.00		0				
124	10	Son La	Song Ma	Pung Banh	103.40	21.03			0.00		0							0.00		0							0.00		0				
125	11	Son La	Song Ma	Muong Cai	103.75	20.90			0.00		0							0.00		0							0.00		0				
126	12	Son La	Thuan Chau	Long He	103.50	21.40			1.00	30	50							0.00		0							0.00		0				
127	13	Son La	Thuan Chau	Muong Bam	103.37	21.40			2.00	30	100							0.00		0							0.00		0				
128	14	Son La	Thuan Chau	Liep Muoi	103.70	21.57			1.00	60	100							0.00		0							0.00		0				
129	15	Son La	Thuan Chau	Ban Lam					0.50	30	50							0.00		0									5				
130	16	Son La	Thuan Chau	Bo Muoi	103.90	21.43			1.00	30	50							0.00		0							0.00		0				
131	17	Son La	Thuan Chau	E Tong	103.47	21.45			0.70	30	50							0.00		0							0.00		0				
132	18	Son La	Thuan Chau	Co Ma	103.53	21.35			0.40	30	50							0.00		0							0.00		0				
133	19	Son La	Thuan Chau	Pa Long	103.53	21.25			1.00	35	50							0.00		0							0.00		0				
134	20	Son La	Thuan Chau	Co Tong	103.5	21.28			0.70	30	50							0.00		0							0.00		0				
135	21	Son La	Muong La	Ngoc Chien	104.25	21.62			0.00		0							0.00		0									24				
136	22	Son La	Muong La	Chieng Cong	104.25	21.43			0.00		0							0.00		0							0.00		0				
137	23	Son La	Muong La	Chieng An	104.17	21.50			0.00		0							0.00		0							0.00		0				
138	24	Son La	Muong La	Chieng Muon	104.13	21.53			0.15	30	24							0.00		0							0.00		0				
139	25	Son La	Muong La	Muong Trai	103.77	21.58			1.00	5	30							0.00		0							0.00		0				
140	26	Son La	Muong La	Chieng Lao	103.90	21.63			0.00		0							0.00		0							0.00		0				
141	27	Son La	Muong La	Hua Trai	104.00	21.63			0.00		0							0.00		0							0.00		0				
142	28	Son La	Mai Son	Chieng Noi	103.82	21.13			0.00		0							0.00		0							0.00		0				
143	29	Son La	Mai Son	Phieng Cam	104.02	21.05			0.00		0							0.00		0							0.00		0				
144	30	Son La	Moc Chau	Chieng Yen	104.95	20.77		20	0.15	60	45	200	104.96	20.77			7	0.05	30	7.5	104.98	20.73					0.00		0				
145	31	Son La	Moc Chau	Muong Men	104.92	20.83		17	0.14	150	150		104.89	20.93				0.00		0							0.00		0				
146	32	Son La	Moc Chau	Suoi Bang	104.82	21.00			0.00		0							0.00		0							0.00		0				
147	33	Son La	Moc Chau	Chieng Khua	104.48	20.87			0.00		0							0.00		0									12				
148	34	Son La	Bac Yen	Phieng Kon	104.45	21.08			3.00		100							0.00		0							0.00		0				
149	35	Son La	Bac Yen	Hang Chu	104.30	21.35			0.15	100	60		104.30	21.35				0.10	100	35		104.31	21.34				0.00		0				
150	36	Son La	Bac Yen	Xim Vang	104.38	21.35			0.00		0							0.00		0							0.00		0				
151	37	Son La	Phu Yen	Kim Bon	104.62	21.12			0.00		0							0.00		0							0.00		0				
152	38	Son La	Phu Yen	Sap Xa	104.55	21.15			0.00		0							0.00		0							0.00		0				

Micro Hydro Potential Data

Note: # Number of

Total No	No.	Province	District	Commune name	Lon	Lat	The First Site: Site No.	Catch-ment Area (km2)	Dis-charge (m3/s)	Head (m)	Hydro Power (kW)	Channel Length (m)	Lon	Lat	Map No. (1:50,000)	The Second Site: Site No.	Catch-ment Area (km2)	Dis-charge (m3/s)	Head (m)	Hydro Power (kW)	Channel Length (m)	Lon	Lat	Map No. (1:50,000)	Existing Hydro Site (not Working): Site No.	Catch-ment Area (km2)	Dis-charge (m3/s)	Head (m)	Hydro Power (kW)	Channel Length (m)	Lon	Lat	Map No. (1:50,000)
153	1	Lai Chau	Tuan Giao	Ta Ma	103.53	21.73			0.00		0							0.00		0							0.00		0				
154	2	Lai Chau	Tua Chua	Huoi so	103.38	22.10		17	0.17	20	20							0.00		0							0.00		0				
155	3	Lai Chau	Tua Chua	Tua Thang	103.45	21.98		20	0.20	20	30							0.00		0							0.00		0				
156	4	Lai Chau	Tua Chua	Lao Xa Phinh	103.35	22.00		10	0.07	45	10							0.00		0							0.00		0				
157	5	Lai Chau	Tua Chua	Xin Chai	103.32	22.08		12	0.15	20	20							0.00		0							0.00		0				
158	6	Lai Chau	Sin Ho	Nam Ban	103.05	22.38		10	0.15	100	30							0.00		0							0.00		0				
159	7	Lai Chau	Sin Ho	Pu Sam Cap	103.45	22.27		14	0.14	80	30							0.00		0							0.00		0				
160	8	Lai Chau	Sin Ho	Noong Heo	103.48	22.20		20	0.20	100	100							0.00		0							0.00		0				
161	9	Lai Chau	Sin Ho	Nam Ma	103.35	22.17		8	0.08	20	10							0.00		0							0.00		0				
162	10	Lai Chau	Sin Ho	Tua Sin Chai	103.27	22.12		20	0.32	30	60							0.00		0							0.00		0				
163	11	Lai Chau	Sin Ho	Nam Tam	103.37	22.25		13	0.15	80	50							0.00		0							0.00		0				
164	12	Lai Chau	Sin Ho	Nam Cha	103.37	22.20		6	0.06	25	10							0.00		0							0.00		0				
165	13	Lai Chau	Sin Ho	Can Co	103.45	22.13		20	0.30	15	30							0.00		0							0.00		0				
166	14	Lai Chau	Sin Ho	Nam Cuoi	103.53	22.08		20	0.10	40	20							0.00		0							0.00		0				
167	15	Lai Chau	Sin Ho	Nam Han				10	0.10	20	15							0.00		0							0.00		0				
168	16	Lai Chau	Muong Lay	Sa Tong	103.20	22.00		10	0.10	40	30							0.00		0							0.00		0				
169	17	Lai Chau	Muong Lay	Nam Hang	103.00	22.18		23	0.30	76	170		103.14	22.02			10	0.10	40	30							0.00		0				
170	18	Lai Chau	Muong Lay	Pu Dao	103.10	22.18		48	1.30	66	600		103.15	22.18			15	0.15	40	40							0.00		0				
171	19	Lai Chau	Muong Lay	Hua Ngai	103.23	21.87		8	0.10		20							0.00		0							0.00		0				
172	20	Lai Chau	Muong Lay	Muong Tung	103.05	21.93		72	0.60	100	450		103.13	21.92				0.00		0									12				
173	21	Lai Chau	Muong Te	Muong Nhe	102.45	22.12		8	0.10	40	30						17	0.24	15	23		102.50	22.10				0.00		0				
174	22	Lai Chau	Muong Te	Sin Thau	102.30	22.42		28	0.30	40	50							0.19	20	25		102.32	22.38				0.00		0				
175	23	Lai Chau	Muong Te	Thu Lum	102.45	22.72		8	0.12	80	50							0.40	8	20		102.43	22.68				0.00		0				
176	24	Lai Chau	Muong Te	Chung Trai	102.32	22.25		130	1.00	10	50							0.21	15	20		102.33	22.23				0.00		0				
177	25	Lai Chau	Muong Te	Pa U	102.67	22.60		10	0.15	30	30							0.30	8.5	16		102.65	22.58				0.00		0				
178	26	Lai Chau	Muong Te	Can Ho	102.73	22.27		28	0.60	40	150							0.00		0							0.00		0				
179	27	Lai Chau	Muong Te	Muong Te	102.58	22.55		60	0.36	70	150	2500	102.67	22.45			67	0.50	12	35	100	102.70	22.70				0.00		0				
180	28	Lai Chau	Muong Te	Mu Ca	102.50	22.43		20	0.20	20	30							0.00		0							0.00		0				
181	29	Lai Chau	Muong Te	Nam Khao	102.72	22.47		35	0.45	10	30							0.00		0							0.00		0				
182	30	Lai Chau	Muong Te	Ka Lang	102.37	22.63		10	0.10	40	30							0.40	12	30		102.57	22.67				0.00		0				
183	31	Lai Chau	Muong Te	Muong Mo	102.87	22.17			0.31	8	15		102.83	22.18				0.40	35	8		102.84	22.19				0.00		0				
184	32	Lai Chau	Muong Te	Ta Tong	102.58	22.32		20	0.20	40	50							0.00		0							0.00		0				
185	33	Lai Chau	Muong Te	Pa Ve Su	102.85	22.50		180	4.00	10	200							0.54	6	20		102.38	22.50				0.00		0				
186	34	Lai Chau	Muong Te	TT Muong Te	102.80	22.37					500							0.00		0							0.00		0				
187	35	Lai Chau	Phong Tho	Si Lo Lau	103.32	22.77		20	0.40	20	50							0.00		0							0.00		0				
188	36	Lai Chau	Phong Tho	Mai Li Chai	103.28	22.72		54	0.80	10	50							0.00		0							0.00		0				
189	37	Lai Chau	Phong Tho	Tung Qua Lin	103.38	22.67		14	0.14	60	42	600	103.37	22.70				0.00		0							0.00		0				
190	38	Lai Chau	Phong Tho	Mu Sang	103.27	22.63		15	0.30	10	20							0.00		0							0.00		0				
191	39	Lai Chau	Phong Tho	Sin Suoi Ho	103.52	22.57		15	0.20	10	20							0.00		0							0.00		0				
192	40	Lai Chau	Phong Tho	Khun Ha	103.60	22.22		7	0.07	40	14	500	103.57	22.26			7	0.07	30	10.5	200	103.61	22.27				0.00		0				
193	41	Lai Chau	Phong Tho	Vang Ma Chai	103.30	22.68		15	0.30	20	30							0.00		0							0.00		0				
194	42	Lai Chau	Phong Tho	Pa Vay Su	103.38	22.70		16	0.20	20	40							0.00		0							0.00		0				
195	43	Lai Chau	Phong Tho	Mo Si San	103.38	22.75		20	0.35	15	40							0.00		0							0.00		0				
196	44	Lai Chau	Dien Bien	Na U	102.93	21.20		12	0.20	20	30							0.00		0							0.00		0				
197	45	Lai Chau	Dien Bien	Muong Nha	103.05	21.08		16	0.30	20	40							0.00		0							0.00		0				
198	46	Lai Chau	Dien Bien	Muong Loi	103.15	20.93		40	0.80	10	50							0.00		0							0.00		0				
199	47	Lai Chau	Dien Bien	Pa Thom	102.88	21.30		20	0.40	10	30							0.00		0							0.00		0				
200	48	Lai Chau	Dien Bien Dong	Hang Lia	103.32	21.12		10	0.15	20	20							0.00		0							0.00		0				
201	49	Lai Chau	Dien Bien Dong	Luan Gioi	103.42	21.18			0.20	20	25		103.42	21.13				0.00		0							0.00		0				
202	50	Lai Chau	Dien Bien Dong	Chieng So	103.37	21.30		24	0.50	20	60							0.00		0							0.00		0				
203	51	Lai Chau	Dien Bien Dong	Phinh Giang	103.23	21.17		12	0.15	20	20							0.00		0							0.00		0				
204	52	Lai Chau	Dien Bien Dong	Sa Dung	103.28	21.37		30	0.30	20	40							0.00		0							0.00		0				

Micro Hydro Potential Data

Note: # Number of

Total No	No.	Province	District	Commune name	Lon	Lat	The First Site									The Second Site									Existing Hydro Site (not Working)								
							Site No.	Catchment Area (km2)	Discharge (m3/s)	Head (m)	Hydro Power (kW)	Channel Length (m)	Lon	Lat	Map No. (1:50,000)	Site No.	Catchment Area (km2)	Discharge (m3/s)	Head (m)	Hydro Power (kW)	Channel Length (m)	Lon	Lat	Map No. (1:50,000)	Site No.	Catchment Area (km2)	Discharge (m3/s)	Head (m)	Hydro Power (kW)	Channel Length (m)	Lon	Lat	Map No. (1:50,000)
205	1	Lao Cai	Bat Xat	Trung Leng Ho	103.67	22.45		42	0.80	80	300						28	0.46	40	100							0.00		0				
206	2	Lao Cai	Bat Xat	Nam Pung	103.77	22.45		13	0.20	40	40							0.00		0							0.00		0				
207	3	Lao Cai	Bat Xat	Y Ty	103.65	22.62		12	0.25	30	30							0.00		0							0.00		0				
208	4	Lao Cai	Bat Xat	Ngai Thau	103.65	22.67												0.00		0							0.00		0				
209	5	Lao Cai	Bat Xat	A Lu	103.65	22.7		10	0.20	40	20							0.00		0							0.00		0				
210	6	Lao Cai	Bat Xat	A Mu Xung	103.68	22.73		15	0.30	20	30							0.00		0							0.00		0				
211	7	Lao Cai	Bat Xat	Sang Ma Sao	103.68	22.53		25	0.30	30	50						16	0.20	20	25							0.00		0				
212	8	Lao Cai	Bac Ha	Ban Lien	104.33	22.52		39	0.78	30	100							0.00		0							0.00		0				
213	9	Lao Cai	Bac Ha	Ta Cu Ty	104.37	22.60		8	0.16	30	20							0.00		0							0.00		0				
214	10	Lao Cai	Bac Ha	Ban Cai	104.32	22.38		6	0.12	40	30							0.00		0							0.00		0				
215	11	Lao Cai	Bac Ha	Coc Ly				25	0.50	50	100							0.00		0							0.00		0				
216	12	Lao Cai	Si Ma Cai	Nam Xin	104.17	22.60		5	0.10	40	20							0.00		0							0.00		0				
217	13	Lao Cai	Si Ma Cai	Xin Cheng	104.22	22.65		8	0.16	40	30							0.00		0							0.00		0				
218	14	Lao Cai	Si Ma Cai	Thao Chu Phin	104.15	22.70		6	0.10	20	10							0.00		0							0.00		0				
219	15	Lao Cai	Si Ma Cai	Ban Me	104.18	22.68		7	0.14	50	40							0.00		0							0.00		0				
220	16	Lao Cai	Van Ban	Nam Tha	104.33	21.97		60	0.80	70	300							0.00		0							0.00		0				
221	17	Lao Cai	Van Ban	Nam Chay	104.02	22.10		25	0.25	20	25	500	104.06	22.10			19	0.19	10	9.5	100	104.07	22.13				0.00		0				
222	18	Lao Cai	Van Ban	Nam Xe	104.05	21.93		30	0.30	50	60							0.00		0							0.00		0				
223	19	Lao Cai	Sa Pa	Nam Cang	104.03	22.18		16	0.35	40	50							0.00		0							0.00		0				
224	20	Lao Cai	Sa Pa	Suoi Thau	104.03	22.25		10	0.15	20	20							0.00		0							0.00		0				
225	21	Lao Cai	Sa Pa	Ban Ho	103.95	22.18		21	0.30	40	60							0.00		0							0.00		0				
226	22	Lao Cai	Sa Pa	Ta Giang Phinh	103.80	22.43		15	0.15	25	40							0.00		0							0.00		0				
227	23	Lao Cai	Sa Pa	Ban Phung	104.00	22.32		10	0.10	20	20							0.00		0							0.00		0				
228	24	Lao Cai	Bao Yen	Tan Tien	104.37	22.47		58	1.16	25	150							0.00		0							0.00		0				
229	25	Lao Cai	Bao Yen	Cam Con	104.22	22.22		10	0.20	40	40							0.00		0							0.00		0				
230	26	Lao Cai	Muong Khuong	La Pan Tan	104.12	22.58		8	0.10	15	10							0.00		0							0.00		0				
231	27	Lao Cai	Muong Khuong	Ta Thang	104.17	22.55		12	0.15	40	20							0.00		0							0.00		0				
232	28	Lao Cai	Muong Khuong	Ta Gia Khau	104.20	22.73		5	0.10	40	10							0.00		0							0.00		0				
233	29	Lao Cai	Than Uyen	Pha Mu	103.77	21.90		35	0.60	25	100						13	0.20	20	20							0.00		0				
234	30	Lao Cai	Than Uyen	Nam So	103.65	22.08		18	0.35	30	50						36	0.70	50	200							0.00		0				
235	31	Lao Cai	Than Uyen	Ho Mit	103.93	22.12		16	0.16	40	32	1000	103.90	22.12			20	0.20	20	20	500	103.87	22.11				0.00		0				
236	1	Thanh Hoa	Nhu Xuan	Thanh Quan					0.00		0							0.00		0							0.00		0				
237	2	Thanh Hoa	Nhu Xuan	Thanh Son	105.25	19.68			0.00		0							0.00		0							0.00		0				
238	3	Thanh Hoa	Thuong Xuan	Yen Nhan	105.13	20.03			0.30	45	80							0.00		0							0.00		0				
239	4	Thanh Hoa	Thuong Xuan	Bat Mot	105.00	20.00			0.40	4	10		105.05	20.02				0.30	5	9							0.00		0				
240	5	Thanh Hoa	Thuong Xuan	Xuan Loc	105.28	19.78			0.00		0							0.00		0							0.00		0				
241	6	Thanh Hoa	Thuong Xuan	Xuan Chinh	105.22	19.75			0.00		0							0.00		0							0.00		0				
242	7	Thanh Hoa	Thuong Xuan	Xuan Le	105.17	19.80			0.00		0							0.00		0							0.00		0				
243	8	Thanh Hoa	Lang Chanh	Yen Khuong	105.03	20.18			0.65	23	75							1.00	4	20		105.08	20.18				0.00		0				
244	9	Thanh Hoa	Lang Chanh	Yen Thang	105.10	20.12			0.00		0							0.00		0							0.00		0				
245	10	Thanh Hoa	Ba Thuoc	Lung Cao	105.13	20.52			1.50	7	63		105.13	20.52				0.00		0							0.00		0				
246	11	Thanh Hoa	Ba Thuoc	Co Lung	105.25	20.43			0.50	2.5	13		105.20	20.43				0.60	4	12							0.00		0				
247	12	Thanh Hoa	Ba Thuoc	Lung Niem	105.17	20.45				2	10							0.00		0							0.00		0				
248	13	Thanh Hoa	Quan Hoa	Thanh Son	104.95	20.60			0.20	5	5							0.00		0							0.00		0				
249	14	Thanh Hoa	Quan Hoa	Trung Son	104.80	20.60			0.00									0.00		0							0.00		0				
250	15	Thanh Hoa	Quan Hoa	Trung Thanh	104.90	20.60			0.00									0.00		0							0.00		0				
251	16	Thanh Hoa	Muong Lat	Muong Ly	104.75	20.50			0.50	30	50							0.00		0							0.00		0				
252	17	Thanh Hoa	Muong Lat	Quang Chieu					0.50	20	40							0.00		0							0.00		0				
253	18	Thanh Hoa	Muong Lat	Muong Chanh					0.50	15	25							0.00		0							0.00		0				
254	19	Thanh Hoa	Quan Son	Tam Thanh					0.20	8	10							0.00		0							0.00		0				
255	20	Thanh Hoa	Quan Son	Tam Lu	104.87	20.18			0.20	8	10							0.00		0							0.00		0				
256	21	Thanh Hoa	Ngoc Lac	Van Am	105.30	20.02			0.00									0.00		0							0.00		0				

Micro Hydro Potential Data

Note: # Number of

							The First Site									The Second Site									Existing Hydro Site (not Working)								
Total No	No.	Province	District	Commune name	Lon	Lat	Site No.	Catch-ment Area (km2)	Dis-charge (m3/s)	Head (m)	Hydro Power (kW)	Channel Length (m)	Lon	Lat	Map No. (1:50,000)	Site No.	Catch-ment Area (km2)	Dis-charge (m3/s)	Head (m)	Hydro Power (kW)	Channel Length (m)	Lon	Lat	Map No. (1:50,000)	Site No.	Catch-ment Area (km2)	Dis-charge (m3/s)	Head (m)	Hydro Power (kW)	Channel Length (m)	Lon	Lat	Map No. (1:50,000)
257	1	Nghe An	Con Cuong	Binh Chuan	104.95	19.25			1.50	6.5	40							0.00		0							0.00		0				
258	2	Nghe An	Tuong Duong	Kim Tien	104.60	19.40			0.15	20	20		104.58	19.43				0.00		0							0.00		0				
259	3	Nghe An	Tuong Duong	Mai Son					0.00				104.10	19.60				0.10	21	15							0.00		0				
260	4	Nghe An	Tuong Duong	Nhon Mai					0.30	20	95							0.00		0							0.00		0				
261	5	Nghe An	Ky Son	Keng Du	104.08	19.63			0.12	18	15							0.00		0							0.00		0				
262	6	Nghe An	Ky Son	Bac Ly	104.22	19.62			0.00									0.00		0							0.00		0				
263	7	Nghe An	Ky Son	My Ly	104.37	19.63			0.24	20	28							0.00		0							0.00		0				
264	8	Nghe An	Ky Son	Dooc May	104.15	19.57			0.00									0.00		0							0.00		0				
265	9	Nghe An	Ky Son	Na Loi	104.17	19.50			0.42	10	25							0.00		0							0.00		0				
266	10	Nghe An	Ky Son	Huoi Tu	104.30	19.52			0.00		0							0.00		0							0.00		0				
267	11	Nghe An	Ky Son	Muong Long	104.40	19.45			0.00		0							0.00		0							0.00		0				
268	12	Nghe An	Ky Son	Nam Can	104.25	19.15			0.00		0							0.00		0							0.00		0				
269	13	Nghe An	Ky Son	Huu Lap	104.23	19.37			0.00		0							0.00		0							0.00		0				
270	14	Nghe An	Ky Son	Bao Thang	104.40	19.38			0.00		0							0.00		0							0.00		0				
271	15	Nghe An	Ky Son	Tay Son	104.12	19.33			0.00		0							0.00		0							0.00		0				
272	16	Nghe An	Ky Son	Muong Ai	103.95	19.28			0.20	18	25							0.00		0							0.00		0				
273	17	Nghe An	Ky Son	Na Ngoi	104.20	19.25			0.45	40	26							0.07	40	15							0.00		0				
274	18	Nghe An	Que Phong	Thong Thu	104.93	19.93			0.29	40	91							0.00		0							0.00		0				
275	19	Nghe An	Que Phong	Nam Giai	104.80	19.67			1.00	5	12							0.00		0							0.00		0				
276	20	Nghe An	Que Phong	Tri Le	104.70	19.60			0.24	10	19							0.00		0							0.00		0				
277	21	Nghe An	Que Phong	Nam Nhoong	104.72	19.53			1.00	10	12							0.00		0							0.00		0				

Selecting target communes

Database Instructions

1 Screening communes for micro hydro development

The following is an example of using the database that was created during this study. Communes which will be candidates of micro hydropower development are to be selected based on four conditions: resources, village distribution, accessibility and financial ability.

(1) Resources

Figure 1-1 shows the distribution of communes with micro hydropower potential. According to the map, 169 communes or 61% of all un-electrified communes have micro hydropower potential. It is obvious that many of these communes are located in mountainous and border areas mainly in the provinces of Lai Chau, Lao Cai, Son La, Thanh Hoa, and Nghe An.

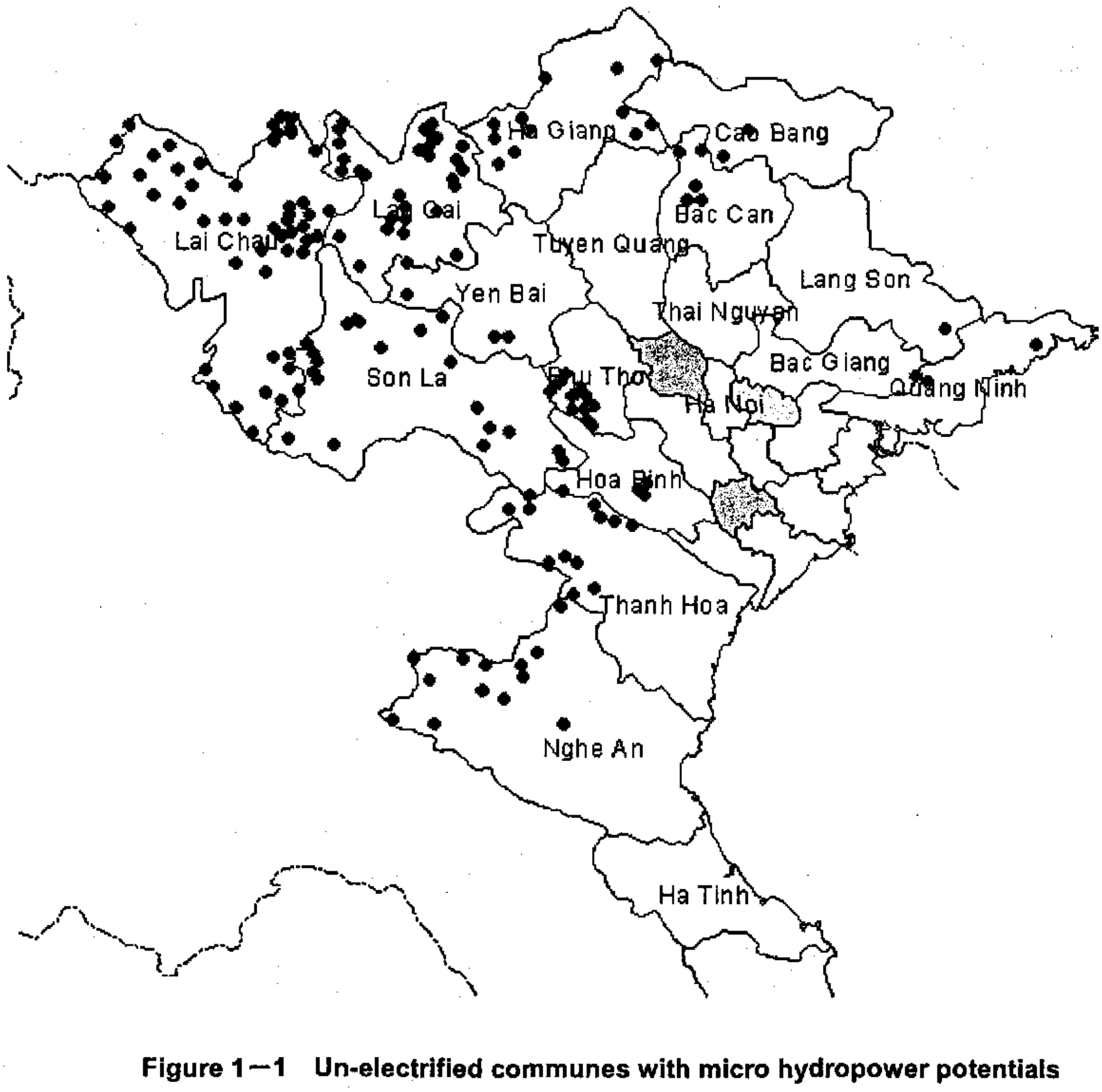


Figure 1－1 Un-electrified communes with micro hydropower potentials

(2) Village distribution

Shorter distance between villages is financially advantageous because distribution costs can be smaller. Out of the communes identified in (1), the next criterion, that is the distance between villages is less than the average value of 4.8km, is applied, and 103 communes are selected as shown below.

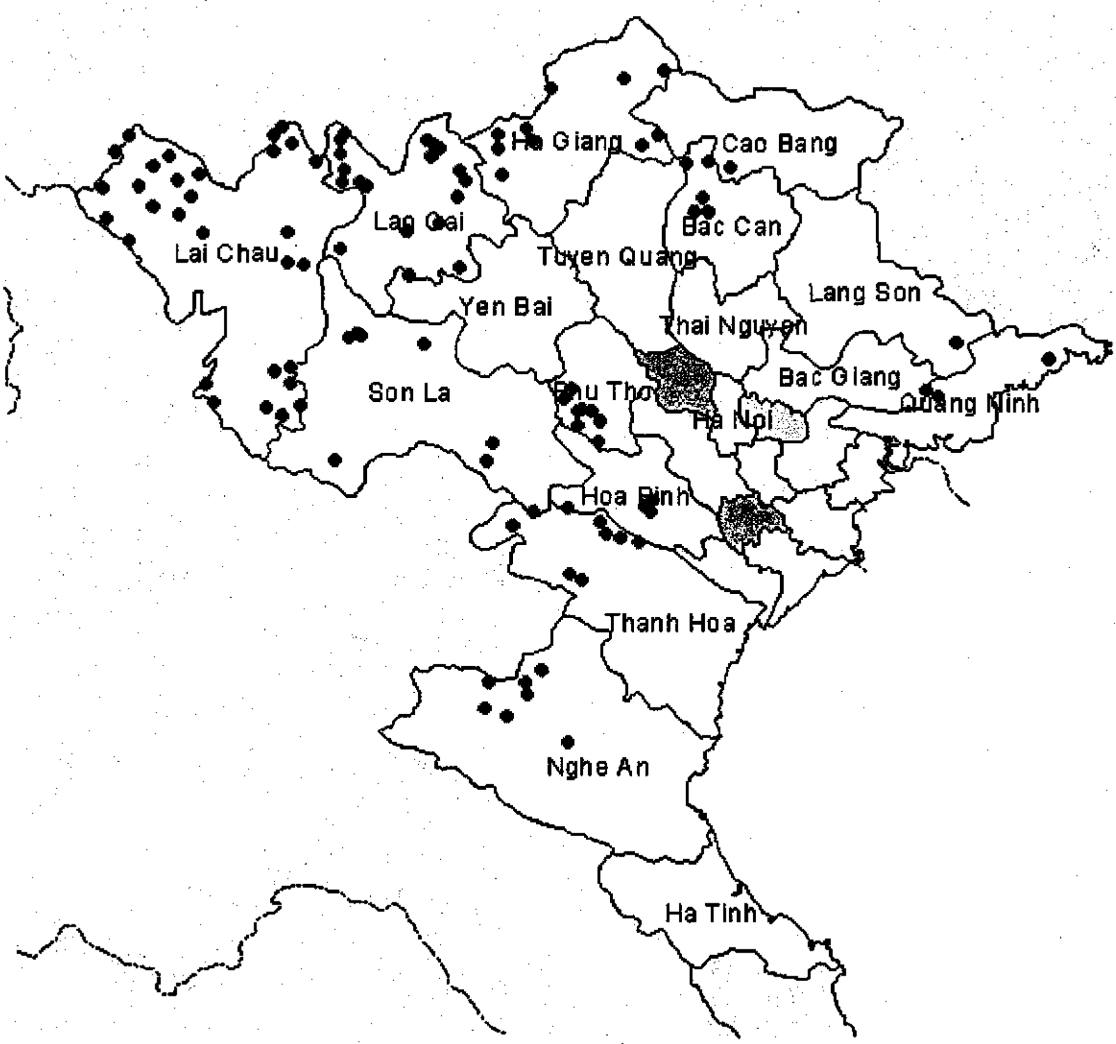


Figure 1—2 Un-electrified communes with less than 4.8km distance between villages

(3) Accessibility

In case of micro hydro, it is often inevitable to carry materials and tools by hand. However, material transportation by vehicles close to the site will dramatically improve construction efficiency. When the condition of being accessible by vehicles to the commune center is applied to the communes identified in (2), 83 communes are selected.

Figure 1—3 Un-electrified communes which can be reached by vehicles in the dry season

(4) Financial ability

The electricity users should bear the initial costs such as connection fee, etc. The higher their incomes are, the more applicants. Finally, with the condition of more-than-average income per capita, 33 communes are picked out as good candidates for micro-hydro development. (See Figure 1-4 and Table 1-1)

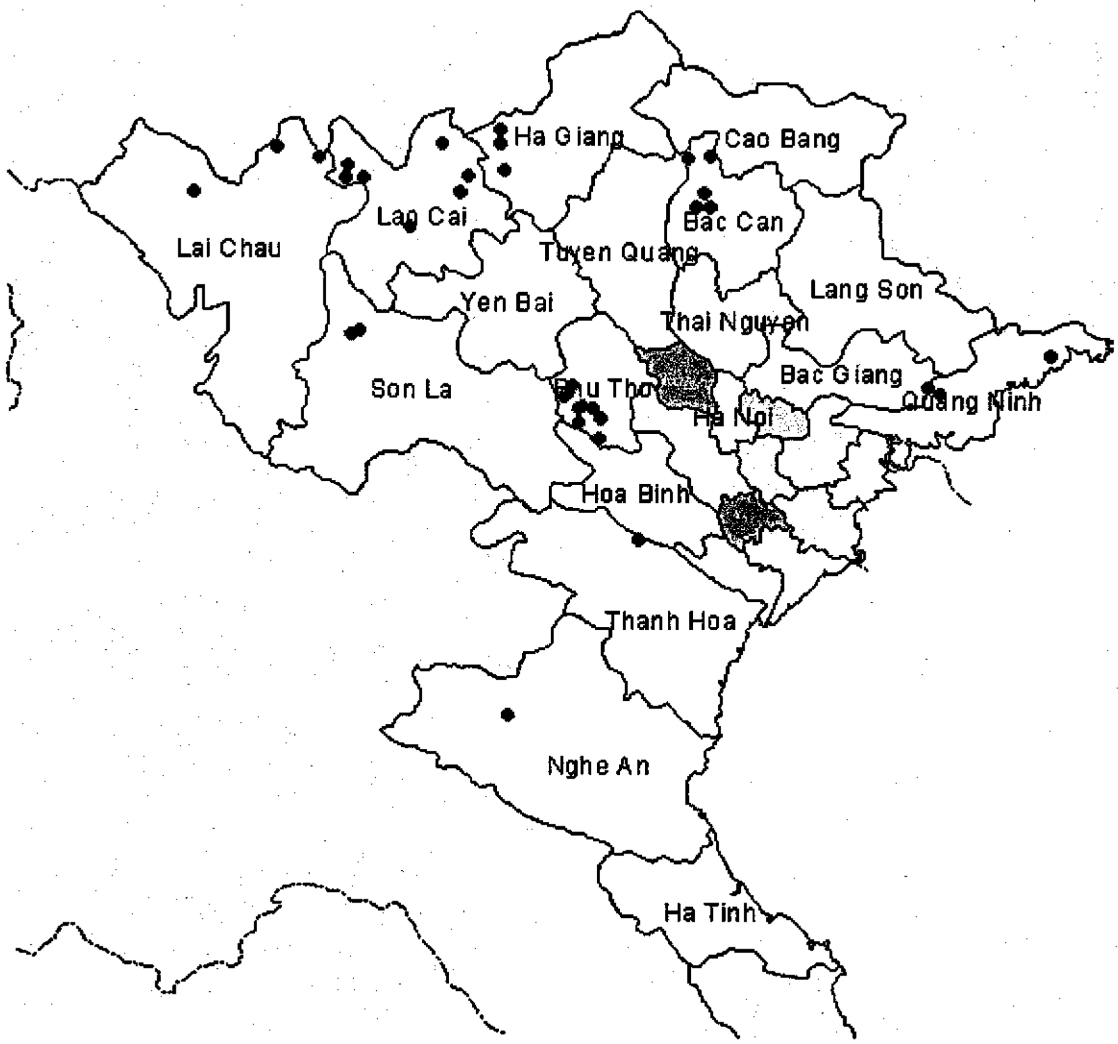


Figure 1—4 Un-electrified communes having per capita income over 1.132 million VND

Table 1—1 Search result based on four criteria

Province	Number of selected communes	Remarks
Ha Giang	3	
Quang Ninh	3	
Bac Kan	5	
Phu Tho	8	
Hoa Binh	1	
Son La	2	
Lai Chau	3	
Lao Cai	7	
Nghe An	1	
Total	33	

2 Screening communes for solar power development

The following is another example that analyzes solar potentials. Communes that will be candidates of solar power development are to be selected based on photovoltaic energy resource (insolation).

(1) Photovoltaic resources

Sunshine hours should be, on average, more than five hours per a day in the target areas for photovoltaic electrification. Figure 2-1 shows the distribution of communes with photovoltaic potentials. According to the map, 82 communes or 30% of all un-electrified communes have photovoltaic power potentials. It is found that most of these communes are located in the provinces of Lai Chau, Lao Cai, and Son La.

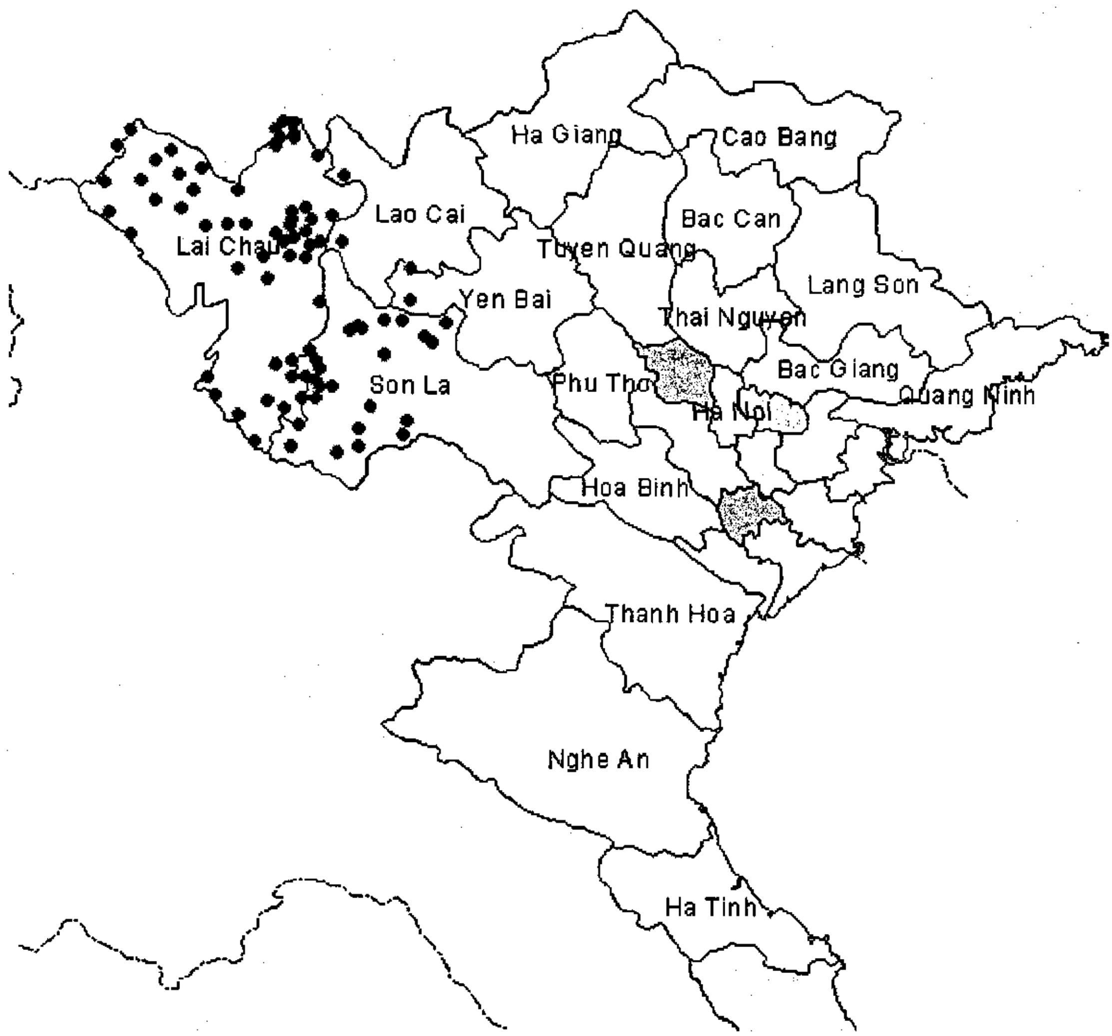


Figure 2—1 Distribution map of un-electrified communes with photovoltaic potentials

(2) Elimination of micro-hydro potential sites

Since micro hydropower resources are rich in northern Vietnam, many communes have both photovoltaic and micro-hydro potentials. If so, micro-hydro development should be considered first. Those communes that have to inevitably rely on solar systems are limited. Out of the communes identified in (1), 13 communes do not have micro hydropower potentials, and therefore have to go for solar-based rural electrification. Most of them are located in Son La Province as shown below.

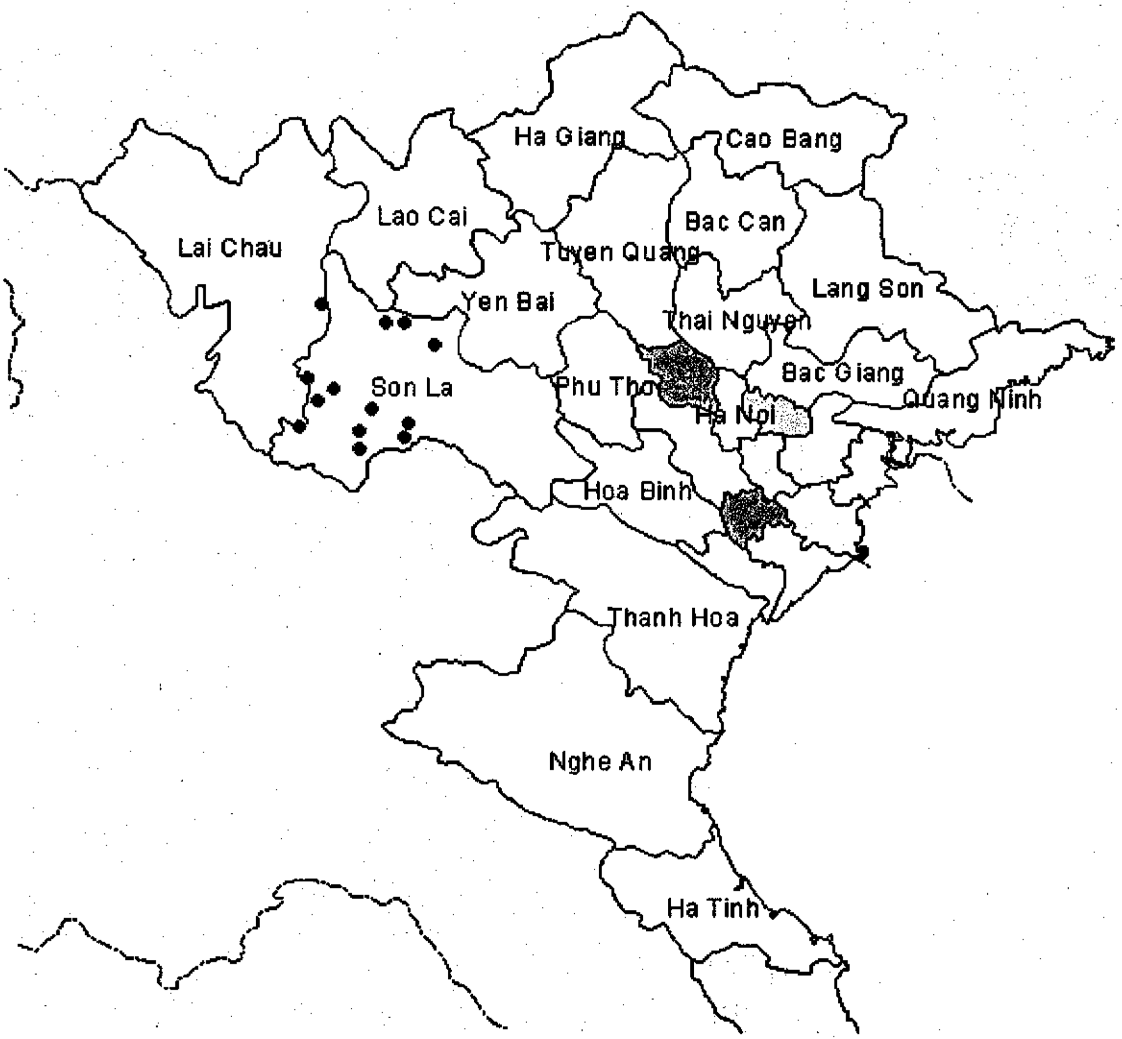


Figure 2—2 Distribution map of un-electrified communes with only photovoltaic potentials

Village Hydro
Basic Design Data

1 Basic specifications

Table 1-1 Basic specifications of Village Hydro (Run-of-river)

Item	Specifications	Remarks
1.Basic factors		
(1)System	Run-of-river type	
(2)Output	Up to 20kW	Village-scale
(3)Water head	Maximum 50m	Maximum head is determined by tolerable internal pressure of PVC pipe.
(4)Water volume	Maximum $0.20m^3/s$	Maximum water volume is determined by maximum available diameter of PVC pipe.
(5)Supply area	Maximum 2 km radius	Length of distribution line is determined by tolerable voltage drop.
2.Civil Work		
(1)Weir	Stone masonry concrete	Combined with irrigation system
(2)Intake	Stone masonry concrete	Combined with irrigation system
(3)Settling basin	Reinforced concrete	Can be omitted when silt in water is little
(4)Headrace	Excavation	Combined with irrigation system
(5)Head tank	Reinforced concrete	Combined with irrigation system
(6)Penstock	PVC pipe	Lightweight, low cost and maintenance-free
(7)Powerhouse	Brick	Conventional method
(8)Tailrace	Excavation	
3.Electrical facilities		
(1)Water turbine	One-box type	Pelton, Turgo, Propeller or Cross-flow
(2)Generator		Induction motor with capacitor excitation
(3)Voltage controller		Electronic controller with dummy-load
4.Distribution facilities		
(1)Voltage	220V	
(2)Connection	Single Phase	
(3)Supply voltage	220V - 198V	
(4)Frequency	50Hz± 5%	

2 Power output estimation

The power output (kW) of a Village Hydro is roughly calculated by the following formula.

$P=5\times Q\times H$

Where

P : Power output (kW)

Q : Water volume (m^3/s)

H : Gross head (m)

3 Design of Village Hydro components

(1) Civil works

Figure 3-1 illustrates a typical layout of civil works in Village Hydro.

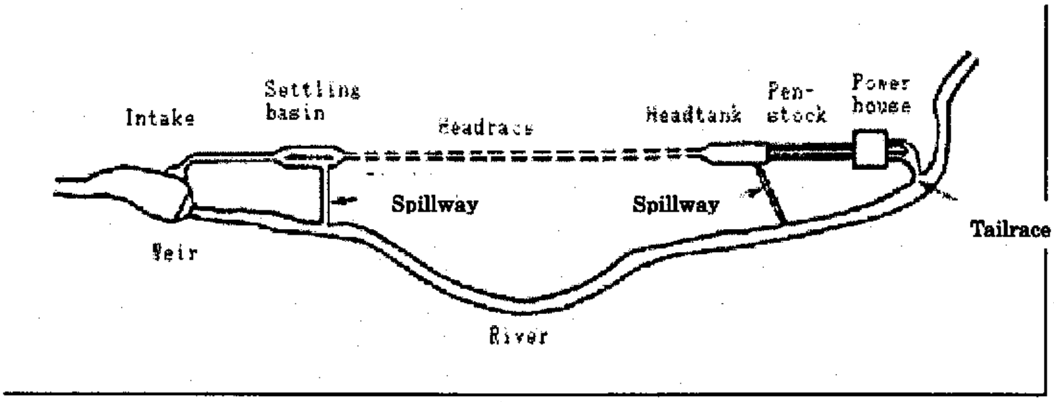


Figure 3-1 A typical layout of civil works

1) Weir and intake

The weir acts to divert water through an "intake" into a channel.

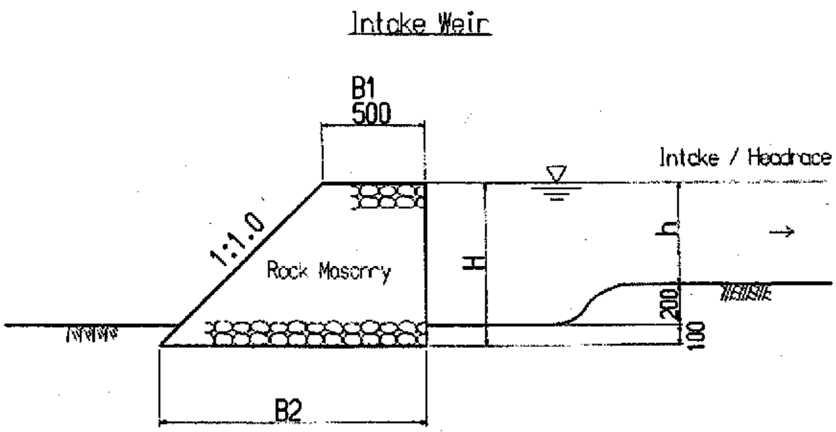


Figure 3-2 Section of a weir

Table 3-1 Dimensions of weir

Headrace depth H (m)	Weir height H (m)	Crest width B1 (m)	Width of weir bottom B2 (m)
0.20	0.50	0.50	0.70
0.30	0.60		0.80
0.40	0.70		0.90
0.50	0.80		1.00
0.60	0.90		1.10
0.70	1.00		1.20

The intake should be located at the point where the river flows straight to prevent damage by flood and avoid collecting debris and sediments. When modifying an existing irrigation channel, the intake mouth and other structures need to be renovated to increase the water flow into the channel.

2) Settling basin

The settling basin is used to remove sand particles from the water.

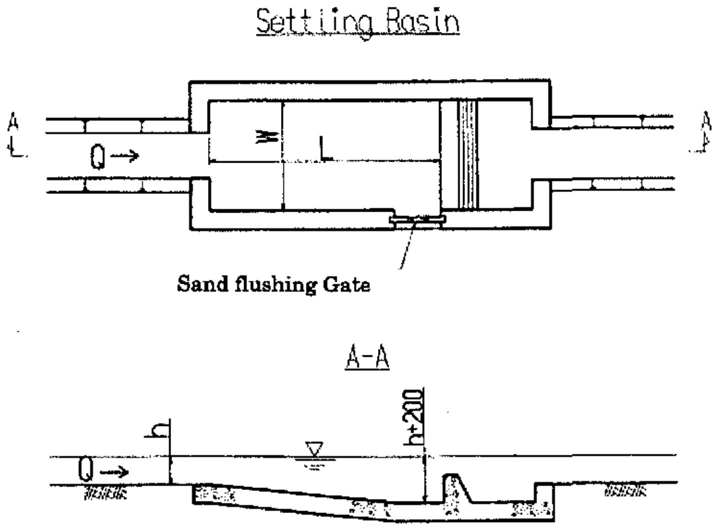


Figure 3-3 Plan and section of a settling basin

Table 3-2 Dimensions of settling basin

		Width W (m)																	
		0.80			1.00			1.20			1.50			2.00			3.00		
Headrace depth h (m)		0.30	0.40	0.50	0.30	0.40	0.50	0.30	0.40	0.50	0.30	0.40	0.50	0.30	0.40	0.50	0.30	0.40	0.50
Water Volume Q (m³/s)	0.02		L = 1.00 (m)			L = 1.00 (m)			L = 1.00 (m)						L = 0.50 (m)				
	0.03		1.50			1.50						L = 1.00 (m)						L = 0.50 (m)	
	0.04		2.00						1.50						L = 1.00 (m)				
	0.05		2.50			2.00						1.50							
	0.06		3.00			2.50			2.00									L = 1.00 (m)	
	0.07		3.50						2.50			2.00			1.50				
	0.08	4.00				3.00													
	0.09	4.50	4.00			3.50			3.00			2.50							
	0.10		4.50												2.00				
	0.11		5.00			4.00			3.50									1.50	
	0.12			5.50		4.50						3.00							
	0.13								4.00						2.50				
	0.14			6.00		5.00						3.50							
	0.15						5.50		4.50									2.00	
	0.16											4.00			3.00				
	0.17						6.00		5.00										
	0.18						6.50			5.50		4.50							
	0.19														3.50			2.50	
	0.20									6.00		5.00							
	0.22											5.50	5.00		4.00				
	0.24												5.50		4.50			3.00	
	0.26												6.00						
	0.28														5.00			3.50	
	0.30															5.50			
	0.32																	4.00	
	0.34															6.00			
	0.36															6.50		4.50	
	0.38																		
	0.40																	5.00	

Note: Gray cells indicate that the water flow speed exceeds 0.3m/s and silt will not settle.

3) Headrace (Channel)

The channel follows the contour of the hillside to keep the elevation of the diverted water. The standard design in Village Hydro is the conventional "open no-lining channel", which is widely used for irrigation in remote areas.

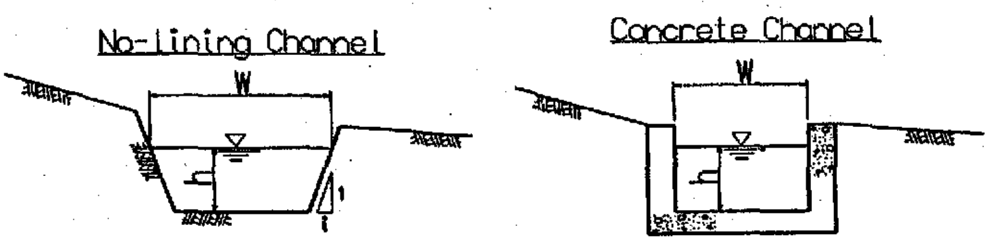


Figure 3-4 Section of a no-lining channel (left) and concrete channel (right)

When modifying an existing irrigation channel, the channel should be excavated to allow more water flow. The water flow speed should be set at more than 0.3m/s to avoid the accumulation of sediments and less than 1.0m/s to avoid the erosion of channel.

Table 3-3 Dimensions of headrace

(1) Water slope is 1/250

		No-lining channel										Concrete channel				
Slope i		1:0.6					1:0.3					Vertical				
Width of water surface W (m)		0.40	0.60	0.80	1.00	1.20	0.40	0.60	0.80	1.00	1.20	0.40	0.60	0.80	1.00	1.20
Water Volume Q (m^3/s)	0.02															
	0.03		h = 0.20 (m)													
	0.04						0.30	h = 0.20 (m)								
	0.05		0.30				0.40						h = 0.20 (m)			
	0.06						0.50									
	0.07		0.40					0.30								
	0.08											0.30				
	0.09															
	0.10							0.40								
	0.11															
	0.12															
	0.13			0.40	0.30			0.50				0.40				
	0.14									0.30						
	0.15			0.50				0.60								
	0.16															
	0.17			0.60										0.30		
	0.18											0.50				
	0.19															
	0.20															
	0.22				0.40				0.50	0.40		0.60	0.40			
	0.24				0.50											
	0.26								0.60							
	0.28				0.60											
	0.30									0.50						
	0.32												0.50			
	0.34					0.50								0.40		
	0.36															
	0.38									0.60	0.50		0.60			
	0.40					0.60										

Note: Gray cells indicate that the water flow speed is less than 0.3m/s.

(2) Water slope is 1/500

		No-lining channel										Concrete channel				
Slope i		1:0.6					1:0.3					Vertical				
Width of water surface W(m)		0.40	0.60	0.80	1.00	1.20	0.40	0.60	0.80	1.00	1.20	0.40	0.60	0.80	1.00	1.20
Water Volume Q (m^3/s)	0.02															
	0.03		h = 0.20 (m)				0.30									
	0.04		0.30				0.50									
	0.05		0.40						h = 0.20 (m)				h = 0.20 (m)			
	0.06											0.30				
	0.07							0.40	0.30							
	0.08															
	0.09			0.40	0.30			0.50				0.40				
	0.10															
	0.11			0.50				0.60	0.40							
	0.12											0.50				
	0.13				0.40											
	0.14															
	0.15								0.50							
	0.16											0.60	0.40	0.30		
	0.17				0.50											
	0.18					0.40				0.40						
	0.19								0.60							
	0.20				0.60											
	0.22									0.50			0.50			
	0.24					0.50										
	0.26									0.60						
	0.28					0.60					0.50		0.60			
	0.30															
	0.32														0.40	
	0.34													0.50		
	0.36										0.60					
	0.38															
	0.40													0.60	0.50	

Note: Gray cells indicate that the water flow speed is less than 0.3m/s.

4) Head tank

The water enters a tank called "head tank", which is designed to work to settle sand particles and bypass the irrigation water to downstream.

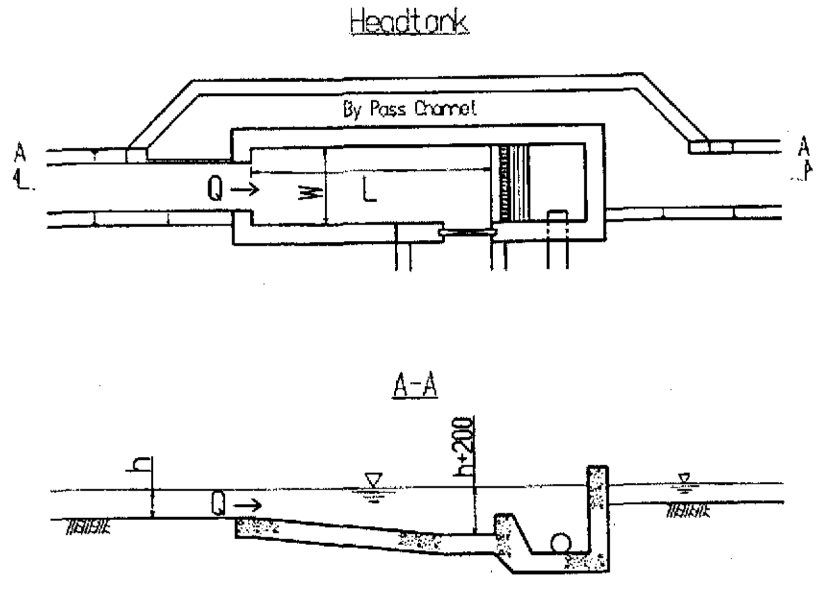


Figure 3-5 Plan and section of a head tank having a settling basin and bypass channel

Table 3-4 Dimensions of head tank

		Internal width of tank W (m)											
		0.80			1.00			1.20			1.50		
Depth of headrace h (m)		0.30	0.40	0.50	0.30	0.40	0.50	0.30	0.40	0.50	0.30	0.40	0.50
Water volume Q (m^3/s)	0.02		L = 1.00 (m)			L = 1.00 (m)			L = 1.00 (m)			L = 0.50 (m)	
	0.03		1.50			1.50						1.00	
	0.04		2.00						1.50				
	0.05		2.50			2.00						1.50	
	0.06		3.00			2.50			2.00				
	0.07		3.50						2.50			2.00	
	0.08	4.00				3.00							
	0.09	4.50	4.00			3.50			3.00			2.50	
	0.10		4.50										
	0.11		5.00			4.00			3.50				
	0.12			5.50		4.50						3.00	
	0.13								4.00				
	0.14			6.00		5.00						3.50	
	0.15						5.50		4.50				
	0.16											4.00	
	0.17						6.00		5.00				
	0.18						6.50			5.50		4.50	
	0.19												
	0.20									6.00		5.00	

Note: Gray cells indicate that the flow speed exceeds 0.3m/s and silt will not settle

5) Spillway

The spillway is a channel flow regulator. In the case of flood, it protects the channel and other civil works from damage by letting the excess water pass over.

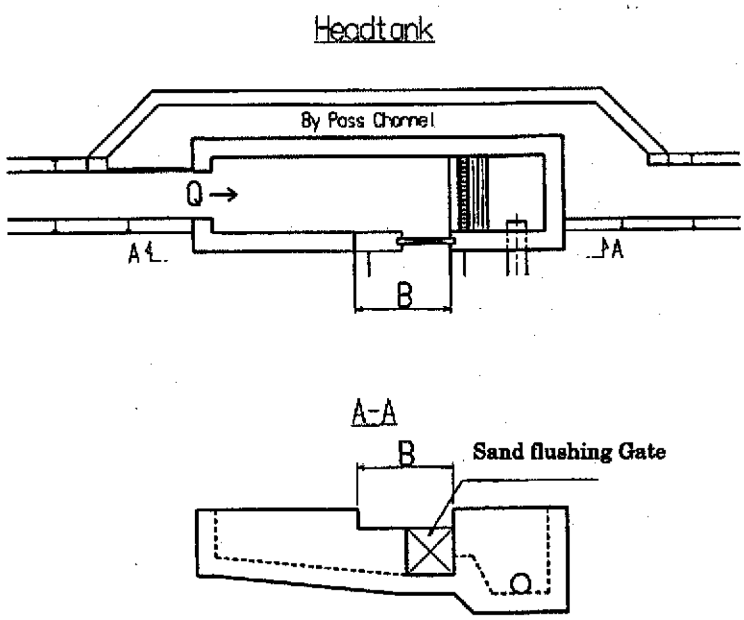


Figure 3-6 Plan and section of a spillway

Table 3-5 Dimensions of spillway

Water Volume Q (m^3/s)	Width of spillway B (m)
0.02	0.50
0.03	
0.04	1.00
0.05	
0.06	1.50
0.07	
0.08	
0.09	2.00
0.10	
0.11	2.50
0.12	
0.13	
0.14	3.00
0.15	
0.16	3.50
0.17	
0.18	
0.19	4.00
0.20	

6) Bypass channel

When an irrigation channel is used for power generation, a bypass channel at the head tank to separate the irrigation water should be installed.

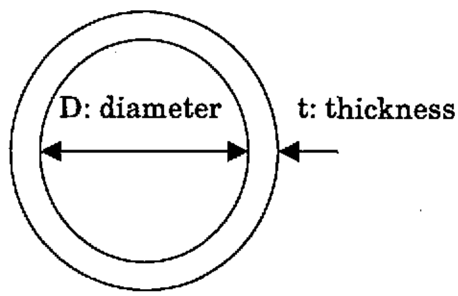
7) Penstock

The penstock is the pipe to convey water under pressure to the turbine. For the penstock, Village Hydro uses PVC pipes, which are prone to mechanical damage from falling rocks, etc., and deteriorate under ultraviolet light, so that the PVC pipes should be laid in a trench and backfilled with soil for protection. An anchor block should be placed at the point where the penstock enters the powerhouse.

The diameter of the penstock significantly affects the friction loss. The recommended diameter of PVC pipe is shown in Table 3-6. The penstock friction loss is kept less than 10% of the gross head.

Table 3-6 Sizing of PVC penstock

		L/H=Length of Penstock/Head		
		2.5	3.0	3.5
Water Volume Q (m^3/s)	0.02	D=125mm (t=7.5mm)	D=125mm (t=7.5mm)	D=150mm
	0.03	D=150mm (t=8.5mm)	D=150mm (t=8.5mm)	D=200mm (t=10.0mm)
	0.04	D=200mm (t=10.0mm)	D=200mm (t=10.0mm)	D=200mm (t=10.0mm)
	0.05	D=200mm (t=10.0mm)	D=200mm (t=10.0mm)	D=200mm (t=10.0mm)
	0.06	D=200mm (t=10.0mm)	D=200mm (t=10.0mm)	D=200mm (t=10.0mm)
	0.07	D=200mm (t=10.0mm)	D=250mm (t=11.0mm)	D=250mm (t=11.0mm)
	0.08	D=250mm (t=11.0mm)	D=250mm (t=11.0mm)	D=250mm (t=11.0mm)
	0.09	D=250mm (t=11.0mm)	D=250mm (t=11.0mm)	D=250mm (t=11.0mm)
	0.10	D=250mm (t=11.0mm)	D=250mm (t=11.0mm)	D=250mm (t=11.0mm)
	0.11	D=250mm (t=11.0mm)	D=250mm (t=11.0mm)	D=250mm (t=11.0mm)
	0.12	D=250mm (t=11.0mm)	D=250mm (t=11.0mm)	D=300mm (t=13.0mm)
	0.13	D=250mm (t=11.0mm)	D=300mm (t=13.0mm)	D=300mm (t=13.0mm)
	0.14	D=300mm (t=13.0mm)	D=300mm (t=13.0mm)	D=300mm (t=13.0mm)
	0.15	D=300mm (t=13.0mm)	D=300mm (t=13.0mm)	D=300mm (t=13.0mm)
	0.16	D=300mm (t=13.0mm)	D=300mm (t=13.0mm)	D=300mm (t=13.0mm)
	0.17	D=300mm (t=13.0mm)	D=300mm (t=13.0mm)	D=300mm (t=13.0mm)
	0.18	D=300mm (t=13.0mm)	D=300mm (t=13.0mm)	D=300mm (t=13.0mm)
	0.19	D=300mm (t=13.0mm)	D=300mm (t=13.0mm)	D=300mm (t=13.0mm)
	0.20	D=300mm (t=13.0mm)	D=300mm (t=13.0mm)	D=300mm (t=13.0mm)



Note: Gray cells indicate the friction loss is more than 10% of gross head

Reference: Effective head calculation

When the pipe diameter is decided, the effective head can be calculated by the following formula.

$$He = H - fe \times H - \Delta H$$

Where

He : Effective head [m]

H : Gross head [m]

fe : Friction loss coefficient

ΔH : Other losses [m] a rough sum of inflow loss, bend loss and others.

Table 3-7 Factors for effective head calculation

Water Volume Q (m3/s)	Length of penstock /Head L/H	Diameter of penstock (mm)	Friction loss coefficient fe	Other losses ΔH (m)
0.02	2.5	125	0.08	0.27
	3.0	125	0.10	0.27
	3.5	150	0.05	0.14
0.03	2.5	150	0.07	0.31
	3.0	150	0.09	0.31
	3.5	200	0.02	0.10
0.04	2.5	200	0.03	0.18
	3.0	200	0.04	0.18
	3.5	200	0.04	0.18
0.05	2.5	200	0.05	0.28
	3.0	200	0.06	0.28
	3.5	200	0.06	0.28
0.06	2.5	200	0.07	0.40
	3.0	200	0.08	0.40
	3.5	200	0.09	0.40
0.07	2.5	200	0.09	0.55
	3.0	250	0.03	0.22
	3.5	250	0.04	0.22
0.08	2.5	250	0.04	0.29
	3.0	250	0.04	0.29
	3.5	250	0.05	0.29
0.09	2.5	250	0.05	0.37
	3.0	250	0.05	0.37
	3.5	250	0.06	0.37
0.10	2.5	250	0.06	0.46
	3.0	250	0.07	0.46
	3.5	250	0.08	0.46
0.11	2.5	250	0.07	0.56
	3.0	250	0.08	0.56
	3.5	250	0.10	0.56
0.12	2.5	250	0.08	0.66
	3.0	250	0.10	0.66
	3.5	300	0.04	0.33
0.13	2.5	250	0.10	0.78
	3.0	300	0.04	0.38
	3.5	300	0.05	0.38
0.14	2.5	300	0.04	0.45
	3.0	300	0.05	0.45
	3.5	300	0.06	0.45
0.15	2.5	300	0.05	0.51
	3.0	300	0.06	0.51
	3.5	300	0.07	0.51
0.16	2.5	300	0.06	0.58
	3.0	300	0.07	0.58
	3.5	300	0.08	0.58
0.17	2.5	300	0.06	0.66
	3.0	300	0.08	0.66
	3.5	300	0.09	0.66
0.18	2.5	300	0.07	0.74
	3.0	300	0.09	0.74
	3.5	300	0.10	0.74
0.19	2.5	300	0.08	0.82
	3.0	300	0.10	0.82
	3.5	300	0.11	0.82
0.20	2.5	300	0.09	0.91
	3.0	300	0.11	0.91
	3.5	300	0.12	0.91

Note: Gray cells indicate that the friction loss is more than 10% of gross head.

8) Powerhouse

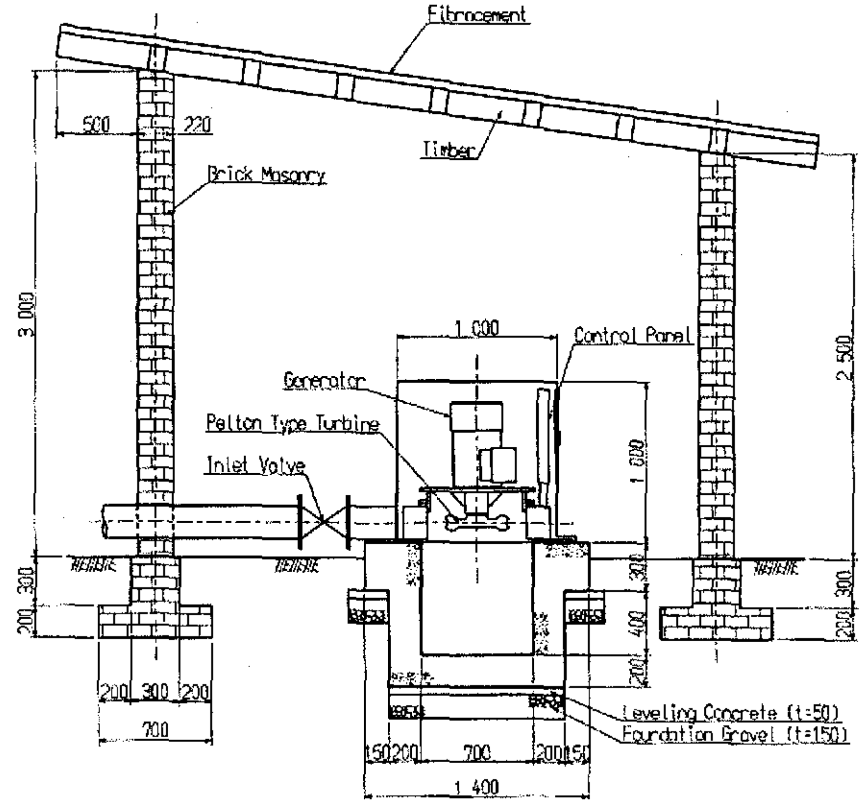


Figure 3-7 A typical layout of powerhouse

(2) **Electro-mechanical facilities**

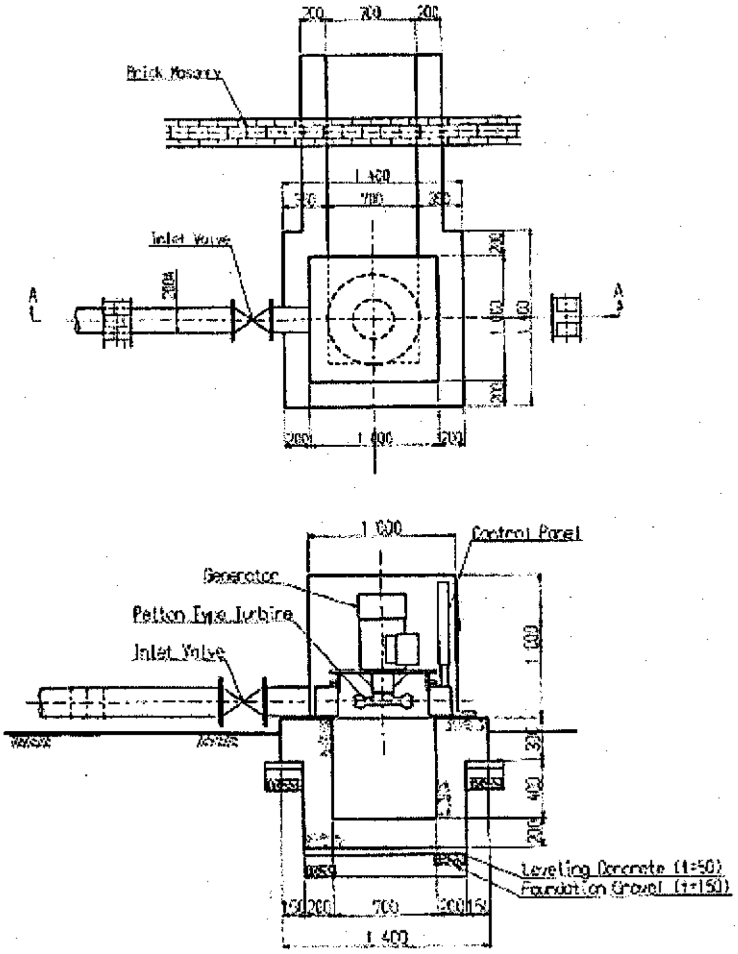


Figure 3-8 Plan and section of a one-box type turbine and generator

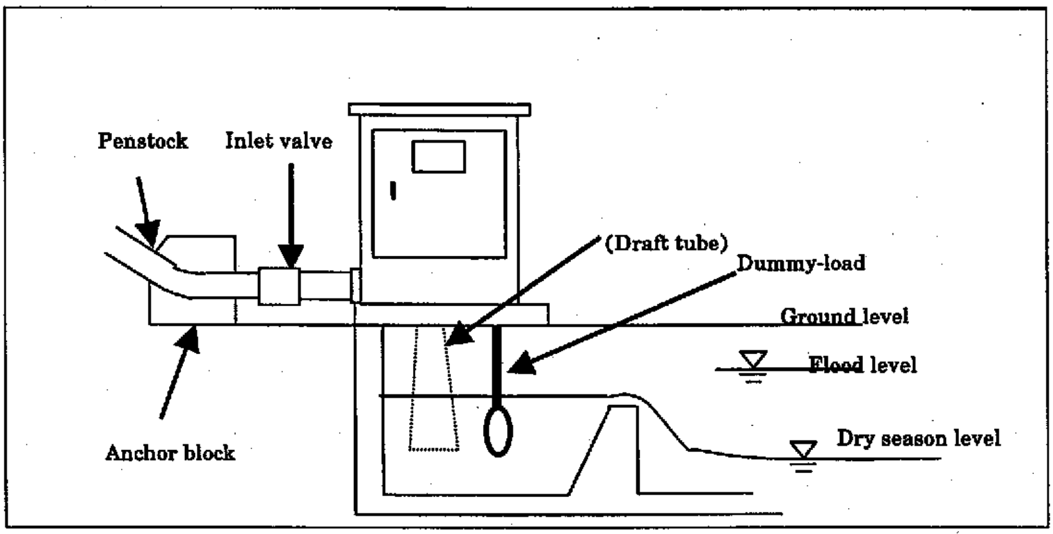


Figure 3-9 A typical layout of electro-mechanical components

1) Turbine

Table 3-8 Turbine selection diagram

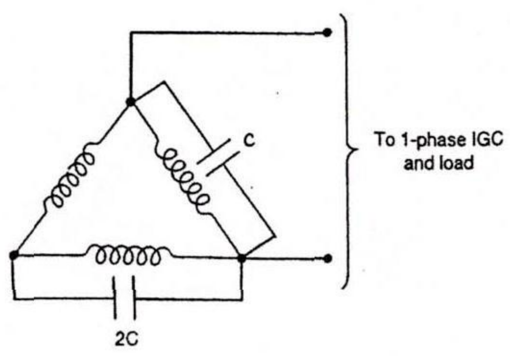
Unit: kW

Water Volume Q (m^3/s)	Gross Head (m) 1	2	3	4	5	7	10	15	20	25	30	35	40	50
0.02								1	2	2	3	3	4	5
0.03							1	2	3	4	4	5	6	8
0.04	Less than 1kW					1	2	3	4	5	6	7	8	11
0.05								4	5	6	8	9	11	13
0.06					1	2	3		6	8	9	11	13	16
0.07				1				5	7	9	11	13	15	19
0.08			1				4	6	8	11	13	15	17	
0.09					2	3		7	9	12	14	17	19	
0.10							5	8	11	13	16	19		
0.11			1	2		4	6	9	12	15	18			
0.12					3				13	16	19			
0.13							7	10	14	17				
0.14		1				5	7	11	15	19				
0.15			2				8	12	16	20				
0.16				3	4			13	17	More than 20kW				
0.17						6	9	14	18					
0.18									19					
0.19	1	2	3	4	5	7	10	15	20					
0.20							11	16						

Propeller | CrossFlow | Turgo | Pelton

2) Generator

When using an induction motor as generator, appropriate capacitors are required and should be connected to the motor as follows. The rated capacity of the motor should be more than 120% of the power output.



C-2C connection

Figure 3-10 Single-phase generation from a three-phase induction motor

Table 3-9 shows an example of induction motor specifications available in Vietnam.

Table 3-9 Example of 3-phase 50Hz motors and appropriate capacitors

Rating (kW)	No. of Poles	Speed (min^{-1})	Voltage (V) △/人	Current (A)	Power Factor cos ϕ	Class of non-conductance and heat resistance	Weight (kg)	Excitation capacitance (μF/ per phase)
0.75	8	750	220/380	4.7/2.7	0.64	B	33	35
	6	1000	220/380	3.8/2.2	0.75	B	22	25
	4	1500	220/380	3.8/2.2	0.74	B	16	25
1.1	8	750	220/380	6.1/3.5	0.70	B	35	40
	6	1000	220/380	5.2/3.0	0.76	B	28	30
	4	1500	220/380	4.9/2.8	0.81	B	18	25
1.5	8	750	220/380	8.2/4.7	0.68	B	43	55
	6	1000	220/380	7.1/4.1	0.74	B	35	40
	4	1500	220/380	5.9/3.4	0.85	B	22	30
2.2	8	750	220/380	10.4/6.2	0.71	B	56	65
	6	1000	220/380	9.5/5.5	0.74	B	43	55
	4	1500	220/380	8.66/5.0	0.85	B	27	40
3.0	8	750	220/380	13.5/7.8	0.74	B	70	80
	6	1000	220/380	12.8/7.4	0.76	B	58	70
	4	1500	220/380	11.6/6.7	0.83	B	37	55
4.0	8	750	220/380	18.2/10.5	0.70	B	108	110
	6	1000	220/380	16.0/9.2	0.81	B	72	80
	4	1500	220/380	14.9/8.6	0.84	B	41	70
5.5	8	750	220/380	23.6/13.6	0.74	B	116	140
	6	1000	220/380	21.3/12.3	0.80	B	81	110
	4	1500	220/380	19.8/11.4	0.86	B	62	85
7.5	8	750	220/380	30.7/17.7	0.75	B	170	170
	6	1000	220/380	28.0/16.2	0.82	B	116	140
	4	1500	220/380	26.2/15.1	0.86	B	72	120
11	8	750	220/380	45.0/26.0	0.76	B	225	250
	6	1000	220/380	39.2/22.6	0.86	B	146	170
	4	1500	220/380	38.0/22.0	0.87	B	106	160
15*	8	750	380/660	32.0/18.4	0.83	F	226	260
	6	1000	380/660	30.0/17.3	0.87	F	205	240
	4	1500	380/660	29.0/16.8	0.88	B	127	220
18.5*	8	750	380/660	38.0/22.0	0.84	F	305	360
	6	1000	380/660	37.0/21.5	0.87	F	220	240
	4	1500	380/660	35.5/20.5	0.88	B	170	330
22*	8	750	380/660	48.0/27.6	0.84	F	365	380
	6	1000	380/660	41.4/23.9	0.90	F	245	300
	4	1500	380/660	41.4/23.9	0.90	F	230	260

Source: Technical data from a Vietnamese manufacturer
Capacitance calculated by JICA study team

Notes: Tolerable maximum temperature for non-conductance and heat-resistance class
B-class:130℃, F-class:155℃
15, 18.5, 22kW motors need reconnecting the coils to generate 220V.

3) Electronic controller (Dummy-load governor)

The capacity of the dummy-load is more than 120% of the power output. There are two types of dummy-loads: water-cooled and air-cooled. Water-cooled dummy-loads (resisters) are common in micro-hydro schemes. Air-cooled dummy-loads (convectors) are often used in the case of small power output.

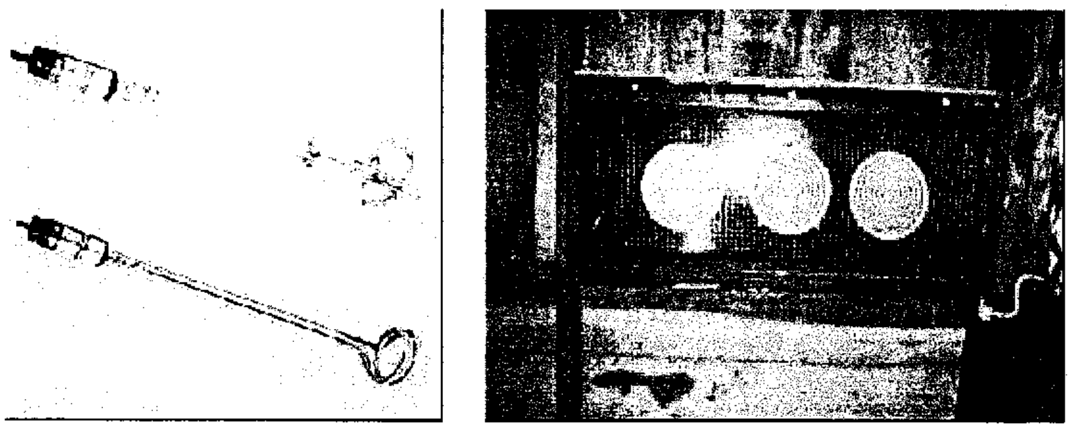


Figure 3-11 A water-cooled (left) and air-cooled (right) dummy-load

4) Distribution system

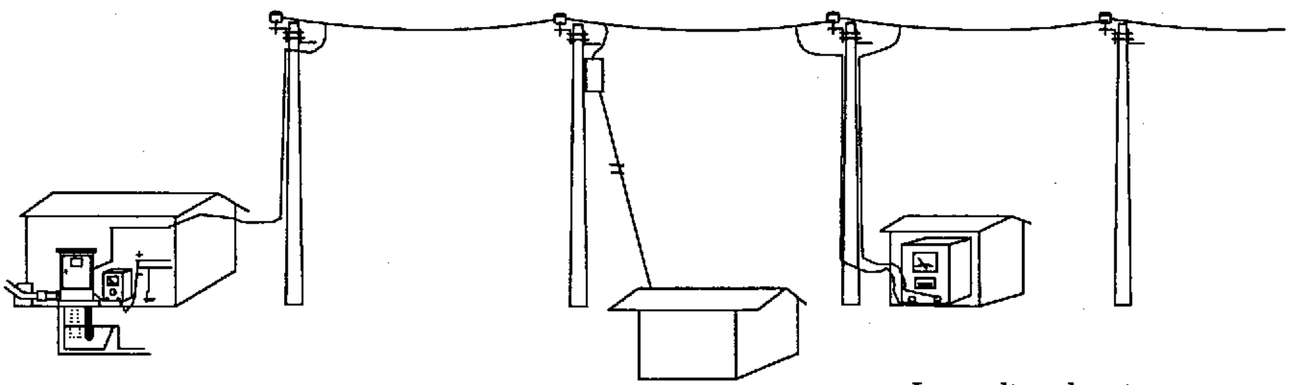


Figure 3-12 A typical layout of distribution system

5) Cable

Insulated aluminum cables (cross-sectional area: 35, 50, 70, and 95mm2) are used in Village Hydro for the following reasons:

- Widely available in Vietnam.
- Lightweight and flexible.
- Cheaper than copper cables
- Good conductivity and mechanical strength

Figure 3-13 Insulated aluminum cables

Since the low voltage (220V) mini-grid is used in Village Hydro, voltage drop is a significant factor in designing the transmission and distribution network. Voltage drop is estimated by the following formula.

$$\nabla V = I \times Ze \times 2 \times L$$

Where,

∇V: Voltage drop (V)

I: Line current (A)

Ze: Equivalent resistance of cable

Ze= Rcosö+Xsinö (ohm/km)

Cosö: Load power factor (In theory, cosö=1)

R: Resistance of wire (ohm/km)

X: Reactance due to capacitive effect (ohm/km)

L: Length of distribution line (km)

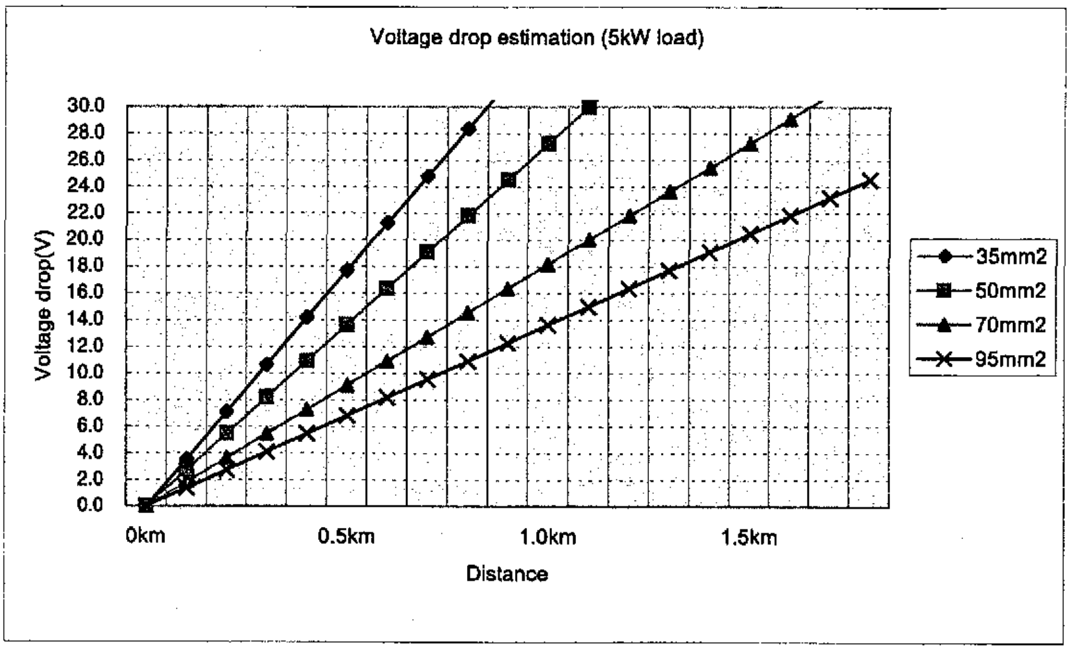


Figure 3-14 Voltage drop by different size of Al cables (5kW load)

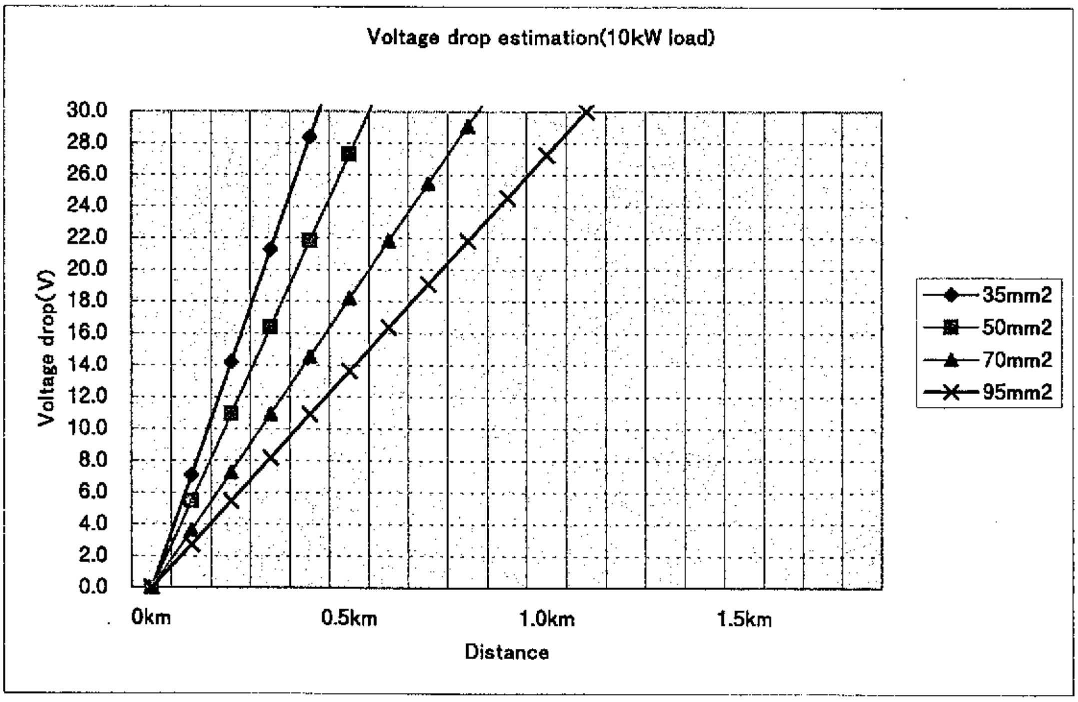


Figure 3-15 Voltage drop by different size of Al cables (10kW load)

Table 3-10 Cable size selection – Al cable

2kW load

Distance (km)	Voltage drop (ΔV)			
	35mm2	50mm2	70mm2	95mm2
0km	0.0	0.0	0.0	0.0
0.1km	1.4	1.1	0.7	0.5
0.2km	2.8	2.2	1.5	1.1
0.3km	4.3	3.3	2.2	1.6
0.4km	5.7	4.4	2.9	2.2
0.5km	7.1	5.5	3.6	2.7
0.6km	8.5	6.5	4.4	3.3
0.7km	9.9	7.6	5.1	3.8
0.8km	11.3	8.7	5.8	4.4
0.9km	12.8	9.8	6.5	4.9
1.0km	14.2	10.9	7.3	5.5
1.1km	15.6	12.0	8.0	6.0
1.2km	17.0	13.1	8.7	6.5
1.3km	18.4	14.2	9.5	7.1
1.4km	19.9	15.3	10.2	7.6
1.5km	21.3	16.4	10.9	8.2
1.6km	22.7	17.5	11.6	8.7
1.7km	24.1	18.5	12.4	9.3
1.8km	25.5	19.6	13.1	9.8

3kW load

Distance (km)	Voltage drop (ΔV)			
	35mm2	50mm2	70mm2	95mm2
0km	0.0	0.0	0.0	0.0
0.1km	2.1	1.6	1.1	0.8
0.2km	4.3	3.3	2.2	1.6
0.3km	6.4	4.9	3.3	2.5
0.4km	8.5	6.5	4.4	3.3
0.5km	10.6	8.2	5.5	4.1
0.6km	12.8	9.8	6.5	4.9
0.7km	14.9	11.5	7.6	5.7
0.8km	17.0	13.1	8.7	6.5
0.9km	19.1	14.7	9.8	7.4
1.0km	21.3	16.4	10.9	8.2
1.1km	23.4	18.0	12.0	9.0
1.2km	25.5	19.6	13.1	9.8
1.3km	27.7	21.3	14.2	10.6
1.4km	29.8	22.9	15.3	11.5
1.5km	31.9	24.5	16.4	12.3
1.6km	34.0	26.2	17.5	13.1
1.7km	36.2	27.8	18.5	13.9
1.8km	38.3	29.5	19.6	14.7

4kW load

Distance (km)	Voltage drop (ΔV)			
	35mm2	50mm2	70mm2	95mm2
0km	0.0	0.0	0.0	0.0
0.1km	2.8	2.2	1.5	1.1
0.2km	5.7	4.4	2.9	2.2
0.3km	8.5	6.5	4.4	3.3
0.4km	11.3	8.7	5.8	4.4
0.5km	14.2	10.9	7.3	5.5
0.6km	17.0	13.1	8.7	6.5
0.7km	19.9	15.3	10.2	7.6
0.8km	22.7	17.5	11.6	8.7
0.9km	25.5	19.6	13.1	9.8
1.0km	28.4	21.8	14.5	10.9
1.1km	31.2	24.0	16.0	12.0
1.2km	34.0	26.2	17.5	13.1
1.3km	36.9	28.4	18.9	14.2
1.4km	39.7	30.5	20.4	15.3
1.5km	42.5	32.7	21.8	16.4
1.6km	45.4	34.9	23.3	17.5
1.7km	48.2	37.1	24.7	18.5

5kW load

Distance (km)	Voltage drop (ΔV)			
	35mm2	50mm2	70mm2	95mm2
0km	0.0	0.0	0.0	0.0
0.1km	3.5	2.7	1.8	1.4
0.2km	7.1	5.5	3.6	2.7
0.3km	10.6	8.2	5.5	4.1
0.4km	14.2	10.9	7.3	5.5
0.5km	17.7	13.6	9.1	6.8
0.6km	21.3	16.4	10.9	8.2
0.7km	24.8	19.1	12.7	9.5
0.8km	28.4	21.8	14.5	10.9
0.9km	31.9	24.5	16.4	12.3
1.0km	35.5	27.3	18.2	13.6
1.1km	39.0	30.0	20.0	15.0
1.2km	42.5	32.7	21.8	16.4
1.3km	46.1	35.5	23.6	17.7
1.4km	49.6	38.2	25.5	19.1
1.5km	53.2	40.9	27.3	20.5
1.6km	56.7	43.6	29.1	21.8
1.7km	60.3	46.4	30.9	23.2

7kW load

Distance (km)	Voltage drop (ΔV)			
	35mm2	50mm2	70mm2	95mm2
0km	0.0	0.0	0.0	0.0
0.1km	5.0	3.8	2.5	1.9
0.2km	9.9	7.6	5.1	3.8
0.3km	14.9	11.5	7.6	5.7
0.4km	19.9	15.3	10.2	7.6
0.5km	24.8	19.1	12.7	9.5
0.6km	29.8	22.9	15.3	11.5
0.7km	34.8	26.7	17.8	13.4
0.8km	39.7	30.6	20.4	15.3
0.9km	44.7	34.4	22.9	17.2
1.0km	49.6	38.2	25.5	19.1
1.1km	54.6	42.0	28.0	21.0
1.2km	59.6	45.8	30.5	22.9

10kW load

Distance (km)	Voltage drop (ΔV)			
	35mm2	50mm2	70mm2	95mm2
0km	0.0	0.0	0.0	0.0
0.1km	7.1	5.5	3.6	2.7
0.2km	14.2	10.9	7.3	5.5
0.3km	21.3	16.4	10.9	8.2
0.4km	28.4	21.8	14.5	10.9
0.5km	35.5	27.3	18.2	13.6
0.6km	42.6	32.7	21.8	16.4
0.7km	49.7	38.2	25.5	19.1
0.8km	56.7	43.6	29.1	21.8
0.9km	63.8	49.1	32.7	24.5
1.0km	70.9	54.5	36.4	27.3
1.1km	78.0	60.0	40.0	30.0
1.2km	85.1	65.5	43.6	32.7

15kW load

Distance (km)	Voltage drop (ΔV)			
	35mm2	50mm2	70mm2	95mm2
0km	0.0	0.0	0.0	0.0
0.1km	10.6	8.2	5.5	4.1
0.2km	21.3	16.4	10.9	8.2
0.3km	31.9	24.6	16.4	12.3
0.4km	42.5	32.7	21.8	16.4
0.5km	53.2	40.9	27.3	20.5
0.6km	63.8	49.1	32.7	24.5
0.7km	74.5	57.3	38.2	28.6
0.8km	85.1	65.5	43.6	32.7
0.9km	95.7	73.6	49.1	36.8
1.0km	106.4	81.8	54.5	40.9
1.1km	117.0	90.0	60.0	45.0

20kW load

Distance (km)	Voltage drop(ΔV)			
	35mm2	50mm2	70mm2	95mm2
0km	0.0	0.0	0.0	0.0
0.1km	14.2	10.9	7.3	5.5
0.2km	28.4	21.8	14.5	10.9
0.3km	42.5	32.7	21.8	16.4
0.4km	56.7	43.6	29.1	21.8
0.5km	70.9	54.5	36.4	27.3
0.6km	85.1	65.5	43.6	32.7
0.7km	99.3	76.4	50.9	38.2
0.8km	113.5	87.3	58.2	43.6
0.9km	127.6	98.2	65.5	49.1
1.0km	141.8	109.1	72.7	54.5
1.1km	156.0	120.0	80.0	60.0

(shaded): Unable to supply power due to large voltage drop

An example of sizing distribution cables

Assumptions:

- Households are clustered at points, A, B and C.
- Minimum supply voltage should be 198V. (Allowable voltage drop is 22V.)
- Maximum load current for each capacity is as follows.

Table 3-11 Maximum load current

Load (kW)	Maximum load current (A)
2	9.0
3	13.6
4	18.2
5	22.7
7	31.8
10	45.5
15	68.2
20	90.8

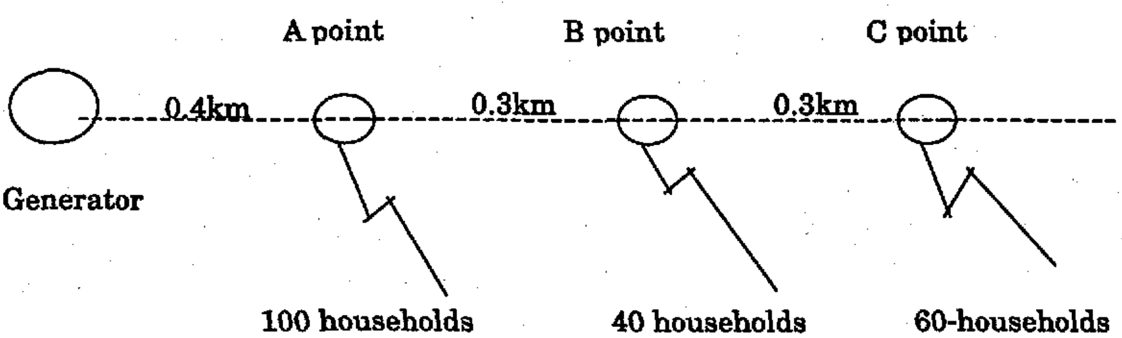


Figure 3-16 An example of distribution network and electricity demand

Table 3-12 Process of analyzing cable size

Factors	Point A	Point B	Point C	Remarks
1. Basic factors				
(1) Number of households	100HH	40 HH	60 HH	Collected data
(2) Demand per household	50W	50W	50W	Estimated data
(3) Load capacity	5.0kW	2.0kW	3.0kW	
2. Analysis				
(1) Cumulative load capacity	10.0kW	5.0kW	3.0kW	
(2) Distance	0.4km	0.3km	0.3km	Collected data
(3) Cross sectional area of cable	95mm2	70mm2	50mm2	Tentative sizing
(4) Voltage drop	10.9V	5.5V	4.9V	From Table 3-10
(5) Accumulated voltage drop	10.9V	16.4V	21.3V	Maximum voltage drop is 22V

Note: There may be other combinations of cables. Cost estimation is also necessary to choose the most appropriate size of cables.

6) Battery charger

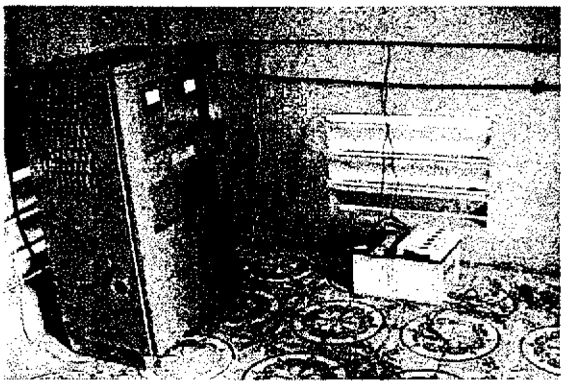


Figure 3-17 Battery charging unit

7) Low-voltage booster

In case of problems associated with low voltage, the users can improve the voltage by about 10% (about 20V) using low-voltage boosters.

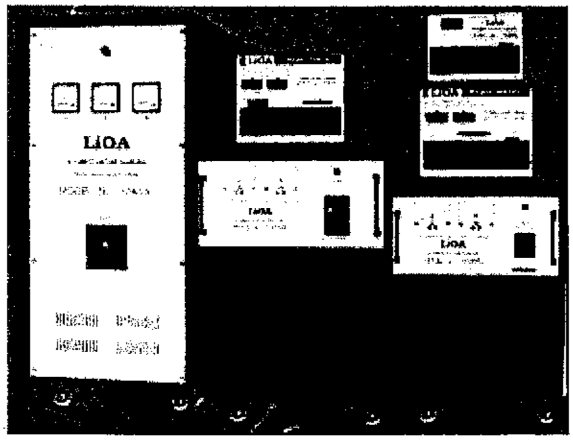


Figure 3-18 Low-voltage boosters

8) Poles

Village Hydro uses square-shaped concrete poles that are available in the local market. Wiring should be done as illustrated.

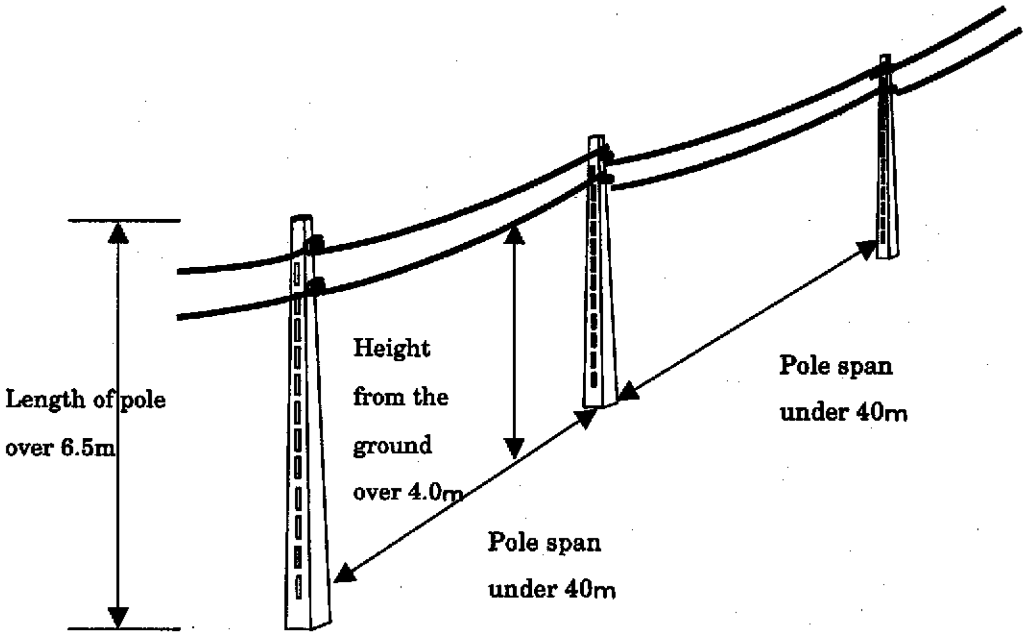


Figure 3-19 A general layout of poles and cables

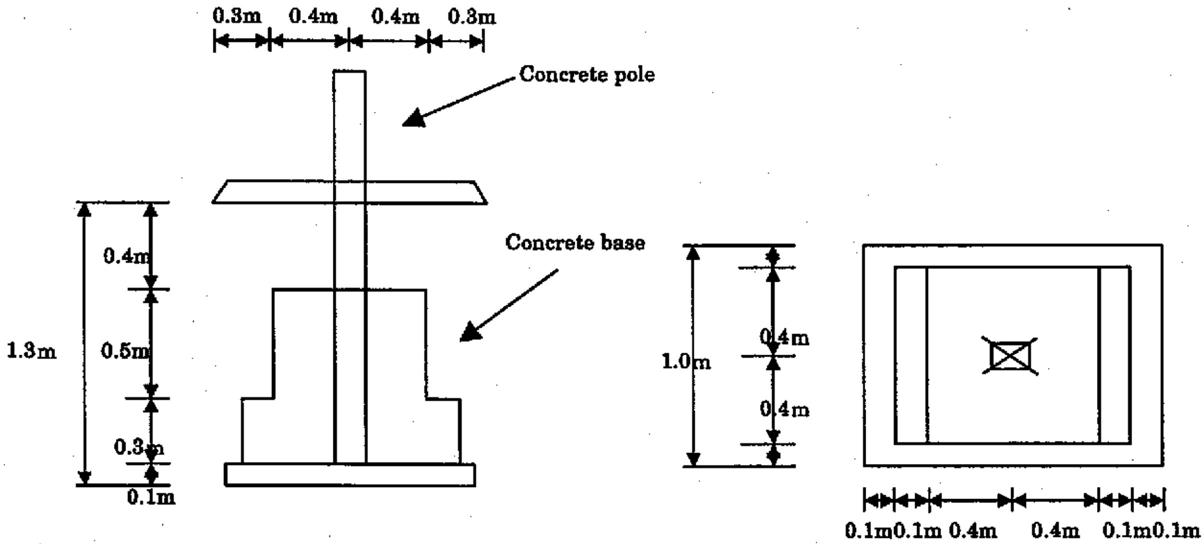


Figure 3-20 Plan and section of a pole foundation

9) Mounting cables

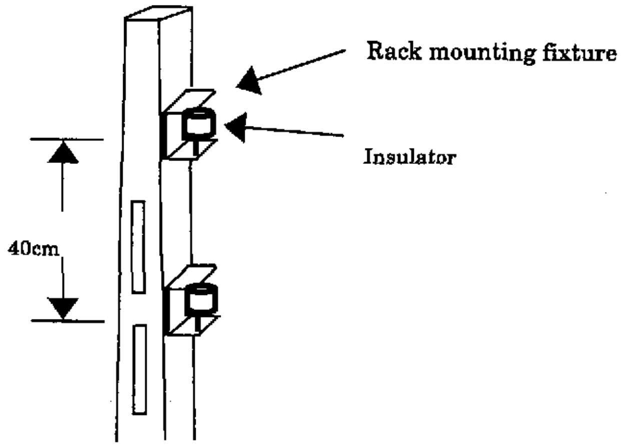


Figure 3-21 Vertical wiring method

4 Operation and maintenance

(1) *Operation*

1) Starting

Conduct routine visual inspection

Clean the trash rack and silt tank if necessary

Turn on water at the intake and head tank as required

Check that all switches are in the OFF position

Inform the village that generating is to be started

Gradually let water into the penstock through the head tank

Gradually let water into the turbine by turning on the inlet valve

Observe the current meter and voltage meter

Once current and voltage come to the normal value, increase water as required

Turn on the controller to divert power into the dummy load

Allow the turbine to run for a few minutes until it keeps stable

Switch on to connect the village load on to the generator

Once this is done it is possible to keep the turbine running without an attendant for a long period of time (overnight).

2) Stopping

Inform the village that generating is to be stopped

Switch off all loads

Reduce water gradually by turning off the inlet valve

Allow the turbine to stop

Stop water at head tank or intake if necessary

(2) Regular maintenance tasks

The Village Hydro installation requires regular maintenance to be carried on a weekly or monthly basis.

1) Renovation of the channel.

Very often sand, stones are deposited along the bed of the channel, vegetation has grown, and the sidewall may be damaged in places. Each month vegetation should be cut back (do not uproot it as it may act to stabilize the walls of the channel and also, if it is cut short, reduce head loss by reducing friction). Every week or month as needed, rebuild the side walls, remove deposits, and if necessary dig the channel deeper and wider to reduce head loss and ensure enough water is reaching the turbine.

2) Renovate spillways.

Water flowing over the spillway should drain back to the river on a rock or cement apron. If this apron is damaged or an earth apron is used, erosion will occur which could eventually cause a land slide destroying the channel. Repair any damage you see each month, and reinforce the spill drain with stones and cement.

3) Painting of metal surfaces

Each month clean all metal parts such as trash racks, gates, entry tank. When dry repaint all scratched surfaces or any areas vulnerable to rusting.

4) Overhaul of turbine.

The turbine may have been damaged by silt erosion or larger objects like stones. It should be inspected carefully for this kind of damage, and for loose bolts and dry bearings. Tighten any loose bolts and apply grease for the bearings. If the turbine has been running for a long time it will be necessary to change the bearings. Usually bearings will run for about three years. When the bearings are due for change the turbine makes a louder noise than usual. This noise will increase and after some time the machine will also vibrate while running. As soon as these indications are noticed the bearings must be changed, because further operation will cause the bearings to collapse which will cause expense additional damage. In the case of propeller turbines, there is sometimes a water lubricated bearing at the bottom of the shaft. This should be inspected monthly and changed if it is badly worn or damaged. In addition, it is recommended to undertake a complete overhaul of turbine every five years to secure long life.

5) Tighten electrical connections and cleaning

After some days or weeks of operation, the screws making the electrical connections are likely to loosen. Loose connections cause the wires to get hot and burn out. Check each connection carefully and tighten it. While doing this, clean the insides and the outsides of the panel boxes and the generator.

6) Repair and renovate overhead lines.

Walk along the length of the distribution wires, inspecting each connection carefully. Re-make securely any suspect connections, and make sure that all parts are carefully insulated (and not easy to take electricity from without permission). The overhead line should be clear of other trees and branches. If the line is sagging low, re-suspend it so that it does not create a nuisance for people and animals. Make sure that it is not in danger from falling branches, and trim back vegetation *touching the wire. If there are signs of people taking electricity* directly from the distribution wires and not from their side of intake boxes, take care to correct this situation by discussing with the CEU and taking action following the terms of the contracts signed by customers.

7) Renovate customer intake boxes and fuses

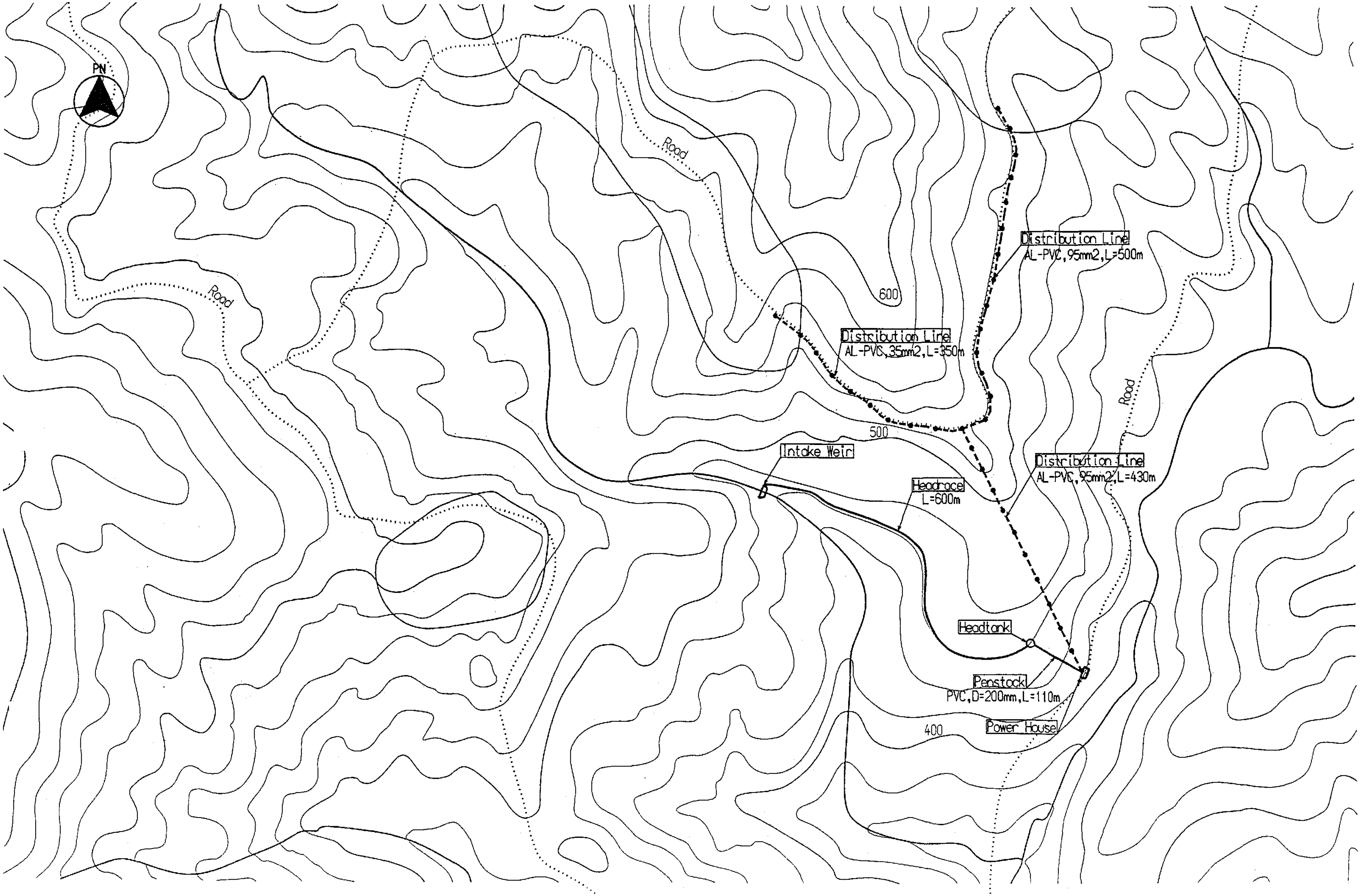
Walk to each house looking carefully at the wire supplying electricity. Check that if it is in poor condition repair it, paying special attention to making it secure, well insulated, and suspended out of the path of people or animals. This is important to avoid any danger of shocks to people or damage by animals. Then check that the intake box is locked properly and not damaged. On the customer side of the box, check to see if the fuse box is being used correctly. If not, provide some wire of the correct size to the householder and show him how to install it in the fuse box.

Specification of Village Hydro Model Plan

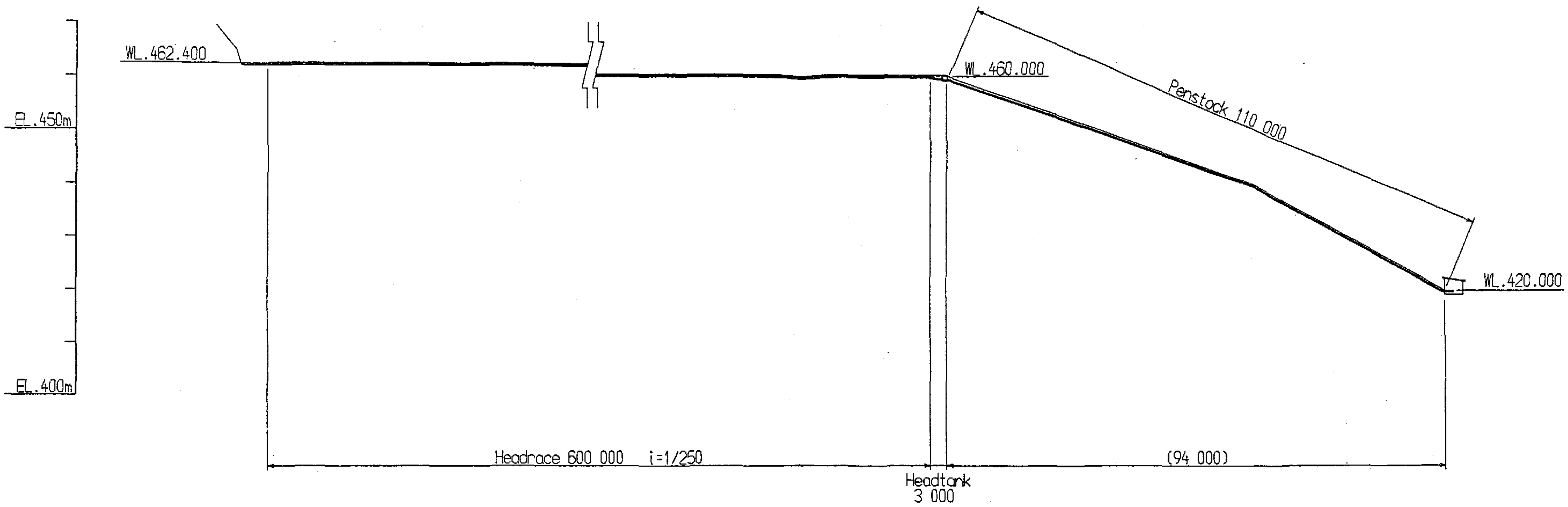
Item	Specification	Notes
1. Site	Village Hydro Model Plan Site	
2. Demand Scale		
(1) No. of households	212 households	
(2) Design demand	50W/HH	
(3) Total estimate demand	11kW	
3. *Features of micro-hydro model*		
(1) Type of scheme	Run-of-river type	
(2) Output capacity	11kW	
(3) Gross head	40m	
(4) Effective head	37.3m	
(5) Design flow	0.05m3/s	Based on the river flow during dry season
4. Civil construction		
(1) Weir	Overflow type, Rock masonry	
size(W×Lt/Lb×H)	5.0m x 0.5m(top) / 1.1m(bottom) x 0.6m	
(2) Water intake	Rock masonry	
size(W×L×H)	1.0m x 6.0m x 0.7, 1.5m	
(3) Settling basin	–	
(4) Headrace	Lowering bed of existing irrigation channel	
	Water Velocity 0.7m/s	restrict water velocity below 1.0m/s considering erosion of ground
size(Ws×Wb×D)	0.7m(surface) x 0.5m (bottom) x 0.3m	
	Length of headrace 600m	
(5) Head tank	Reinforced concrete	
size(W×L×D)	0.8m x 3.5m x 0.3-0.5m	Construct a desilting chamber considering erosion of headrace
Bypass for Irrigation	W 0.35m x D 0.2m	
Spillway	Overflow type; overflow length 1.0m	
(6) Penstock	Burying PVC pipe ϕ200	Materials are to be selected according to easiness of handling and price
	Length 110m	
	Internal diameter 196mm, thickness 10.0mm	
(7) Power House	Brick masonry	Easy specification on site
size(W×L×H)	3.72m x 3.72m x 2.5-3.0m	

Items	Specifications	Notes
5. Electro-mechanical		Adoption of unit-type
(1) Turbine		
a. Type	Pelton	
b. Runner width	230mm	
c. Speed	1,000 min^{-1}	
d. Speed up gears	None	
e. Governor	Dummy-load type	
(2) Generator		
a. Type	Single-phase induction generator	Induction motor by taking the condenser-excitation method
b. Speed	1,000 min^{-1}	
c. Voltage	220/380V	
d. Voltage Control	-	
6. Electric Grid		
(1) System	Single-phase, Double-wire	
(2) Voltage	220V	Voltage drop rate at distribution terminals is set under 10%.
(3) Length	1.3km	
(4) Cable	ACSR95mm2 x 1.9km, 35mm2 x 0.7km	

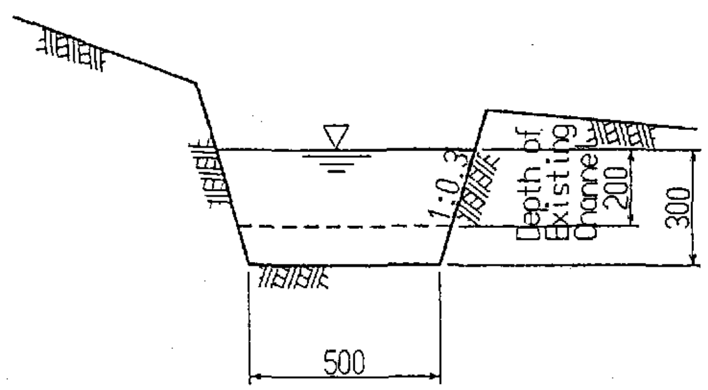
Layout of Village Hydro Project (S=1:5,000)



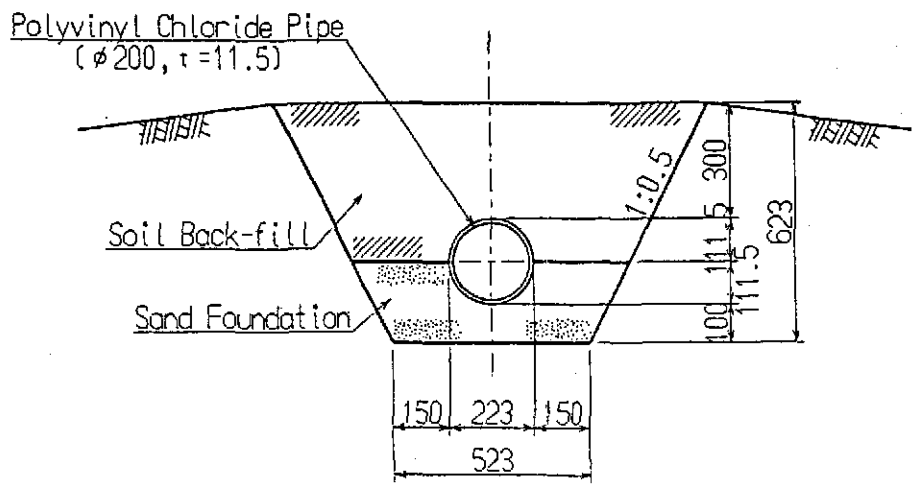
Village Hydro Profile (S=1:800)



Section of Headrace Channel (S=1:20)

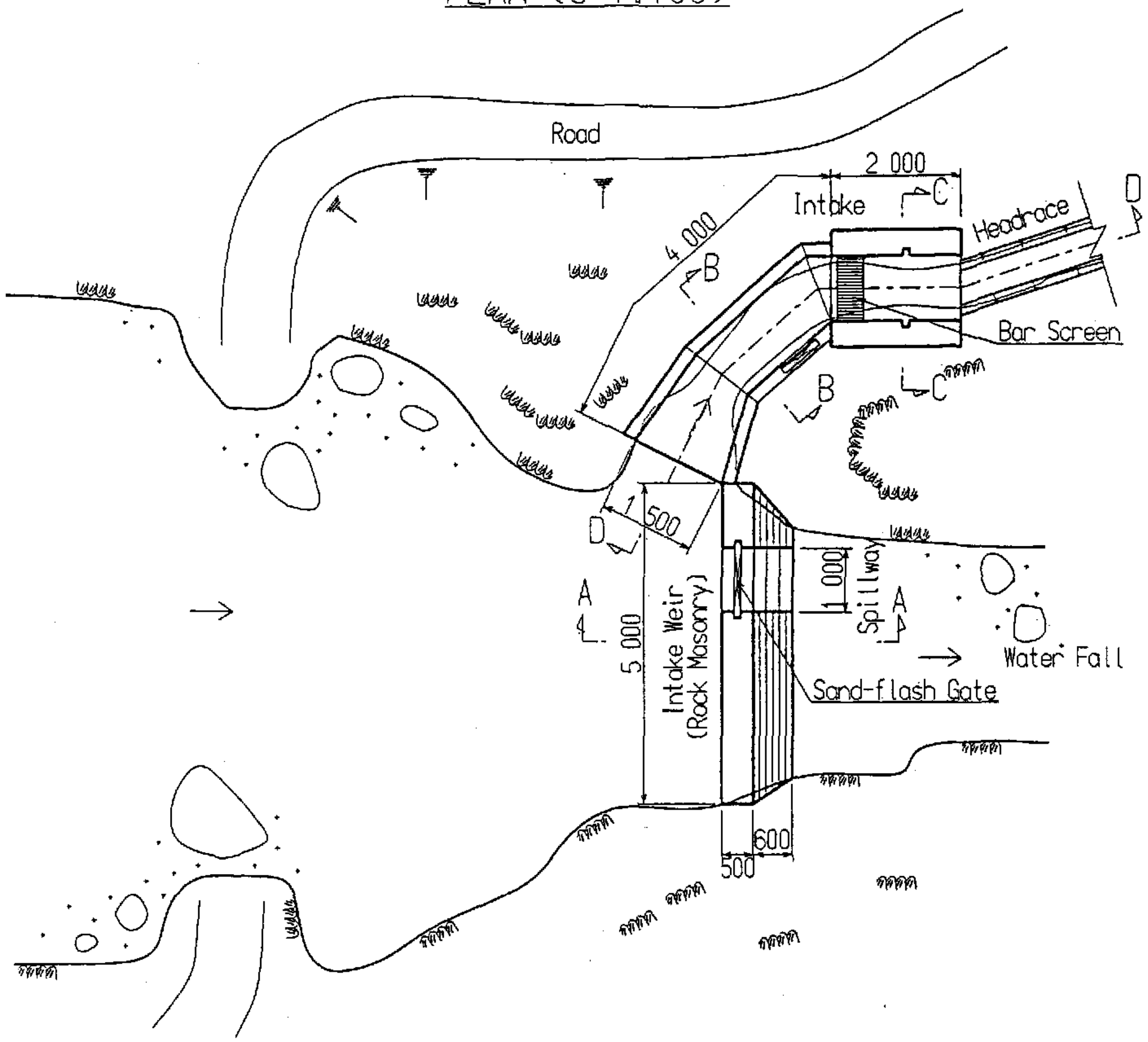


Section of Penstock (S=1:20)

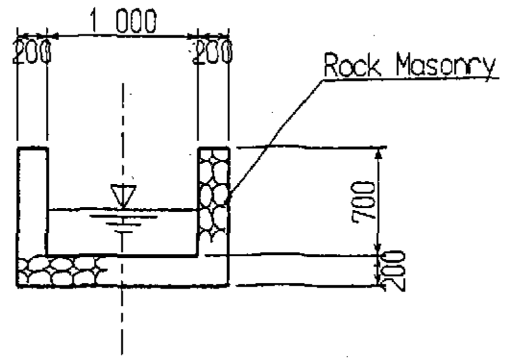


Village Hydro Intake

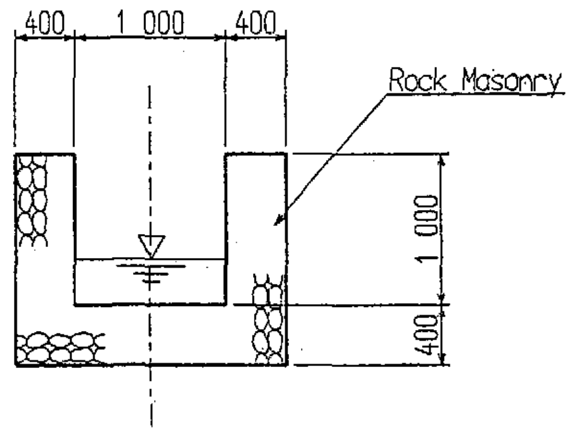
PLAN (S=1:100)



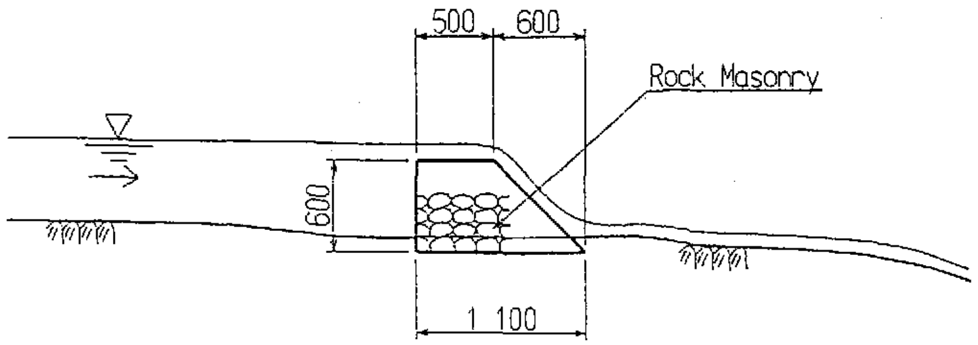
B-B (S=1:50)



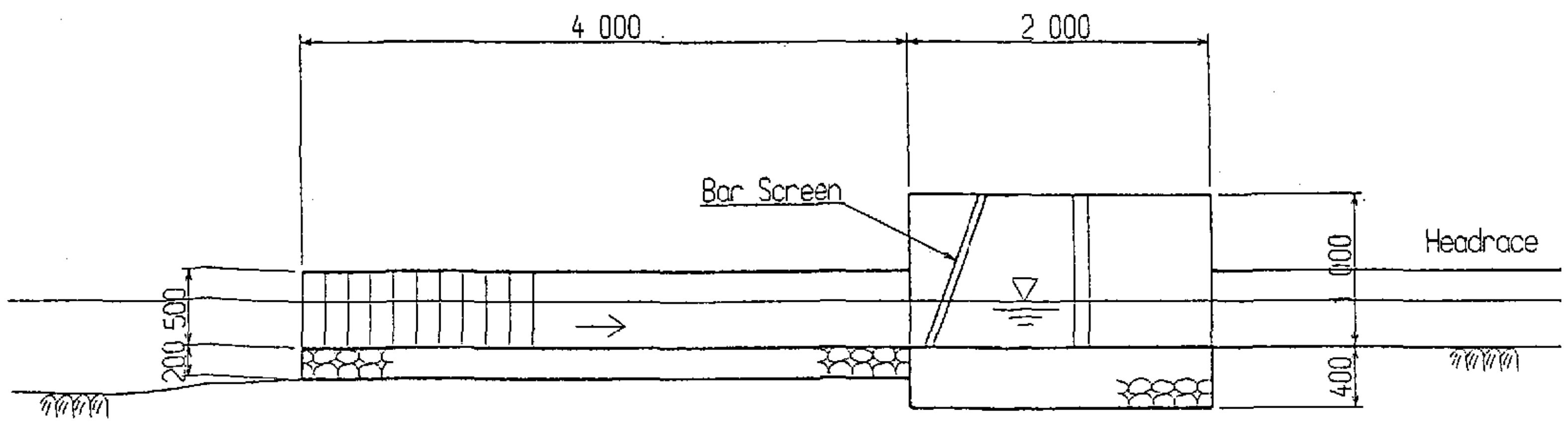
C-C (S=1:50)



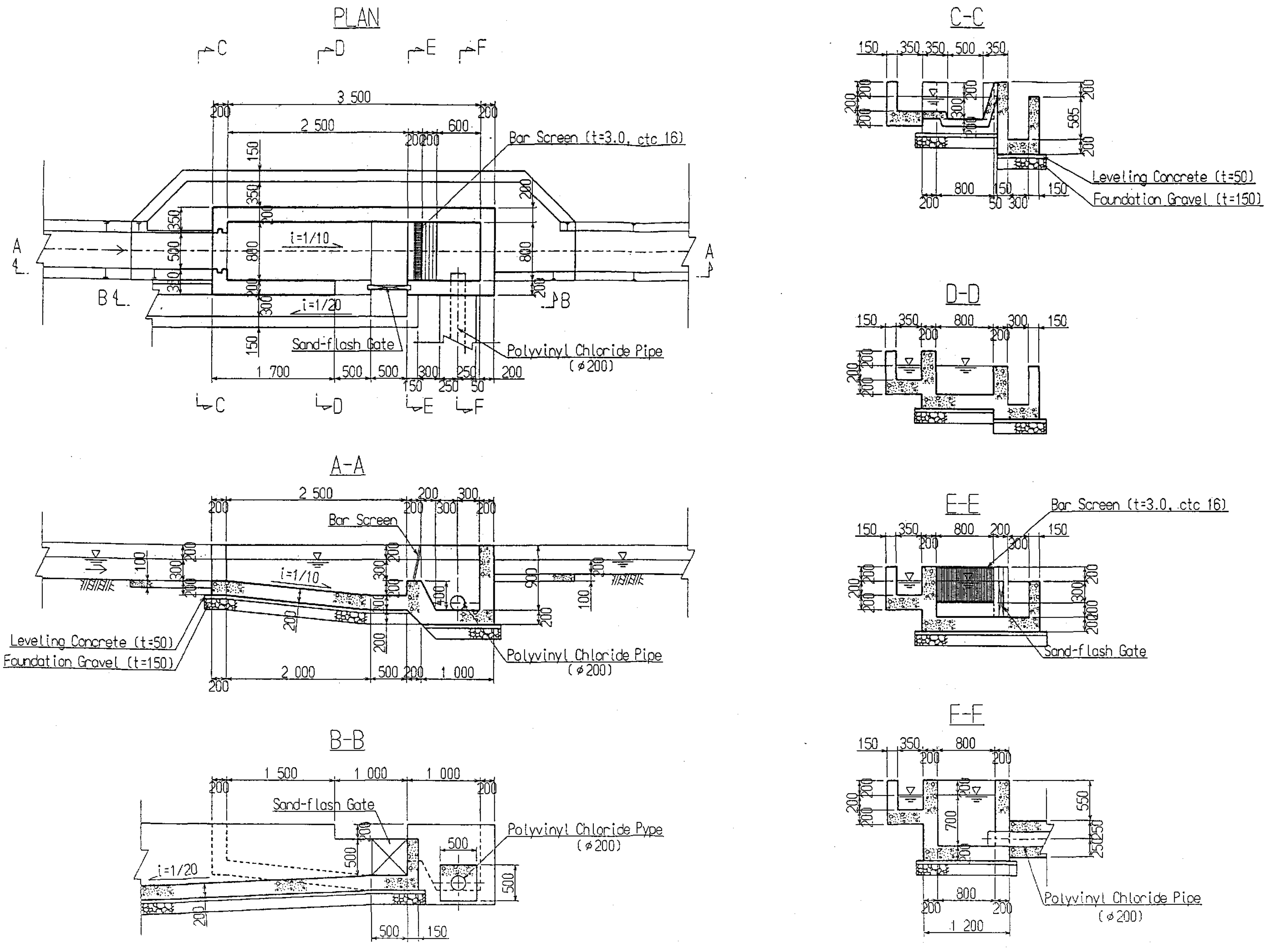
A-A (S=1:50)



D-D (S=1:50)

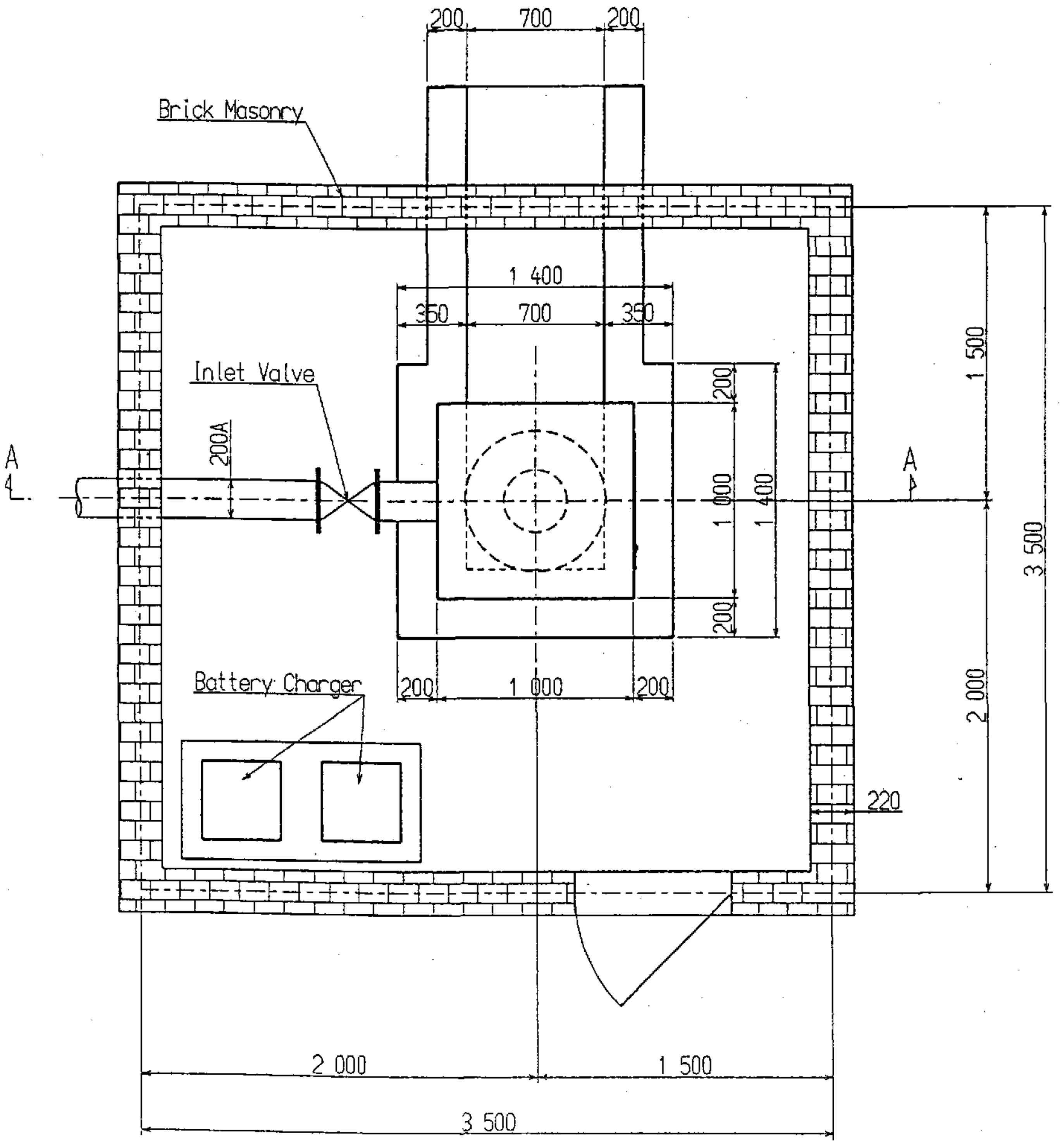


Village Hydro Headtank (S=1:50)

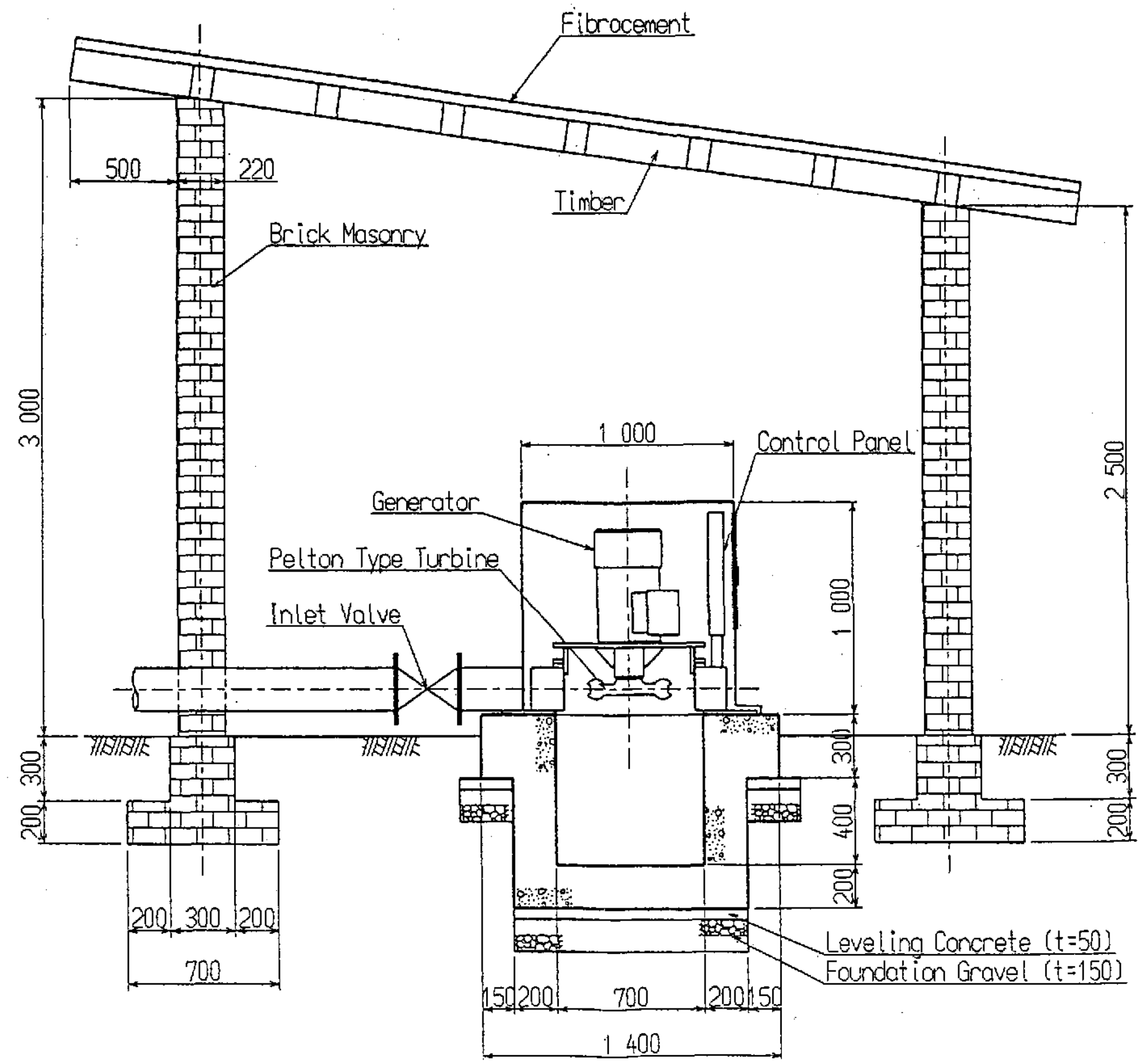


Village Hydro Power House (S=1:30)

PLAN



A-A



Electrification Cost by Village Hydro Model Plan

1. Project	Village Hydro Model Plan				
2. General Information					
(1) Output Capacity	11kW				
(2) Gross Head	40m				
(3) Effective Head	37.3m				
(4) Design Flow	0.05m3/s				
3. Demand Scale					
(1) No.of Households	212 Households				
(2) Design Demand	50W/HH				
(3) Length of Electric Grid	1.3km				
4. Electrification Cost	Cost	Cost/kW	Cost/HH	Cost/km	Notes
(1) Generation Cost	$9,475	$861	$45		
a. Civil Works	$4,594	$418	$22		
b. Electric Mechanical	$4,881	$444	$23		
(2) Electric Grid Cost	$7,748	$704	$37	$5,960	
Total Cost	$17,223	$1,566	$81		
Profit	$947	$86	$4		
VAT	$909	$83	$4		
Project Cost	$19,079	$1,734	$90		

Cost Estimation for Village Hydro Model Plan

1. Project	Village Hydro Model Plan					
2. General Information						
(1) Output Capacity	11kW					
(2) Gross Head	40m					
(3) Effective Head	37.3m					
(4) Design Flow	0.05m3/s					
3. Demand Scale						
(1) No.of Households	212 Households					
(2) Design Demand	50W/HH					
(3) Length of Distribution Line	1.3km					
4. Electrification Cost	Work Items	Unit	Quantity	Unit Price (US$)	Cost (US$)	Notes
(1) Generation Cost					9,475	
a. Civil Works					4,594	
- Weir					(107)	
	Rock Masonry	m3	3	23.4	70	
	Rock Excavation	m3	1	8.8	9	
	Concrete	m3	1	28.4	28	
- Intake					(272)	
	Rock Masonry	m3	7	23.4	164	
	Rock Excavation	m3	4	8.8	35	
	Concrete	m3	1	28.4	28	
	Bar Screen	kg	30	1.5	45	
- Headrace					(176)	
	Mud Excavation	m3	39	4.3	168	
	Mud Disposal	m3	39	0.2	8	
- Head Tank					(695)	
	General Excavation	m3	17	3.7	63	
	Back-filling	m3	5	0.7	4	
	Soil Disposal	m3	13	0.1	1	
	Reinforced Concrete	m3	10	50.5	505	
	Foundation Gravel	m3	3	13.5	41	
	Concrete	m3	1	28.4	28	
	Bar Screen	kg	35	1.5	53	
- Penstock					(2,974)	
	PVC-pipe φ200	m	110	10.9	1,199	
	PVC installation	m	110	5.0	550	
	PVC transportation	set	1	200.0	200	
	Expansion Joint	set	2	57.1	114	
	PVC-pipe Accessories	set	1	239.8	240	Socket, Elbow, etc. 20% of PVC-pipe cost
	Steel Pipe φ200	m	5	57.1	286	
	Inlet Valve	set	1	190.5	191	
	Reinforced Concrete	m3	3	50.5	152	
	Foundation Gravel	m3	1	13.5	14	
	Concrete	m3	1	28.4	28	
- Power House					(370)	
	House Building	unit	1	150.0	150	
	General Excavation	m3	18	3.7	67	
	Back-filling	m3	13	0.7	9	
	Soil Disposal	m3	6	0.1	1	
	Reinforced Concrete	m3	2	50.5	101	
	Foundation Gravel	m3	1	13.5	14	
	Concrete	m3	1	28.4	28	
b. Electric Mechanical					4,881	
- 1-box Generation Unit	Pelton, Induction gen. & Controller	unit	1	4,739.3	4,739	
- Battery Charge System	20A, 12V-24V	set	5	28.4	142	
(2) Electric Grid Cost					7,748	
- Installation		km	1.3	1,400.0	1,820	
- Electric Wire	AL-PVC,95mm2	km	1.9	909.5	1,728	
	AL-PVC,35mm2	km	0.7	342.9	240	
- Concrete Pole		pole	33	54.8	1,808	

- Rack		set	33	14.3	472	
- Pole Foundation		set	33	18.0	594	
- Stay,Earth Rod,Ar		set	1	285.7	286	
- Material Transportation	Hanoi～Site	set	1	800.0	800	
Total Cost					17,223	
Profit		%	5.5		947	5.5% of Total Cost
VAT		%	5.0		909	
Project Cost					19,079	

Reference: Cost estimation for 5kW Village Hydro

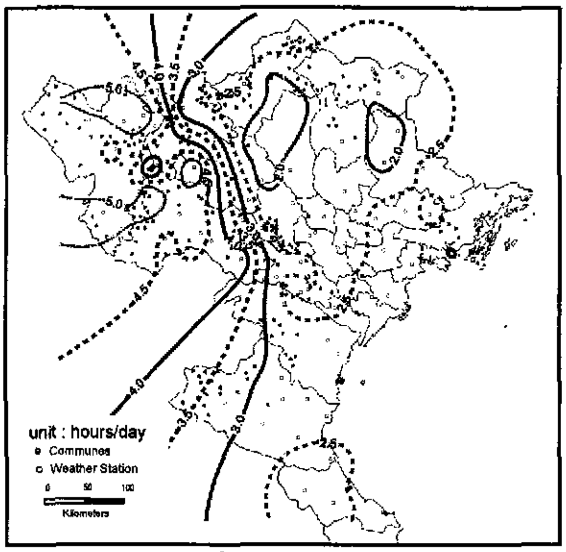
	Village Hydro Model Plan					
1. General Information						
(1) Output Capacity	5kW					
(2) Gross Head	20m					
(3) Effective Head	18.52m					
(4) Design Flow	0.05m3/s					
2. Demand Scale						
(1) Households	100 Households					
(2) Design Unit Demand	50W/HH					
(3) Length of Distribution Line	0.8km					
3. Electrification Cost	Work Items	Unit	Quantity	Unit Price	Cost	Notes
				(US$)	(US$)	
(1) Generation Facility					6,036	
a. Civil Works					3,151	
- Weir					(107)	
	Rock Masonry	m3	3	23.4	70	
	Rock Excavation	m3	1	8.8	9	
	Concrete	m3	1	28.4	28	
- Intake					(273)	
	Rock Masonry	m3	7	23.4	164	
	Rock Excavation	m3	4	8.8	35	
	Concrete	m3	1	28.4	29	
	Bar Screen	Kg	30	1.5	45	
- Headrace					(176)	
	Mud Excavation	m3	39	4.3	168	
	Mud Disposal	m3	39	0.2	8	
- Head Tank					(695)	
	General Excavation	m3	17	3.7	63	
	Back-filling	m3	5	0.7	4	
	Soil Disposal	m3	13	0.1	1	
	Reinforced Concrete	m3	10	50.5	505	
	Foundation Gravel	m3	3	13.5	41	
	Concrete	m3	1	28.4	28	
	Bar Screen	Kg	35	1.5	53	
- Penstock					(1,483)	
	PVC-pipe φ200	M	60	10.9	654	
	PVC installation	M	60	5.0	300	
	Expansion Joint	Set	1	57.1	57	
	PVC-pipe Accessories	Set	1	130.8	131	Socket, Elbow, etc. 20% of PVC-pipe cost
	Inlet Valve	Set	1	190.5	191	
	Foundation Gravel	m3	1	13.5	14	
	Reinforced Concrete	m3	1	50.5	51	
	Steel Pipe Φ200	m	1	57.1	57	
	Concrete	m3	1	28.4	28	
- Power House					(440)	
	House Building	Unit	1	220.0	220	
	General Excavation	m3	18	3.7	67	
	Back-filling	m3	13	0.7	9	
	Soil Disposal	m3	6	0.1	1	
	Reinforced Concrete	m3	2	50.5	101	
	Foundation Gravel	m3	1	13.5	14	

	Concrete	m3	1	28.4	28	
b. Electric Mechanical					2,885	
- 1-box Generation Unit	Pelton (Turgo) turbine Induction generator & Controller	Unit	1	2,800	2,800	
- Battery Charge System	20A, 12V	Set	3	28.4	85	
(2)Electric Grid Cost					3,987	
- Installation		Km	0.8	1,400.0	1,120	
- Electric Wire	AL-PVC,35mm2	Km	1.6	342.9	549	
- Concrete Pole		Pole	20	54.8	1,096	
- Rack		Set	20	14.3	286	
- Pole Foundation		Set	20	18.0	360	
- Stay		Set	1	175.8	176	
- Material Transportation	Hanoi～Site	Set	1	400.0	400	Cables, PVC pipes, etc.
Total Cost					10,023	
Profit Margin		%	5.5		551	5.5% of Total Cost
VAT		%	5.0		528	
Project Cost					**11,102**	

Model communes surveyed by JICA for micro-hydro development

No.	Province	District	Commune	Number of Households	Number of Villages	Access by season		Hydropower (kW)	Discharge (m3/s)	Head (m)	Notes
						Dry	Rainy				
1	Ha Giang	Hoang Su Phi	Nam Khoa	415	7	Car	Motorbike	44	0.40	20	
								27	0.50	10	
2	Cao Bang	Hoa An	Cong Trung	162	5	Car	Car	22	1.00	4	
3	Cao Bang	Nguyen Binh	Thanh Cong	422	18	Car	Motorbike	33	0.10	60	
4	Lang Son	Dinh Lap	Dong Thang	91	7	Car	Motorbike	11	0.20	10	
5	Bac Kan	Ba Be	Quang Khe	498	7	Car	Walking	16	0.10	30	
6	Yen Bai	Van Yen	Mo Vang	526	9	Car	Walking	165	0.50	60	
7	Phu Tho	Thang Son	Thuong Cuu	397	9	Car	Car	2	0.15	3	
8	Phu Tho	Thang Son	Vinh Tien	199	6	Car	Car	3	0.30	2	
								4	0.15	6	
9	Hoa Binh	Lac Son	Tu Do	438	11	Car	Car	44	0.20	40	
10	Hoa Binh	Lac Son	Mien Doi	707	12	Car	Car	49	0.15	60	
								11	0.05	40	
11	Hoa Binh	Kim Boi	Thuong Tien	219	5	Car	Motorbike	5	0.10	10	
12	Hoa Binh	Ky Son	Yen Thuong	463	12	Car	Car	9	0.03	60	
13	Son La	Muong La	Chien Muon	143	4	Motorbike	Walking	24	0.15	30	
14	Son La	Moc Chau	Chieng Yen	783	14	Car	Car	39	0.12	60	
								8	0.05	30	
								11	0.10	20	
								11	0.07	30	
								33	0.10	60	
15	Lai Chau	Muong Te	Muong Te	400	6	Car	Walking	16	0.50	6	
								82	0.50	30	
16	Lai Chau	Phong Tho	Tung Qua Lin	220	6	Car	Walking	46	0.14	60	
17	Lai Chau	Phong Tho	Khun Ha	361	13	Car	Walking	15	0.07	40	
								11	0.07	30	
								20	0.46	8	
								16	0.05	60	
								5	0.18	6	
18	Lao Cai	Bat Xat	Trung Leng Ho	236	5	Car	Walking	16	0.20	15	
19	Lao Cai	Than Uyen	Ho Mit	306	7	Car	Motorbike	11	0.10	20	
20	Lao Cai	Van Ban	Nam Chay	268	8	Car	Car	27	0.25	20	
								10	0.19	10	
								6	0.12	10	
								11	0.10	20	
21	Thanh Hoa	Ba Thuoc	Lung Cao	1027	12	Car	Motorbike	2	0.10	4	
22	Thanh Hoa	Quan Hoa	Thanh Son	405	8	Motorbike	Walking	5	0.20	5	
								16	0.15	20	
23	Nghe An	Que Phong	Thong Thu	706	12	Car	Motorbike	49	0.30	30	
								176	0.80	40	

Average Sunshine Hours (h/day) in Northern Part of Vietnam



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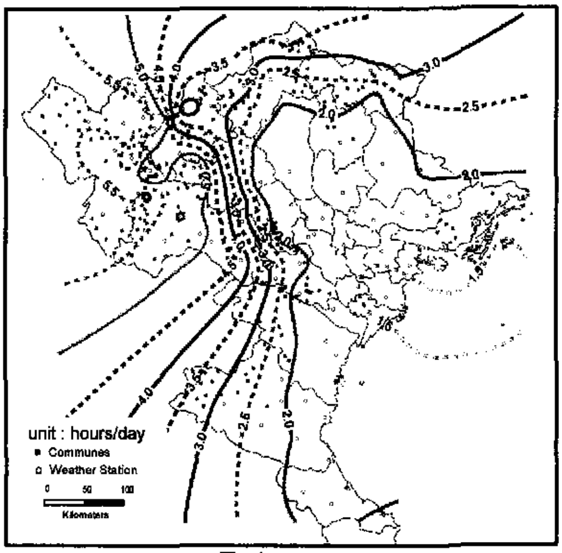

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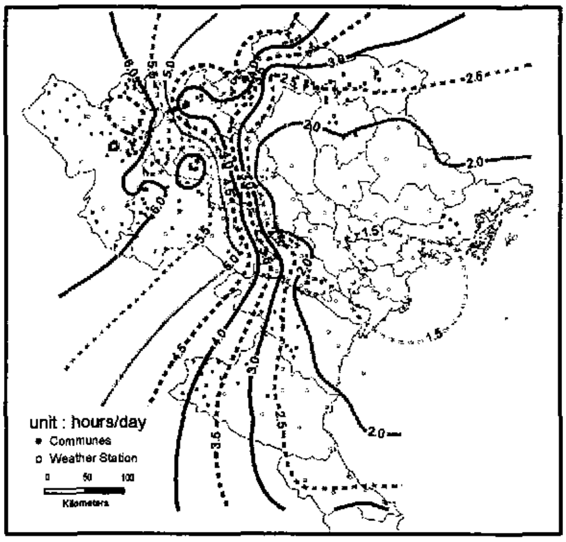

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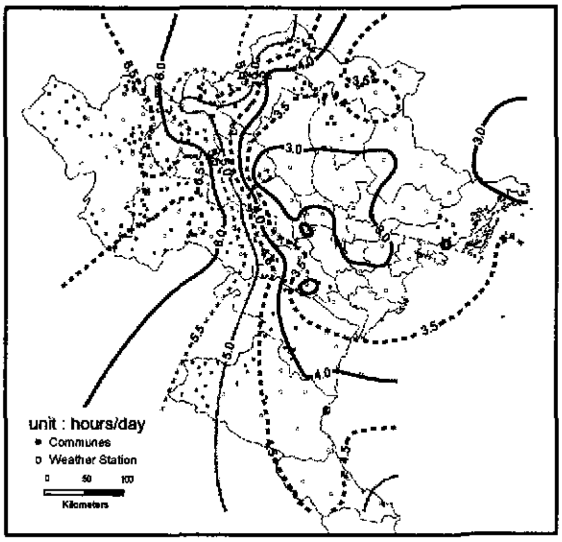

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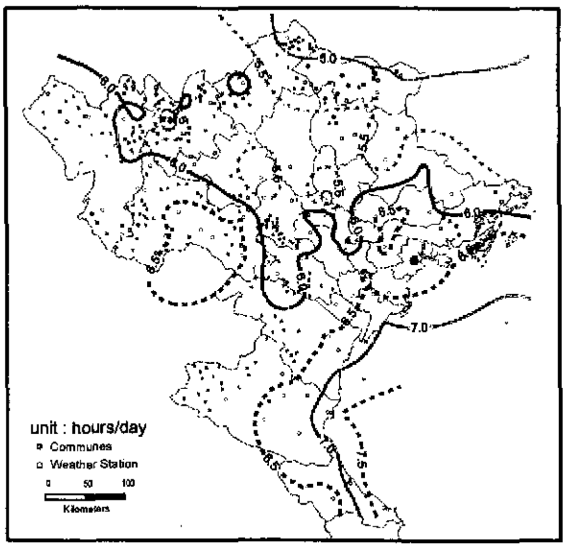

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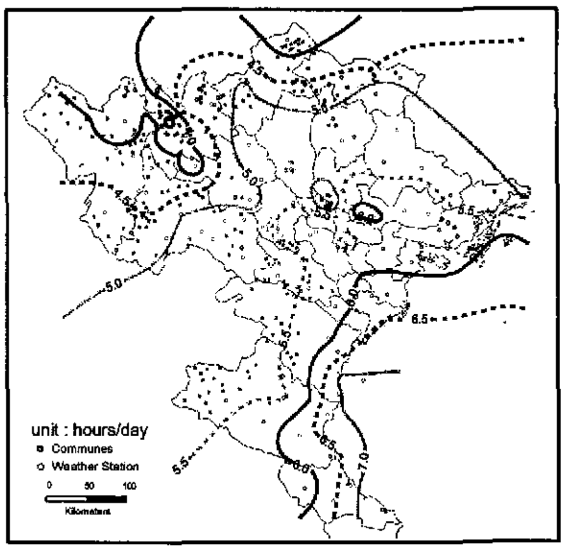

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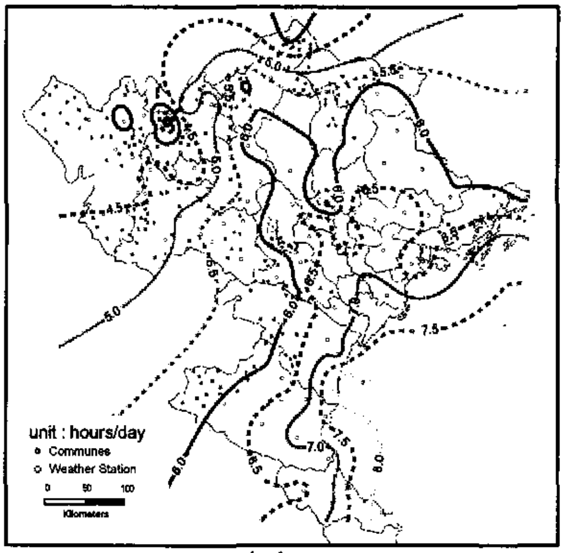

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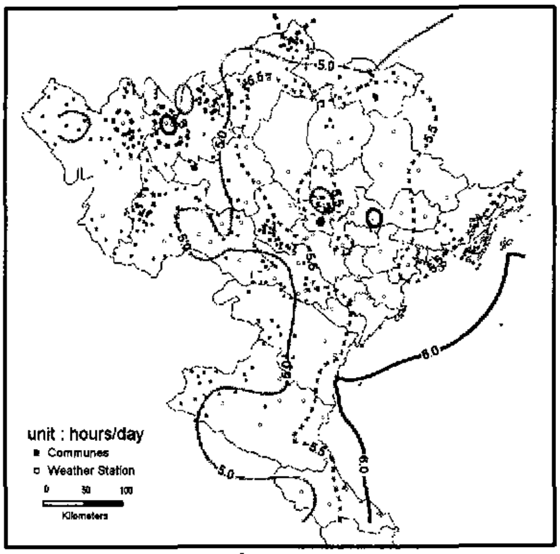

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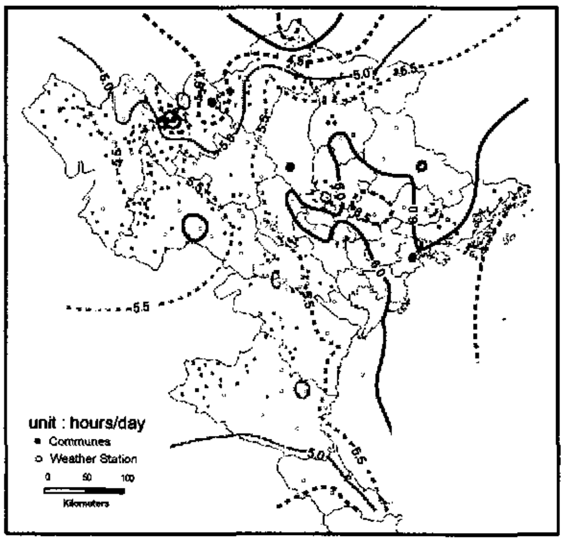
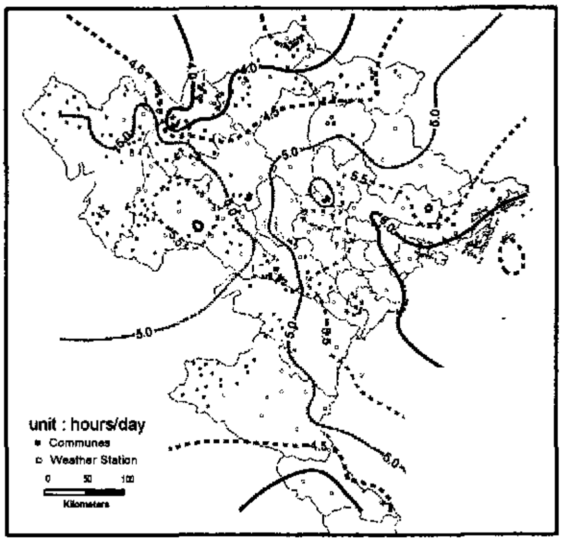


September



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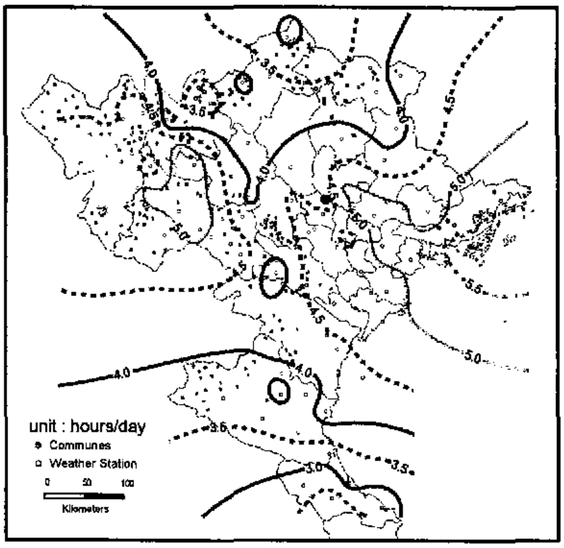

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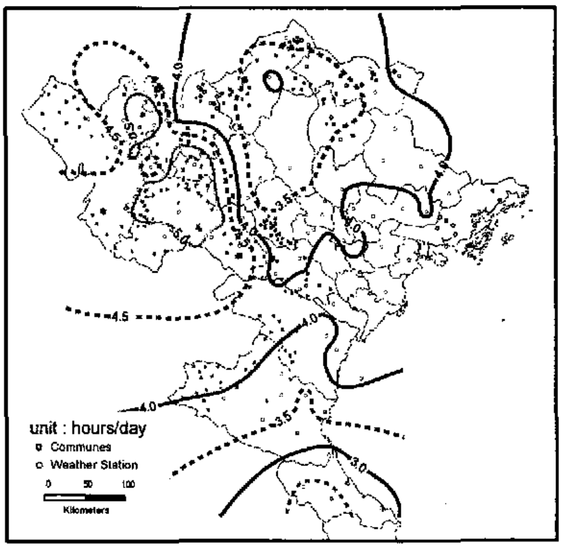

December

Source: JICA study team processed data provided by IE

Village Solar
Technical Instructions

1 Installation

Installation of photovoltaic systems is not difficult. Local people will quickly master the technique to build photovoltaic systems. To this end, the contractor is expected to give proper guidance to CEU members and local electricians, and to let them do the actual installation work as much as possible.

(1) PV module

The installation of PV modules needs to be done properly to make best use of solar power.

Direction:	Face to south
Tilt angle :	20° to 25°

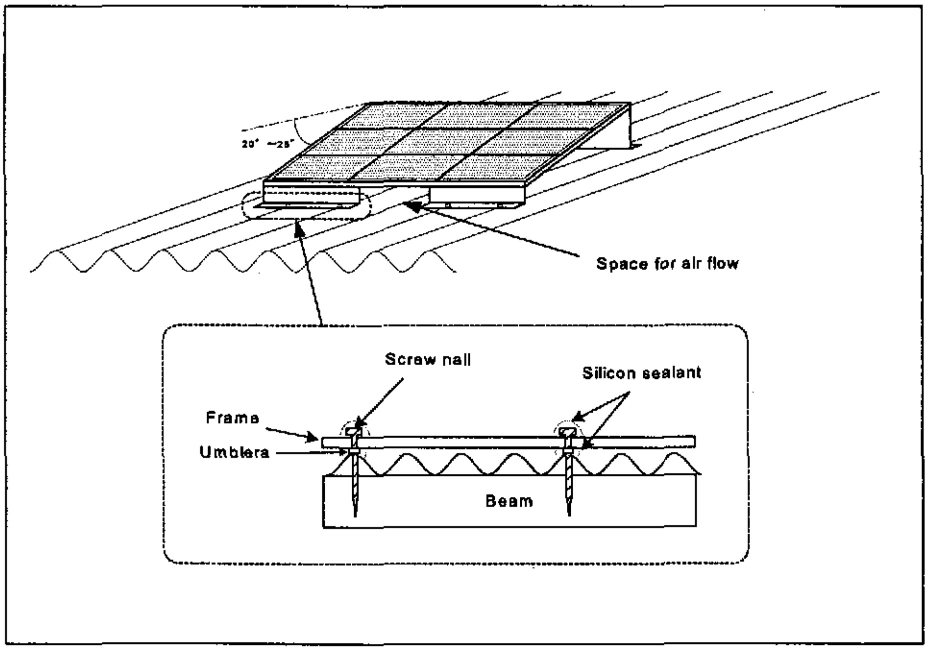

Figure 1-1 Roof-top mount

Table 1-1 Precautions for PV module installation

* The distance between the PV module and roof should be more than 10cm (to regulate temperature of the modules) * Seal holes so that they are water-tight *Strengthen mounting in windy areas *If the roof is not facing south, select the pole-type mount (recommendable range for roof mounting : ±30 degrees from south)

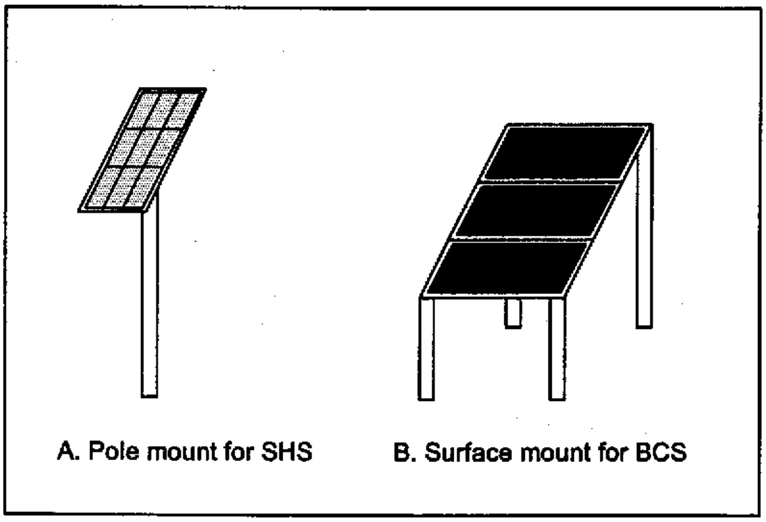

Figure 1-2 Pole mount and surface mount

(2) Wiring

1) SHS

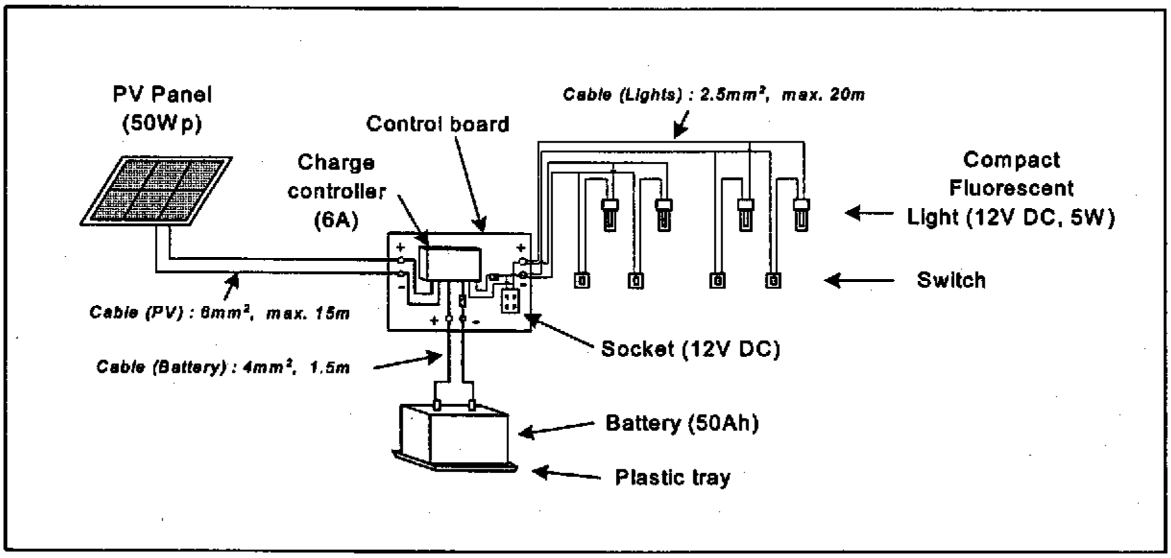

Figure 1-3 Wiring diagram of a communal system (SHS)

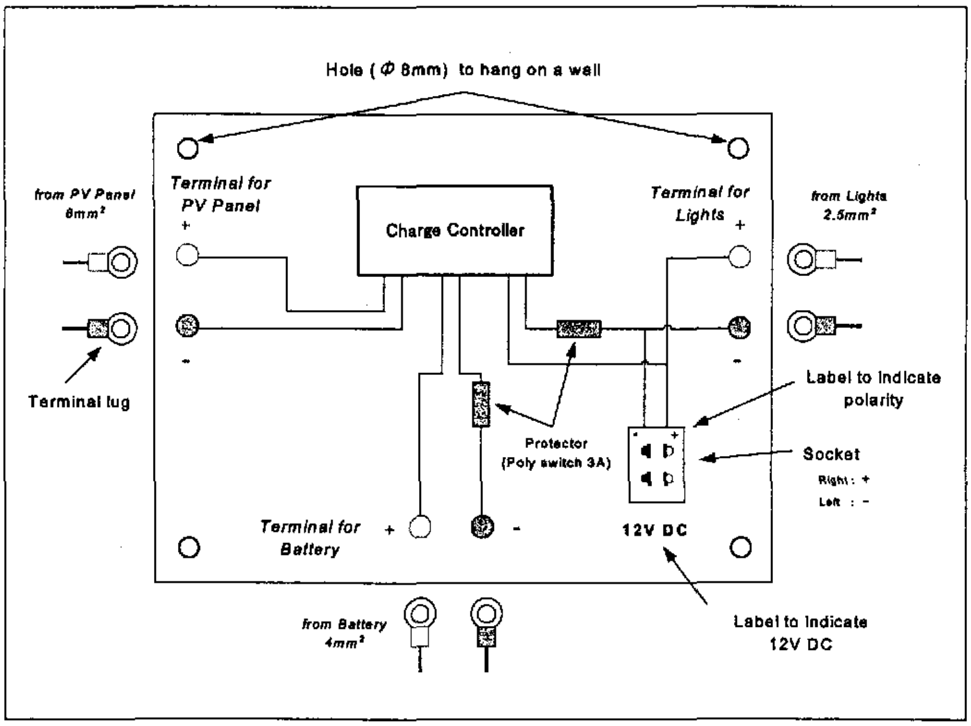

Figure 1-4 A layout of control board (SHS)

The control board of SHS uses screw terminals to make easy connection to the PV panel, battery and lights. Polarity should be clearly marked on the socket.

2) BCS

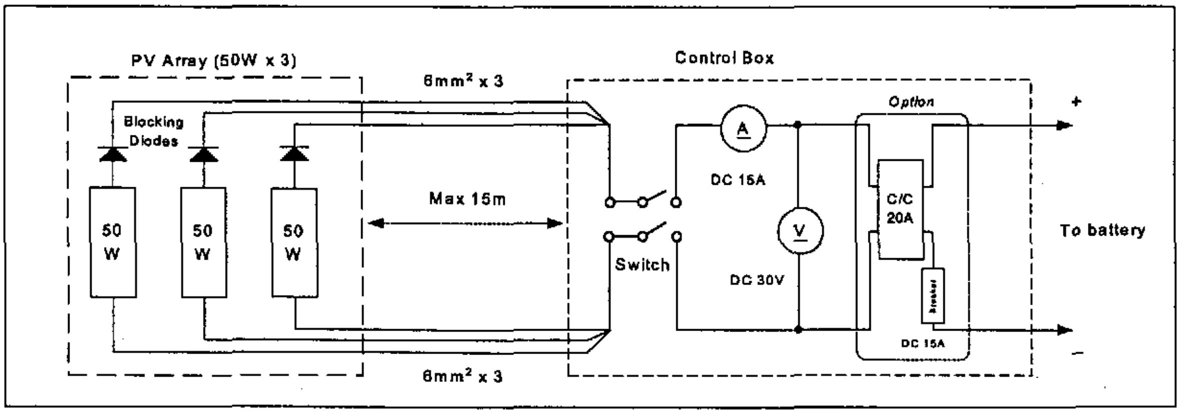

Figure 1-5 Wiring diagram of a communal system(BCS)

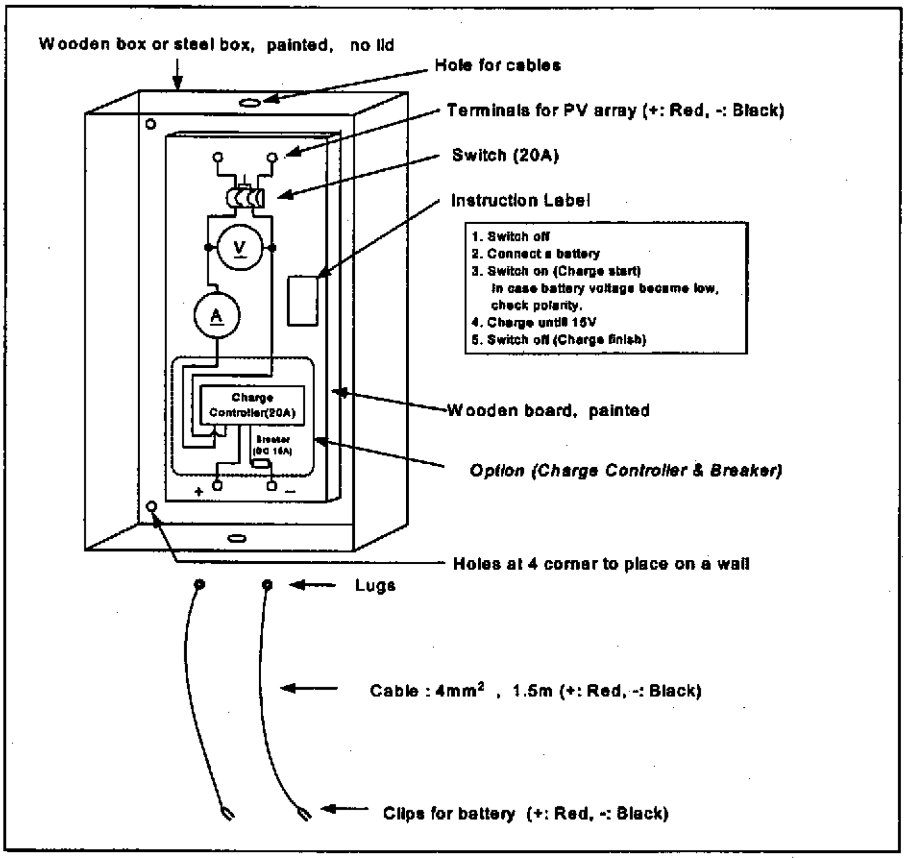

Figure 1-6 A layout of control box (BCS)

The control box of BCS is equipped with a voltmeter and ammeter. Instruction labels need to be placed to prevent wrong operation.

3) Indoor wiring

Table 1-2 Precautions for indoor wiring (SHS)

Item	Precautions
Control Board (Charge Controller, Socket, Ply switch, terminals)	* Install at a high position where children can't reach and but the user can see indicator lamps * Avoid any place that is likely to get wet *Avoid any place that receives direct sunlight or experiences a high temperature * Install on a strong structure such as a pillar or crossbeam
Other equipment (Switch, Lamp)	* Install at a place that is convenient for the user * Avoid any place that is likely to get wet
Battery	* Install on a strong floor * Avoid any place that receives direct sunlight or experiences a high temperature * Ensure good ventilation * Use a battery box or tray to protect floor * Place the battery near to the controller

(3) Inspection after completion

Table 1-3 Inspection after completion

Item	Points for inspection
Wiring	Polarity: Red for positive terminals Black for negative terminals All cables are connected and fixed firmly
Cable size	All cables are of right size
Functioning	Whole system
Direction and angle	Tilt angle of PV module
Voltage	PV modules and batteries

(4) Expansion

Since SHS and BCS of Village Solar are independent systems, it is easy to expand the SHS or BCS by replication. In the case of BCS expansion, a new unit can be installed at a different site to reduce the travel distance for new users to carry their batteries.

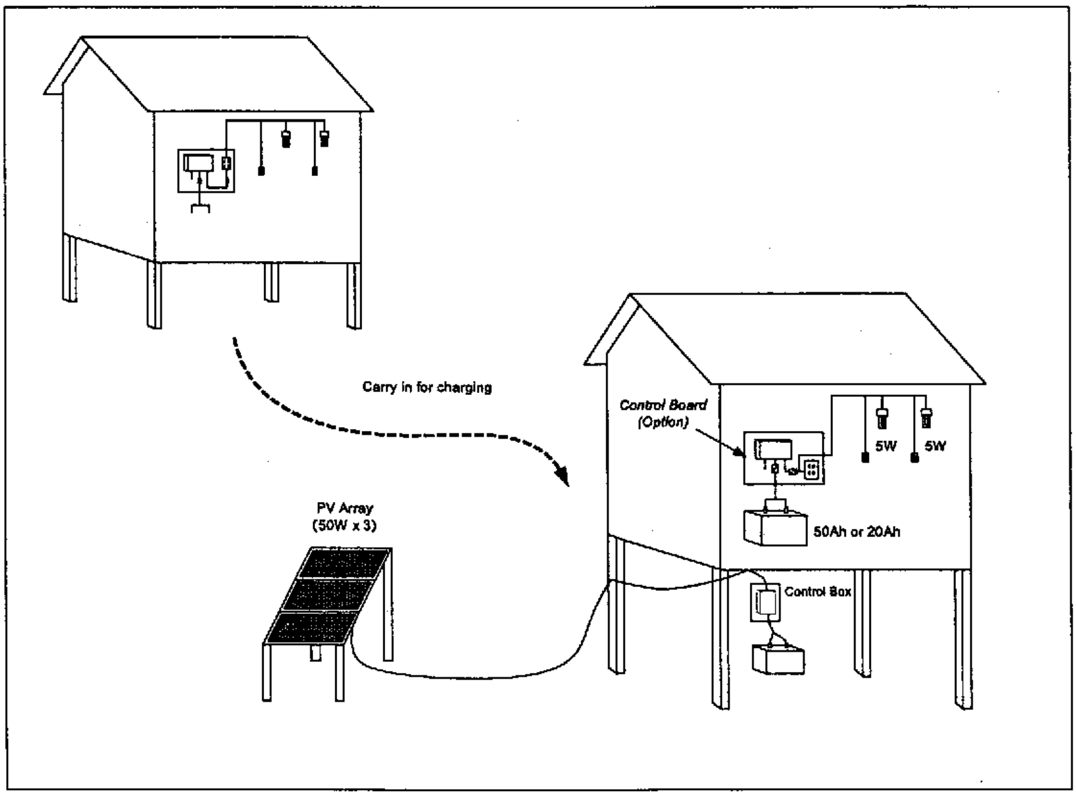

Figure 1-7 Expansion of BCS

2 Operation and maintenance (O&M)

(1) Daily Operation

Since there are no moving parts, daily operation of photovoltaic systems is simple. Just connect or disconnect cables properly and avoid short circuit. In case of BCS, an operator has to deal with a lot of work concerning charging service to customers.

(2) Regular Maintenance

Photovoltaic systems are basically maintenance-free. However, regular inspection and maintenance is recommended to find problems early and to ensure system performance. Inspection and maintenance tasks as listed below should be regularly carried out by the CEU. If any problem is found, then in all cases appropriate measures must be taken immediately. If the CEU cannot fix the problem, they should call local electricians. Also, the CEU should help individual battery users to understand the required maintenance and guide them to take care of their batteries properly. The CEU should undertake a routine visual inspection and maintenance every week.

Table 2-1 Weekly inspection

Item	Maintenance task
Surface of PV module	*If the surface of the PV modules is dirty, wipe with wet cloth or wash with clean water. *If small articles such as leaves are on the PV module, they should be removed immediately.
Shading of PV module	*Check that there is no shading between 10 am and 3 pm. *Remove origin of shade (trim trees, etc.)
Charge controller	*Keep the charge controller clean. * Check for loose connections and tighten firmly.
Electrolyte level of battery	*Keep the electrolyte level between the upper and lower range. *Top up with distilled or pure water if necessary. NEVER add acid.
Battery terminal	*Keep the terminals clean. When the grease gets dirty, remove it, clean the terminals and dry them, then add new clean grease *Check for loose connections and tighten firmly.

In addition, when the CEU finds any damage to the PV system or abnormal operation of system components, they should undertake the maintenance tasks as described immediately. Also, the CEU should keep a record of problems and maintenance activities.

Table 2-2 Measures for system failure

Item	Problems and countermeasures
PV module	*If the direction or angle is changed, put back as before. *If the PV module is damaged, report to local electrician. *If the support structure is damaged, repair it, keeping the correct tilt angle and the southward direction of the panel
Charge Controller	*If the controller operates abnormally or is damaged, replace it or report to local electrician.
Cable	*If the cable is damaged, repair or replace it.

(3) Maintenance record

For effective system management, it is important that the CEU keeps a record of maintenance problems and activities. There must be a record of the following items on each SHS system.

Table 2-3 Maintenance record

Electrolyte addition	*Date of electrolyte addition and volume of added water
Problem	*Date of problem and its details *Details of countermeasures taken
Electrical appliance	*Type and power consumption (W) of electrical appliances

*When charging users' batteries with a BCS, it is recommended to record not only revenues and expenses, but also the date of charging, size and condition of their batteries. This will help to extend the life of batteries.

Reference: Keeping electrolyte level of battery

The most important issue in photovoltaic system maintenance is to keep the electrolyte level of batteries by adding distilled water. Since the practice is not difficult, this point should be stressed to make the CEU members and other individual battery users maintain their batteries properly.

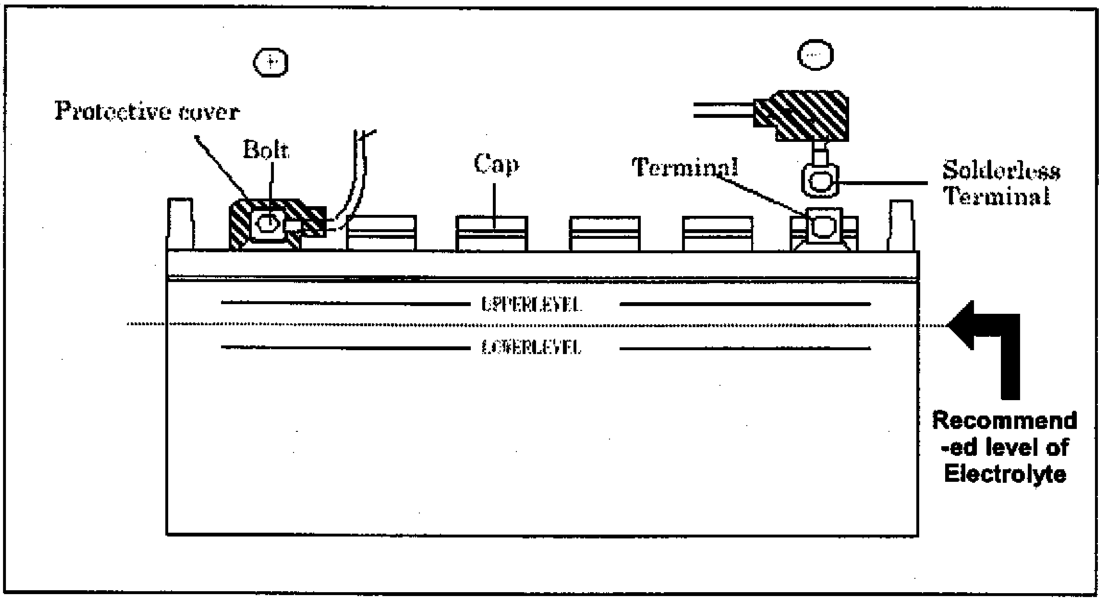

Figure 2-1 Electrolyte level of Battery

Table 2-4 Instructions for battery users

Instructions for battery maintenance

1. Shake battery once a week (SHS).

Remove bubbles trapped between electrodes, and mixture electrolyte.

2. When electrolyte level becomes lower than designated line, add distilled water.

- Use only distilled water.
- Do not use well water, rain water, mineral water or any other water. Such water will damage a battery and shorten its life.
- Do not add sulfuric acid. Since only water decreases in electrolyte, there is no necessity of adding sulfuric acid. Adding acid may cause poor performance of the battery.
- Apply distilled water up to designated level. The capacity of a battery is not related to the quantity of electrolyte. If too much distilled water is topped up, performance of the battery may become low.

3. If battery acid adheres to the skin, clothing, etc., wash away with plenty of water.

Since acid does not evaporate, if it remains, it will cause corrosion.

(4) Trouble shooting

These diagrams will help the CEU to find the cause and solution of problems.

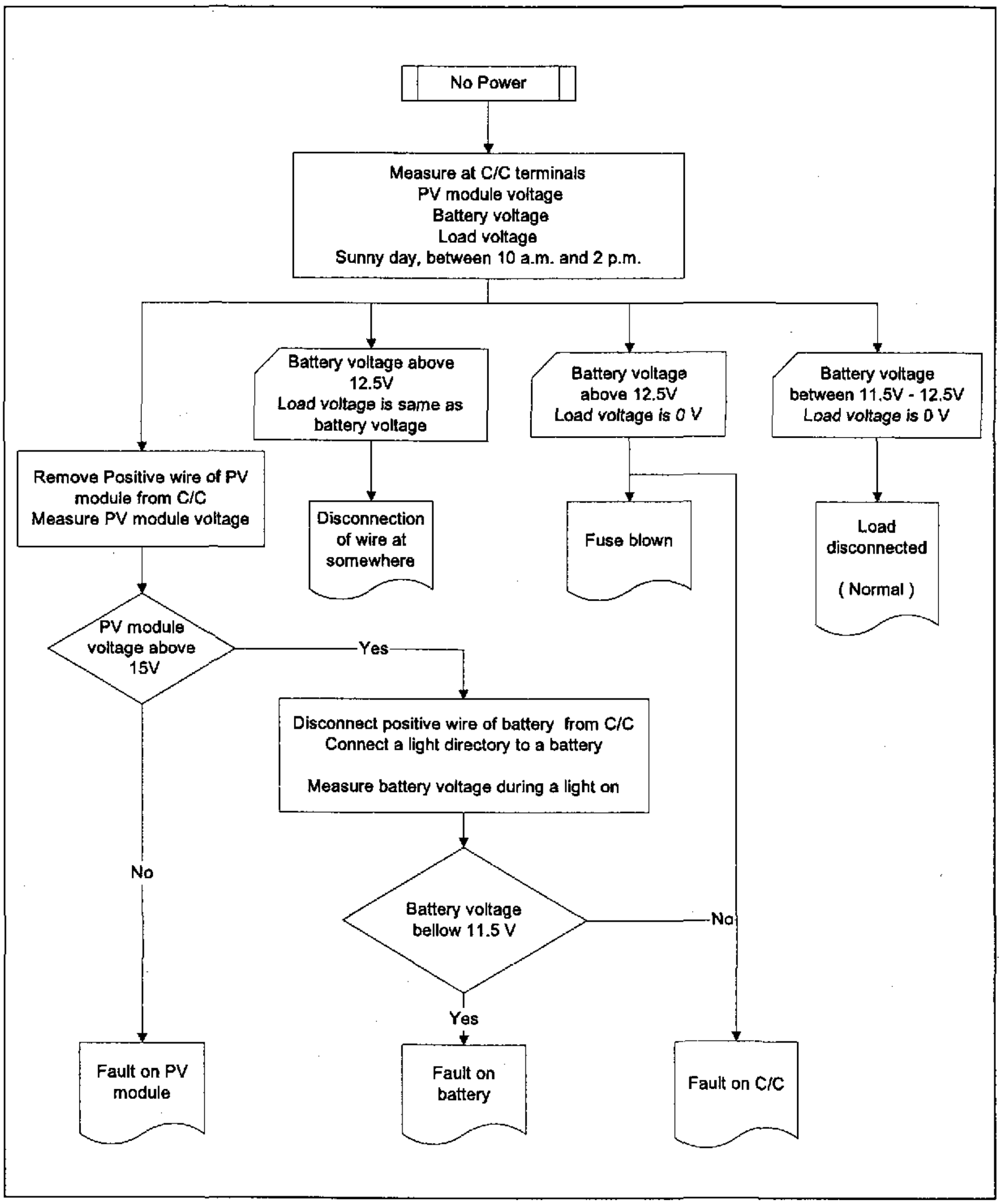

Figure 2-2 Flow diagram to identify the cause of power failure

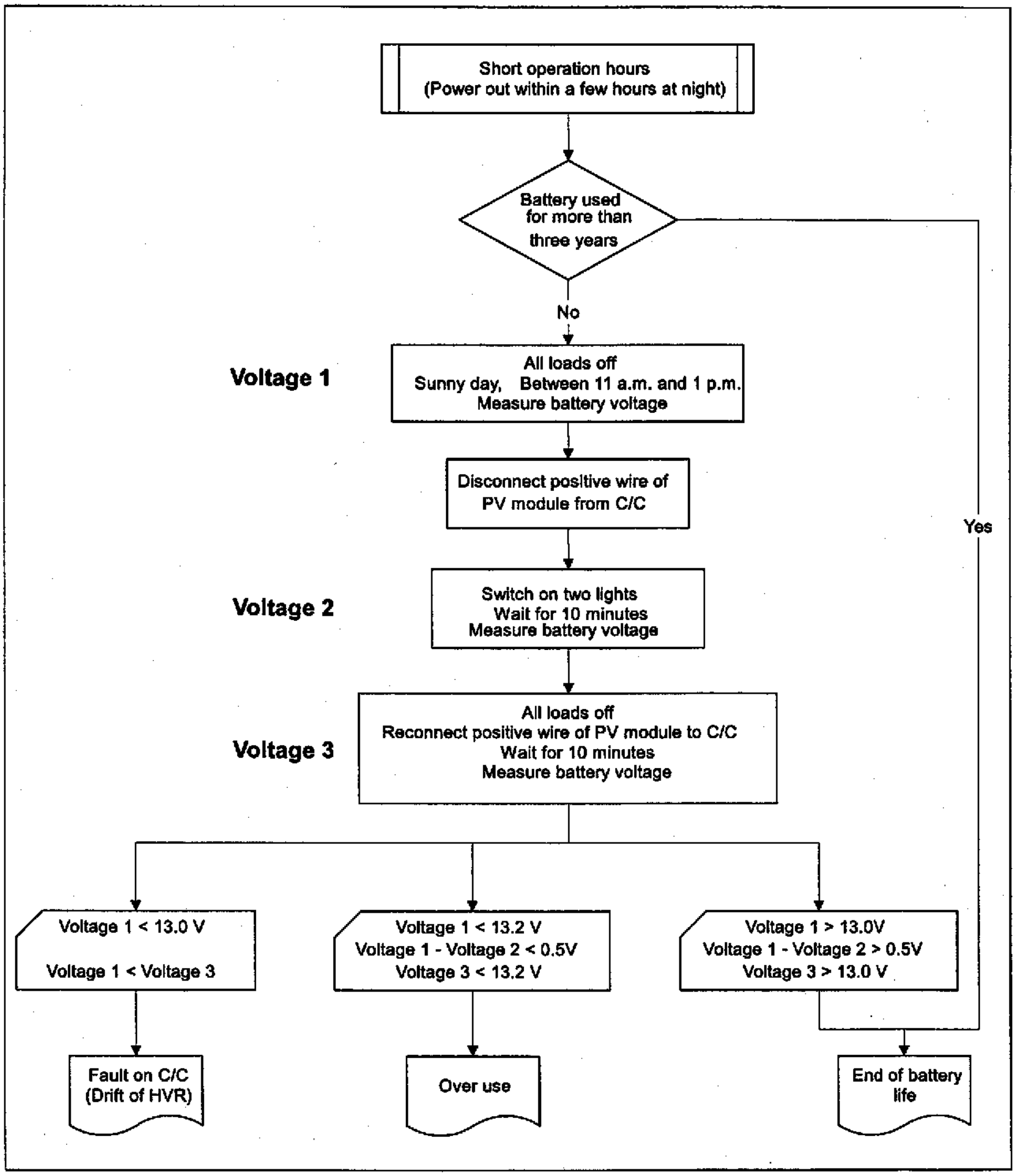

Figure 2-3 Flow diagram to identify the cause of short operational hours

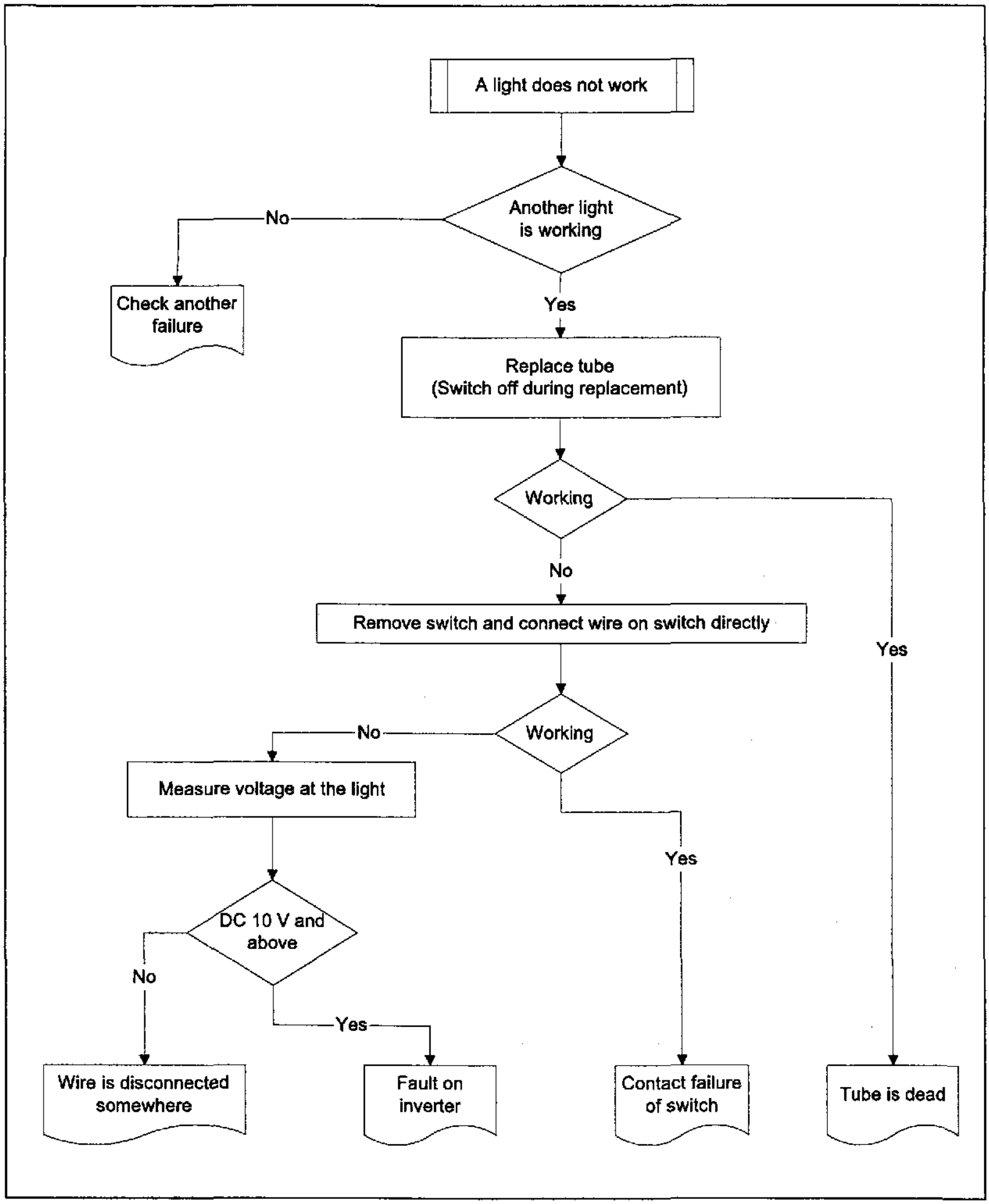

Figure 2-4 Flow diagram to identify the cause of a light not working

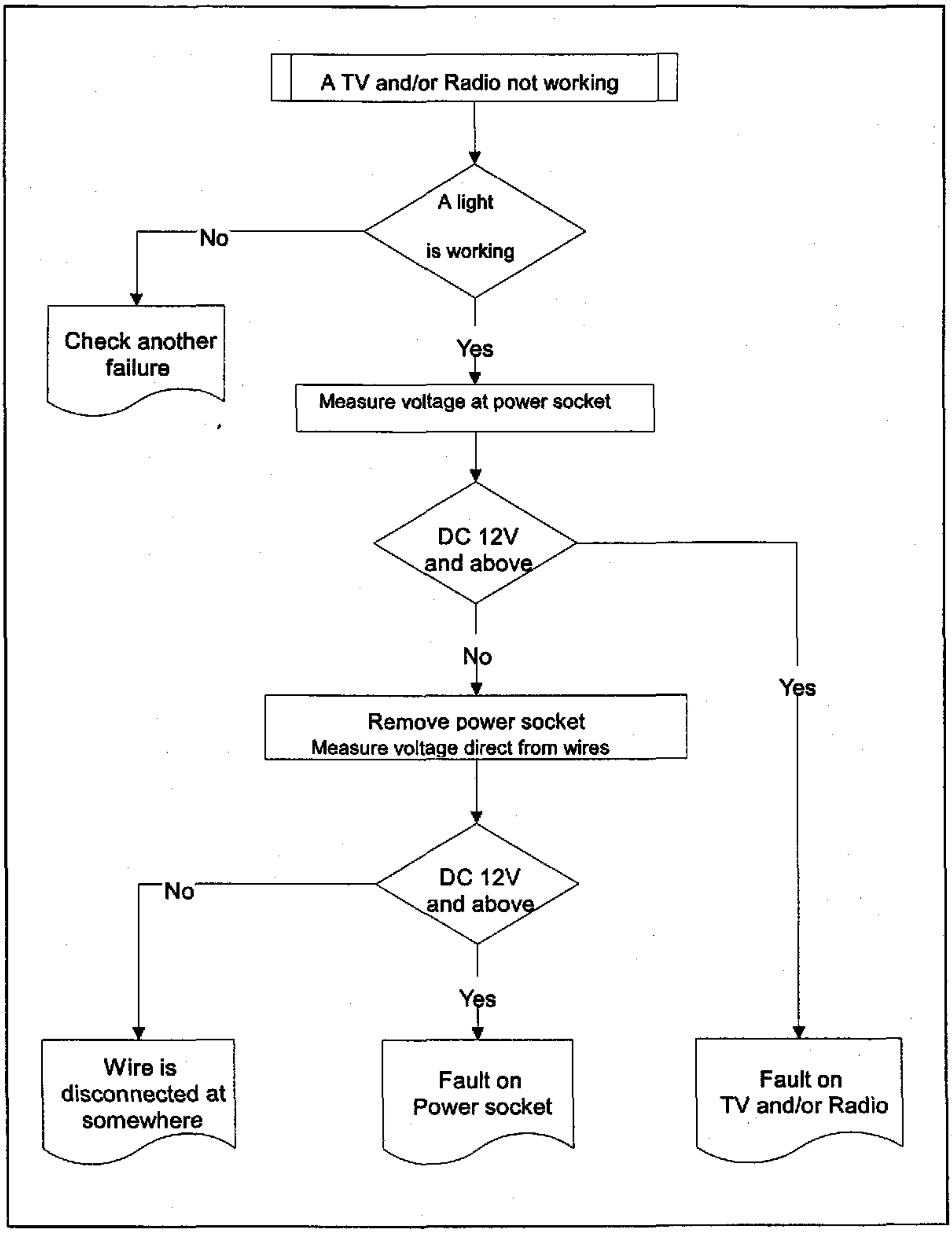

Figure 2-5 Flow diagram to identify the cause of a TV/radio not working