

## **Appendix 14 Evaluation of RCS**

## Appendix 14 Evaluation of RCS

Summary evaluation of RCS done in 1999 by EAD/EECG is shown in Appendix Table 14.1-1.

**Table 14.1-1 Evaluation of Rural Electrification Collective Scheme**

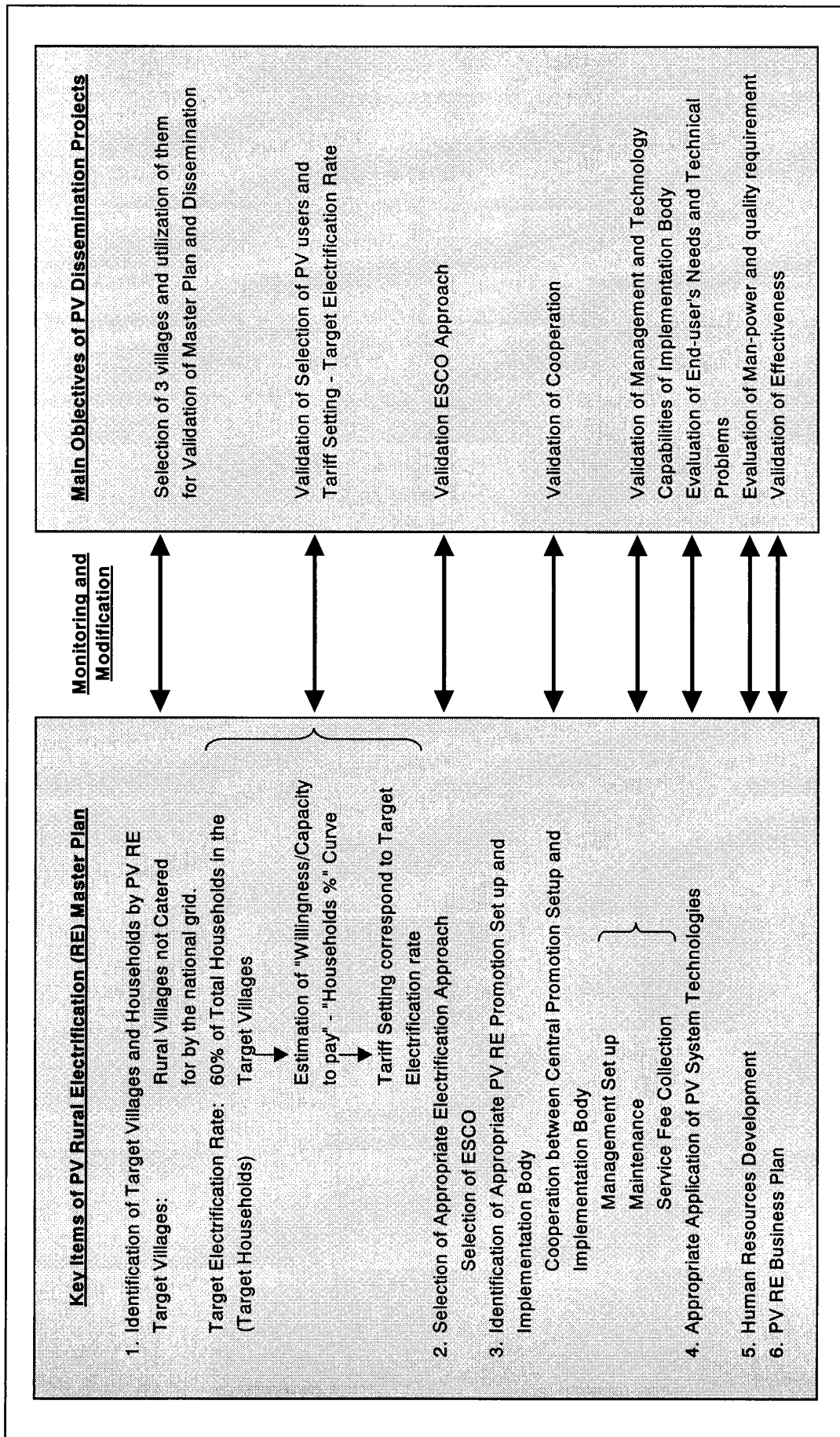
Items	Description
<p>Roundup of RCS</p> <p>Start of RCS</p> <p>Objectives</p> <p>Scheme</p> <p>Results</p>	<p>1988</p> <p>To accelerate rural electrification by making grid-connection fee affordable</p> <p>Group application more than 4 applicants</p> <p>Down-payment: 10% of total cost for both distribution and service connections</p> <p>The rest: 90%, 10 years loan at 9% interest rate loan</p> <p>Loan Fund: by the Government</p> <p>Loan: administer by BPC</p> <p>Connection increase by RCS:</p> <p>By 1990; 275 consumers connected</p> <p>By Nov./1998; 8227 consumers connected (3% of total 265,748 households in Botswana)</p> <p>Deposit paid: over P1400 (27.2% of consumers)</p> <p style="padding-left: 20px;">P400 to P599 (19.2%)</p> <p style="padding-left: 20px;">P600 to P799 (15.5%)</p> <p>Repayment paid: less than P200/month (84.4%)</p> <p>RCS Grouping: average ca 10 members</p>
<p>Evaluation</p> <p>Employment and</p> <p>Income level of</p> <p>Beneficiaries</p>	<p>Down payment and repayment payers:</p> <p>Formal employee; 55.2% and self employment; 26.4%</p> <p>the rest depend on remittance, pension, cattle sales, etc.</p> <p>Income level: (% of beneficiaries)</p> <p style="padding-left: 20px;">P501 to P1500/m (32.4%)</p> <p style="padding-left: 20px;">P1500 to P3000/m (28%)</p> <p style="padding-left: 20px;">More than P3000 /m (23.6%)</p> <p style="padding-left: 20px;">Less than P500/m (14.2%)</p> <p>Income levels of beneficiaries are higher than average income level in rural areas (average: P441/m) and therefore, RCS is out of reach of most rural households)</p>
<p>Success of RCS</p>	<p>80% of RCS beneficiaries could not be connected to the grid without RCS.</p> <p>RCS Loan is beneficial to latent users in respect of no requirement of income guarantee and security, and lower interest rate</p> <p>Benefited by RCS, connection rate increased to average 914 households/y for 9 years since 1990.</p> <p>Reticulations installed by affluent will benefit low-income households.</p> <p>Grouping increased affordability comparing with independent application.</p>
<p>Failures of RCS</p>	<p>Most of households are not affordable for down-payment and monthly repayment due to low income.</p> <p>BPC has not been checking the creditability of consumers for loan application and hence part of government loan may not be recovered.</p> <p>Cost recovery is poor. The majority of consumers are in arrears of above 2 years even those in regular employment.</p> <p>There is no comprehensive policy for grid- and solar electrification.</p> <p>Marketing for RCS is weak.</p> <p>Coordination between BPC and Local Authorities is not so well established.</p>

## **Appendix 15 Dissemination Project**

## **Appendix 15 Dissemination Project**

### **15.1 Objectives of PV Dissemination Project**

The objectives of PV Dissemination Project are to validate Master Plan for PV Rural Electrification and PV rural electrification business plan that exemplifies Master Plan. Simulation operation is to be performed in the selected three villages and the results obtained from monitoring are to be reflected on finalization of the Master Plan. Thus it is expected that the Master Plan will be effective and valid. Refer to Appendix Figure 15.1-1.



**Appendix Figure 15.1-1 Main Objectives of PV Dissemination Projects**

## **15.2 Selection Criteria for Candidate Villages and the Results**

### **15.2.1 Selection Criteria**

1) Willingness of participation

The village has relatively many households and public facilities which show the willingness of participation in the Dissemination Project from the results of field survey.

2) Ability to pay

The village has relatively many households and public facilities which can bear the fee for service of electricity from the results of field survey (results of field survey for willingness and ability of pay for PV systems).

3) Sustainable structure within the village

The Implementation Body for revenue collection and maintenance structure to sustain the Dissemination Project could be relatively effectively formed using existing organizations and human resources within the village.

4) Accessibility

From the point of view of logistics in case the replacement of key equipment or supply of spare parts occur for the installed PV system and monitoring actual condition of the Dissemination Project, accessibility to the village will be taken into account for the selection.

5) Distance from existing grid electricity supply point

Distance from the existing grid will be one of the key parameter to assess the future possibility of grid connection for the said villages.

### **15.2.2 Evaluation and Recommendation**

Based on the above criteria, following 7 evaluation items are chosen and ranking are made in 10 villages.

Evaluation Item A: Willingness of households to participate (in percentage)

Evaluation Item B: Willingness of households to participate (in number)

- Evaluation Item C: Ability of households to pay (in percentage)  
 Evaluation Item D: Ability of households to pay (in number)  
 Evaluation Item E: Sustainable structure within the village  
 Evaluation Item F: Accessibility (Distance from Gaborone)  
 Evaluation Item G: Distance from existing grid electricity supply point

**Appendix Table 15.2-1 Evaluation and Recommendation**

Evaluation Item  Best Village Ranking	A	B	C	D	E	F	G
	Willingness of participation in Verification project		Willingness to pay		Sustainability	Accessibility (Distance from Gaborone)	Distance from existing Grid (km)
	in %	in number of HHs	in %	in number of HHs			
Top	Oliphant	Kudum.	Dutlwe	Kudum.	No significant difference was found at this stage	Oliphant (132km)	Paraka (80km)
2	Kudum.	Makala.	Oliphant	Dutlwe		Dutlwe (192km)	Khawa (80km)
3	Motlha.	Motlha.	Kudum.	Makala.		Lorol. (197km)	Oliphant (70km)
4	Dutlwe	Dutlwe	Gojwane	Gojwane		Kudum. (200km)	Lorol. (60km)
5	Lorol.	Gojwane	Lorol.	Motlha.		Gojwane (359km)	Motlha. (60km)
6	Paraka.	Paraka	Motlha	Lorol.		Motlha. (572km)	Kudum. (50km)
7	Makala.	Lorol.	Makala.	Paraka		Khawa (740km)	Dutlwe (40km)
8	Gojwane	Oliphant	Paraka	Oliphant		Makala. (843km)	Makala. (40km)
9	Khawa	Kule	Khaw	Kule		Kule (904km)	Kule (20km)
10	Kule	Khawa	Kule	Khawa		Paraka (1100km)	Gojwane (15km)

The following table shows the overall score points with below scoring conditions

<u>Best Village</u>	<u>Point</u>	<u>Best Village</u>	<u>Point</u>
1st	10	6th	10
2nd	9	7th	4
3rd	8	8th	3
4th	7	9th	2
5th	6	10th	1

**Appendix Table 15.2-2 Evaluation and Recommendation (Score Point)**

Village Name	Evaluation Item							Total Score	Ranking
	A	B	C	D	E	F	G		
Dutlwe	7	7	10	9		9	4	46	<b>2</b>
Gojwane	3	6	7	7		6	1	30	<b>7</b>
Kudumatse	9	10	8	10		9	5	51	<b>Top</b>
Khawa	2	1	2	1		4	10	20	<b>9</b>
Kule	1	2	1	2		2	2	10	<b>10</b>
Lorolwana	6	4	6	5		9	7	37	<b>5</b>
Makalamabedi	4	9	4	8		3	4	32	<b>6</b>
Motlhabaneng	8	8	5	6		5	7	39	<b>4</b>
Parakarungu	5	5	3	4		1	10	28	<b>8</b>
Oliphant's Drift	10	3	9	3		10	8	43	<b>3</b>

According to the above overall evaluation table, the highest scored 5 villages are Kudumatse, Dutlwe, Oliphant's Drift, Motlhabaneng, Lorolwana.

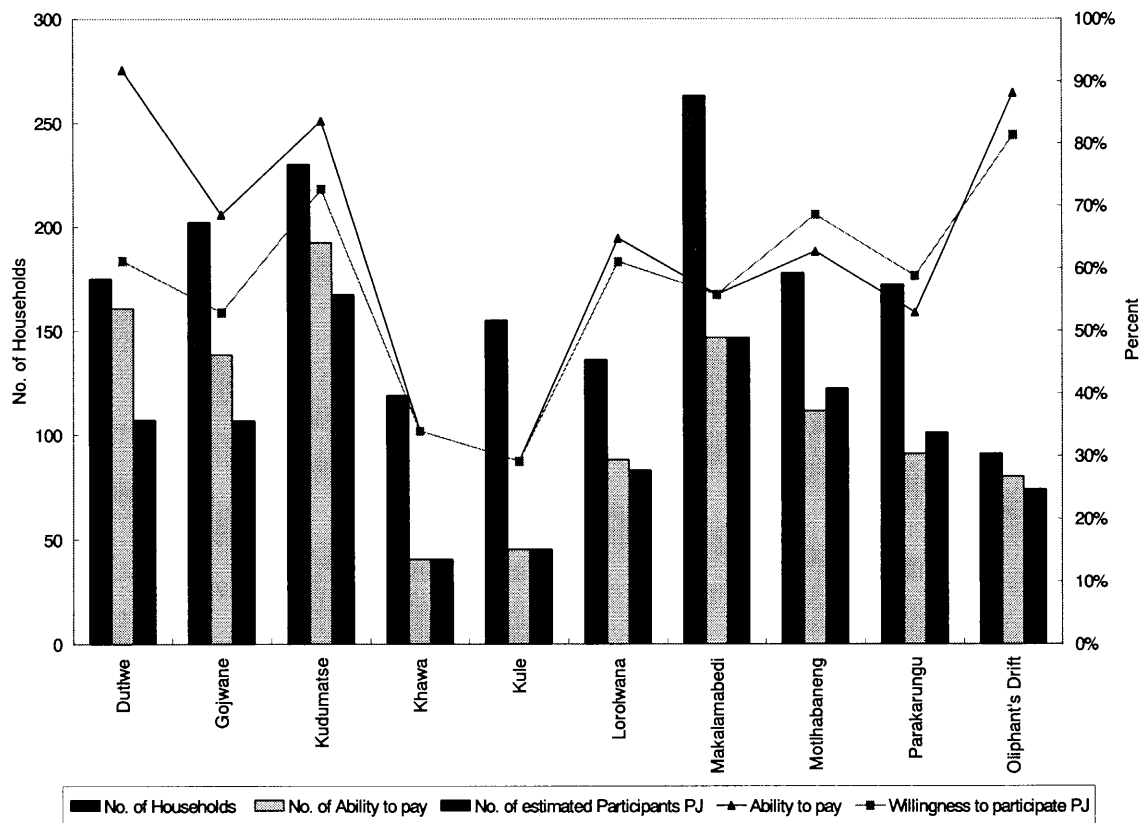
To assess actual willingness and ability to pay for the PV system, it is preferable that various income levels of villages, i.e., relatively richer village, poorer village and medium positioned village will be selected in this Dissemination Project.

Appendix Figure 15.2-2 shows the income distribution curves for 10 villages, which are developed from the cash income survey data for the villagers in socio-economic survey. Based on these curves, Kudumatse (the 1st rank) and Dutlwe (the 2nd rank) are categorized in medium positioned village and Oliphant's Drift (the 3rd rank) and Motlhabaneng (the 4th rank) richer villages are categorized in richer villages and Lorolwana (the 5th rank) is categorized in poorer village.

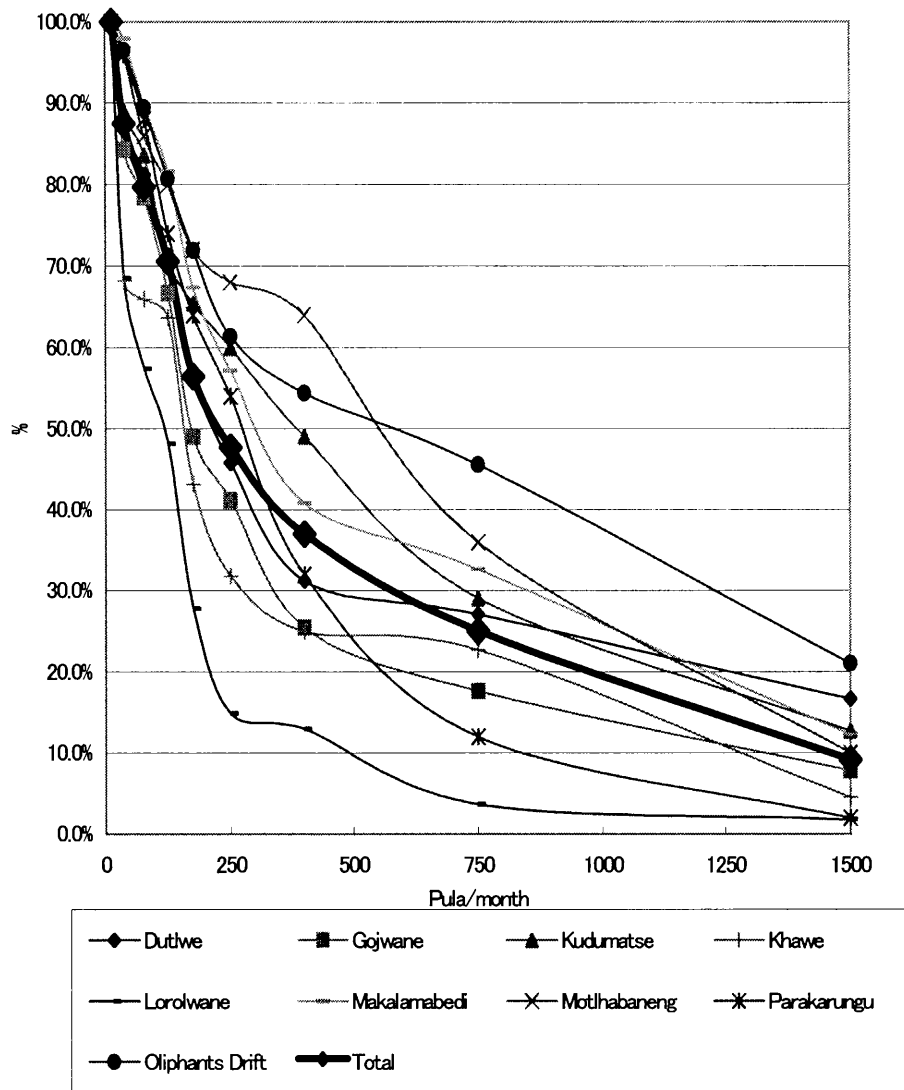


Therefore Kudumatse (the 1st rank) was selected as a medium positioned village and Lorolwana was selected as a poorer village. Motlhabaneng was selected as a richer village, because it was located relatively remote area rather than Oliphant's Drift, even though Motlhabaneng was ranked behind Oliphant's Drift.

It is informed unofficially that Dutlwe and Oliphant's Drift are the candidate villages that will be grid connected in the next grid electrification plan, which is also taken into account for the selection of 3 villages.



**Appendix Figure 15.2-1 No. of Households/Ability to Pay/Participation for Verification Project**



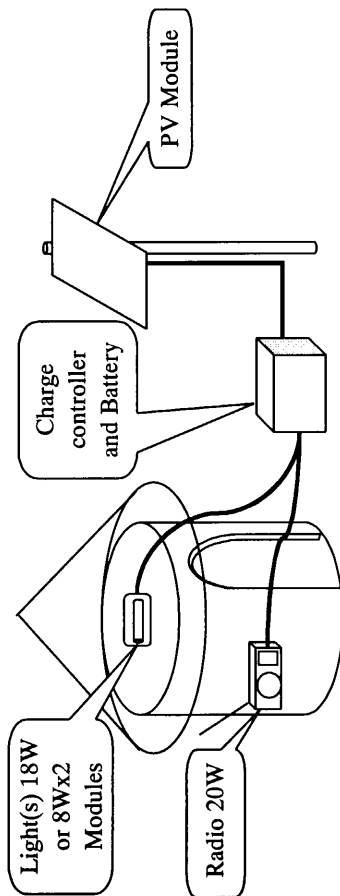
**Appendix Figure 15.2-2 Income Distribution in 10 Villages**

### 15.3 PV Applications and System Specifications

System configuration and specifications and tender documents for the Dissemination Project are referred to Appendix Figure 15.3-1~4 and Attachment Document 15.3-1.

**P. V.(Photovoltaic) System Design**

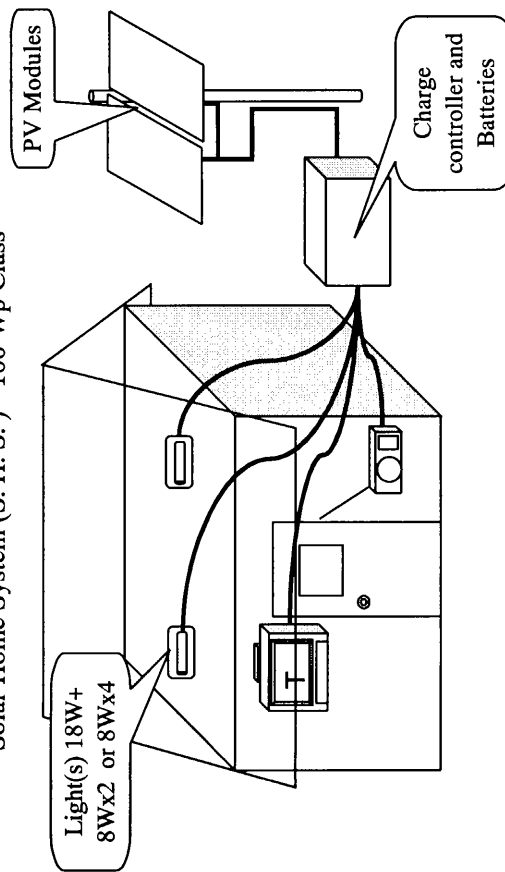
**Solar Home System (S. H. S.) - 50 Wp Class**



**System Specification**

No.	Solar Home System (S. H. S.) - 50 Wp Class	Stand Alone Type
1	System Type:	DC 12V
2	Input Voltage:	DC 12V
3	Power Output:	50Wp (or 55Wp)
4	PV Module:	120Ah
5	Battery Capacity:	Protect overcharging and dis-overcharging battery
6	Control Function:	
<b>Load(s) availability</b>		
1	Irradiant:	4 kWh/sq. m
2	Light(s):	18Wx1 or 8Wx2
3	Radio (DC) or TV(DC):	20Wx1
4	Power Consumption:	18Wx1 + 20W = 38W or 8Wx2 + 20W =36W
5	Available Time;	3 hours per day

**Solar Home System (S. H. S.) - 100 Wp Class**

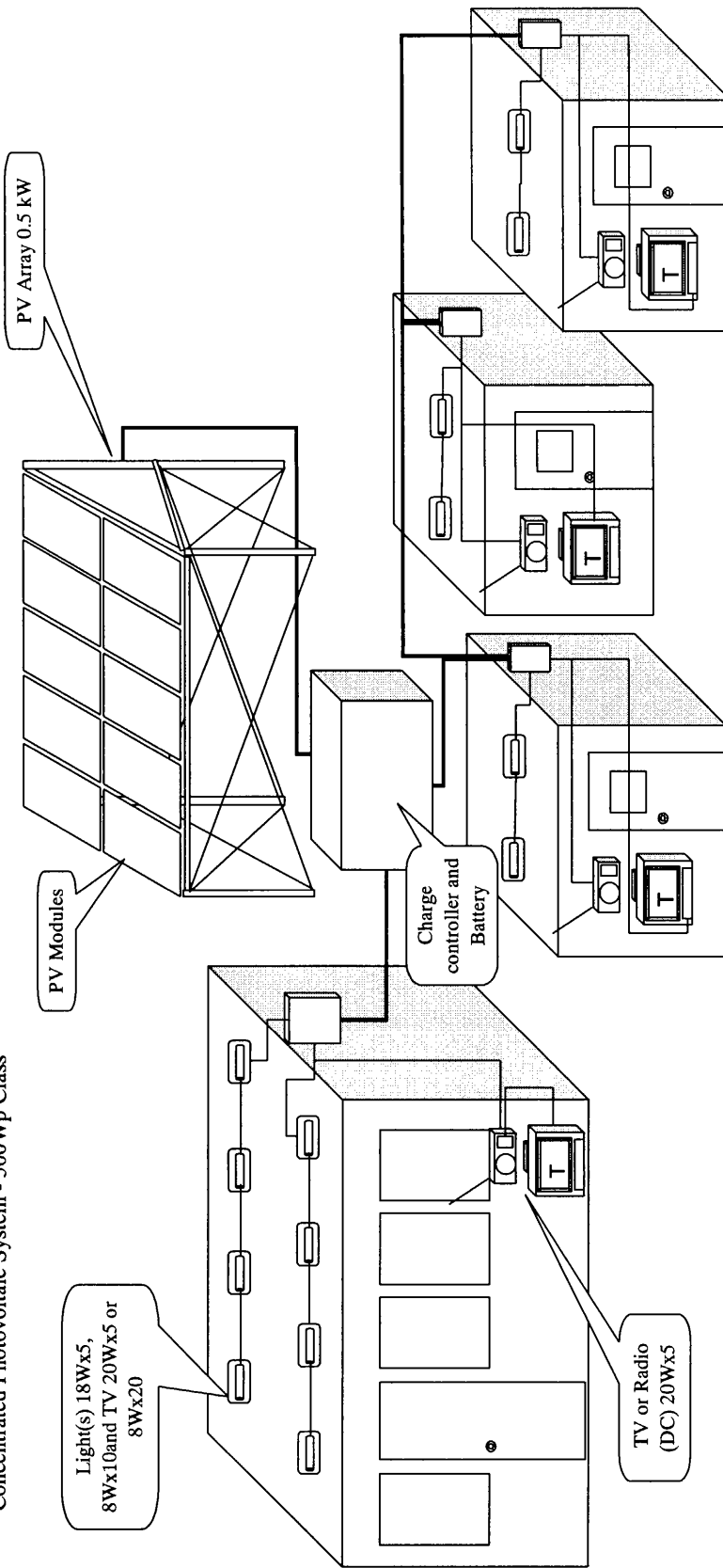


**System Specification**

No.	Solar Home System (S. H. S.) - 100 Wp Class	Stand Alone Type
1	System Type:	DC 12V
2	Input Voltage:	DC 12V
3	Power Output:	50Wpx2=100Wp (or 110Wp)
4	PV Modules:	120Ah x2=240Ah
5	Batteries Capacity:	Protect overcharging and dis-overcharging battery
6	Control Function:	
<b>Load(s) availability</b>		
1	Irradiant:	4 kWh/sq. m
2	Light(s):	18Wx1 and 8Wx2 or 8Wx4
3	Radio (DC) or TV(DC):	20Wx1
4	Power Consumption;	18Wx1+ 8Wx2+20W =54W
5	Available Time;	4 hours per day

**Appendix Figure 15.3-1**

**P.V.(Photovoltaic) System Design**  
**Concentrated Photovoltaic System - 500Wp Class**



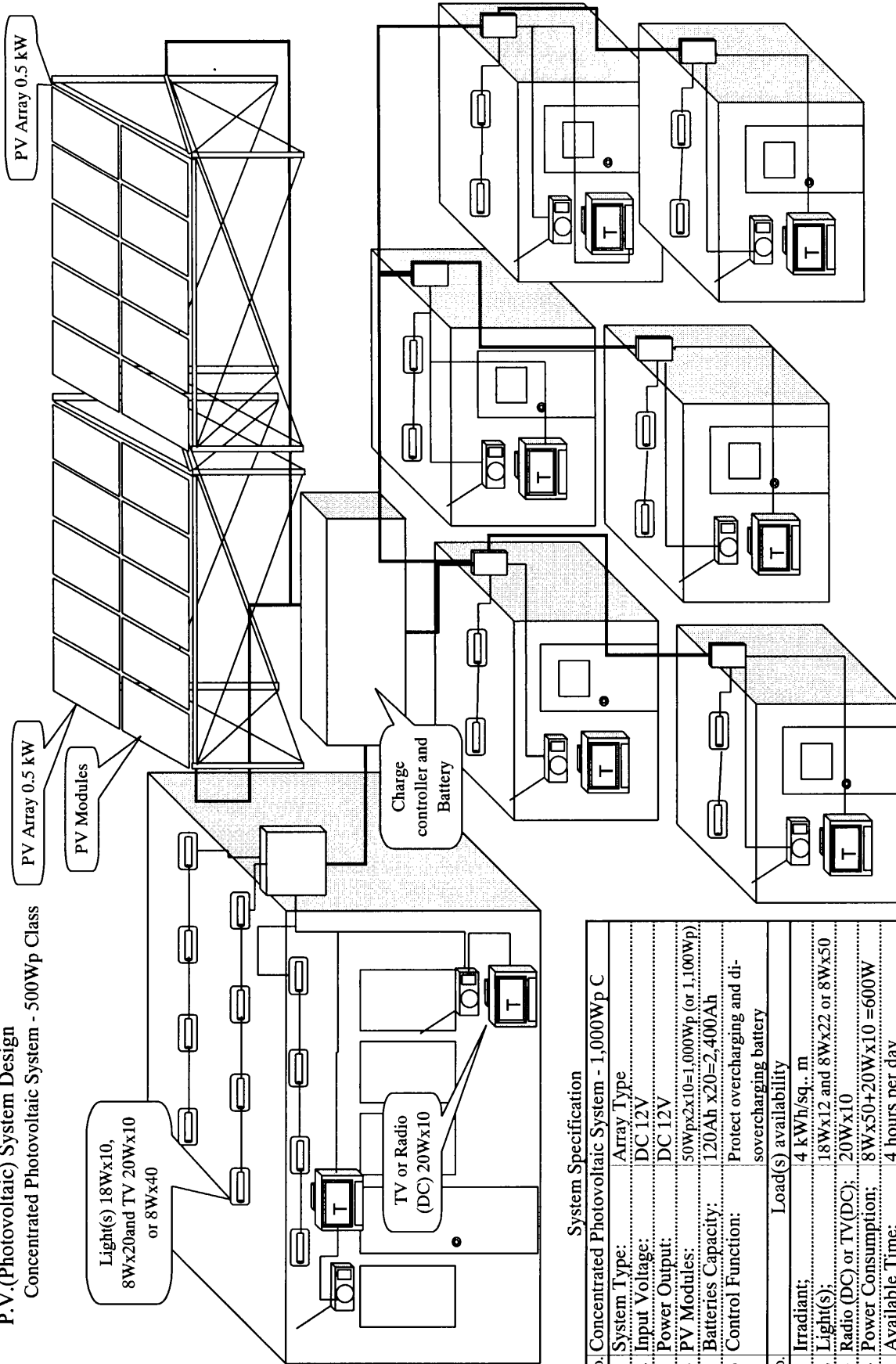
**System Specification**

No.	Concentrated Photovoltaic System - 500Wp Class
1	System Type: Array Type
2	Input Voltage: DC 12V
3	Power Output: DC 12V
4	PV Modules: 50Wpx10=500Wp (or 550Wp)
5	Batteries Capacity: 120Ah x10=1,200Ah
6	Control Function: Protect overcharging and disovercharging battery

No.	Load(s) availability
1	Irradiant: 4 kWh/sq. m
2	Light(s): 18Wx5 and 8Wx10 or 8Wx20
3	Radio (DC) or TV(DC): 20Wx5
4	Power Consumption: 18Wx5+ 8Wx10+20Wx5 =270W
5	Available Time: 4 hours per day

**Appendix Figure 15.3-2**

**P.V.(Photovoltaic) System Design**  
**Concentrated Photovoltaic System - 500Wp Class**



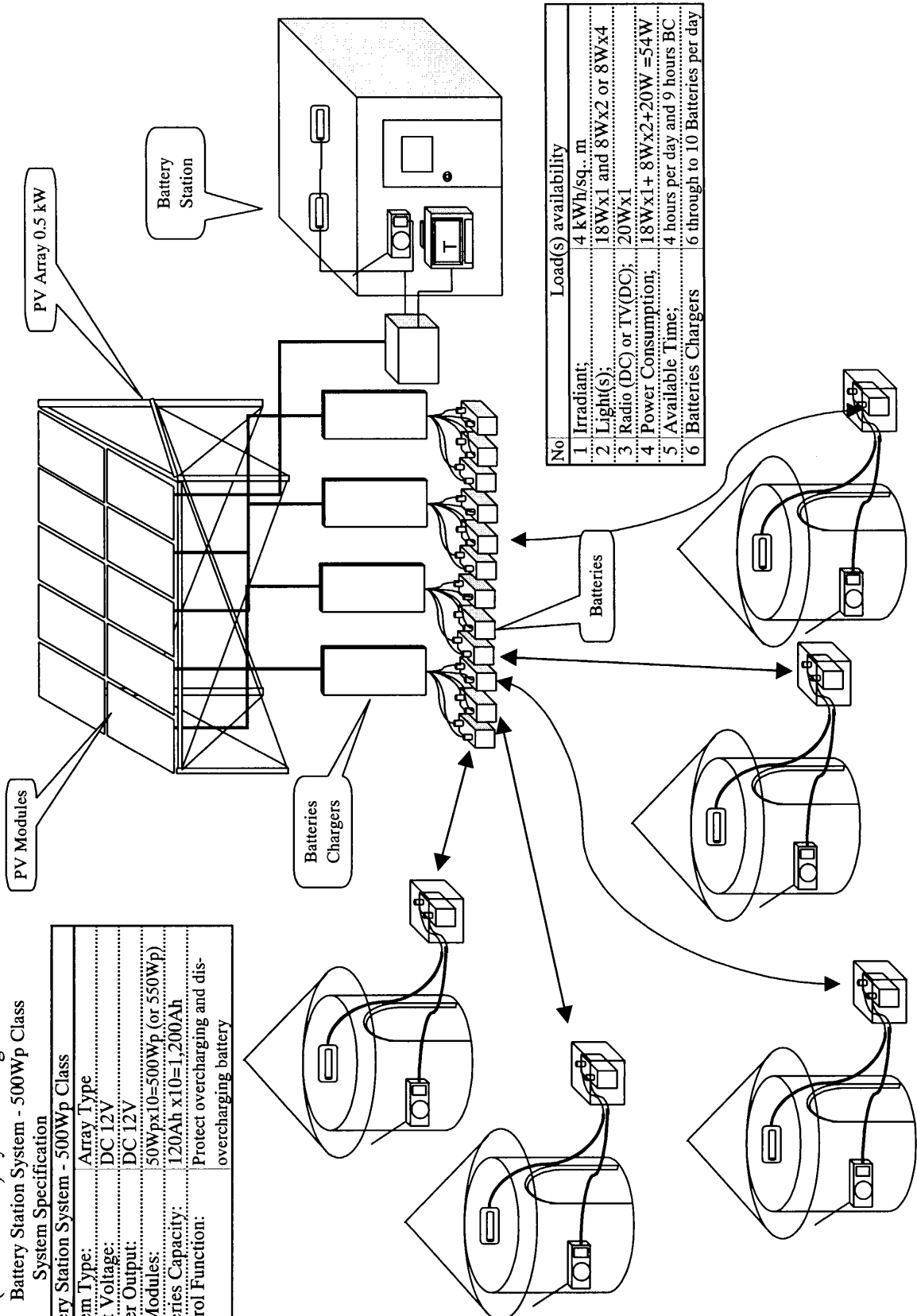
**System Specification**

No.	1	System Type:	Array Type
			DC 12V
	2	Input Voltage:	DC 12V
	3	Power Output:	50Wp x 2 x 10 = 1,000Wp (or 1,100Wp)
	4	PV Modules:	120Ah x 20 = 2,400Ah
	5	Batteries Capacity:	Protect overcharging and disovercharging battery
	6	Control Function:	Load(s) availability
No.	1	Irradiant:	4 kWh/sq. m
	2	Light(s):	18W x 12 and 8W x 22 or 8W x 50
	3	Radio (DC) or TV (DC):	20W x 10
	4	Power Consumption:	8W x 50 + 20W x 10 = 600W
	5	Available Time:	4 hours per day

**Appendix Figure 15.3-3**

**PV(Photovoltaic) System Design**  
**Battery Station System - 500Wp Class**  
**System Specification**

No.	Battery Station System - 500Wp Class
1	System Type: Array Type
2	Input Voltage: DC 12V
3	Power Output: DC 12V
4	PV Modules: 50Wpx10=500Wp (or 550Wp)
5	Batteries Capacity: 120Ah x10=1,200Ah
6	Control Function: Protect overcharging and dis-overcharging battery



No	Load(s) availability
1	Irradiant; 4 kWh/sq. m
2	Light(s); 18Wx1 and 8Wx2 or 8Wx4
3	Radio (DC) or TV(DC); 20Wx1
4	Power Consumption; 18Wx1+ 8Wx2+20W =54W
5	Available Time; 4 hours per day and 9 hours BC
6	Batteries Chargers; 6 through to 10 Batteries per day

**Appendix Figure 15.3-4**

## **15.4 Project Basis**

The scheme of the PV rural electrification business plan studied in Chapter 7 is to be applied for the PV Dissemination Project.

### **(1) Electrification Approach and Implementation Body**

ESCO approach studied in Chapter 5 is to be applied. BPC is the Implementation Body.

### **(2) Tariff System**

The payment conditions were as shown in Chapter 7, Section 7.5.3.

### **(3) Operation**

Project management concept described in Chapter 7, Section 7.5.6 was applied.

## **15.5 Contractor Selection and System Installation**

### **15.5.1 Tender Procedure**

#### **(1) Outline of the Tender**

##### **1) Bill of Quantity in the Tender**

The Study team has proceeded, together with BPC, accepting applicants and signing contract for the Dissemination Project for both villagers and public facilities located in the villages through the 2nd Site survey and 3rd Survey period. The signer of the contract was BPC as the Implementation Body. Unfortunately, no public facility participates such as an Elementary School, a Health Post and Kgotla in the Dissemination Project due to a lack of budgeting by the Local Government. On the other hand, 33 villagers in Motlhabaneng, 49 villagers in Kudukmatse and 44 villagers in Lorolwana wished to participate in the Dissemination Project and signed the contract, which was corresponding to 169 sets of 50Wp PV system. In addition to this, 26 sets of 50Wp PV system, which were about 15% of the above, were prepared as spares for the case of new applicants brought by the completion of installation work, the theft and the damage.

Battery Charging Station (BCS) having a capacity of 1000Wp was installed in Lorolwana only. There were 37 villagers who wished to use BCS. 47 batteries were prepared for spares taking it into account that a few new applicants were expected and that 2 days of charging time for a battery is planned using BCS.

**Appendix Table 15.5-1 Bill of Quantity in the Tender**

Village Name DistrictName Sub-DistrictName	Motlhabaneng Central Bobonong	Kudumatse Central Mahalapye	Lorolwana Southern Ngwaketse	Total
SHS				
50Wp	23	39	39	101
100Wp	6	7	3	16
150Wp	1	1	2	4
200Wp		1		1
250Wp	3	1		4
Total (No. of Users)	33	49	44	126
Q' ty Corresponding to 50Wp	53	65	51	169
Public Facility 500WpCentral	0	0	0	0
Battery Charger Station (1000Wp)			1	1
Battery User			37	37
Battery for Battery C. Room			3	3
Spare Battery			47	47
Q' ty Corresponding to 50Wp	53	65	71	189
Spare complete sets of 50wp-unit	8	10	8	26
Total Qty. inc. Spare sets	61	75	79	215

Prepaid card system was adopted as a method of collection of monthly fee in response to BPC's strong request.

PV system components and Bill of quantities are to be referred to Appendix Table 15.5-2.



**Appendix Table 15.5-2 System Components and Bill of Quantities for the Dissemination Project**

Items	unit	Solar Home System					Battery Charging Station			Q'ty	
		50Wp User	100Wp User	150Wp User	200Wp User	250Wp User	Battery Charging House	Battery Charging System	BCS User		
PV Module(50Wp)	(pce)	1	2	3	4	5	20			215	
Contoller											
for 6A	(pce)	1							1	204	
for 10A	(pce)		1							18	
for 20A	(pce)			1	1	1	1			11	
Battery											
for 102Ah	(pce)	1	2	3	4	5	3			190	
for 45Ah	(pce)								1	93	
Battery Box	(pce)	1	2	3	4	5	3		1	283	
Fuse and Breaker for Battery	(pce)	1	2	3	4	5	1			283	
Inverter (DC→AC 250VA)											
for 150VA	(pce)			1			1			6	
for 250VA	(pce)				1	1				6	
DC Lighting apparatus											
Light	(pce)	2	4						1	339	
Switch	(pce)	2	4							293	
Socket /Plug	(pce)	1	2						2	332	
Plug	(pce)						20		1		
AC Lighting Apparatus											
Light	(pce)			6	6	6	4			64	
Switch	(pce)			6	6	6	4			64	
Socket /Plug	(pce)			2	3	3	2			28	
Distribution Board	(pce)			1	1	1	1	1		13	
Prepaid Card System	(lot)	1	1	1	1	1				152	
Pole and supporting structure for PV Module	(lot)	1	1	1	1	1				152	
Lightning Rod and Building work	(lot)						1			1	
Cable										8500m	
PV Module→Controller											
Size	(mm <sup>2</sup> )	4	6	10	10	10	25				
Length	(m)	10	10	10	10	10	10				
Controller→Battery											
Size	(mm <sup>2</sup> )	2.5	4	6	6	6	25	2.5	2.5		
Length	(m)	0.5	0.5	0.5	0.5	0.5	5	80	0.5		
Controller→Light											
Size	(mm <sup>2</sup> )	2.5	2.5	2.5	2.5	2.5	2.5		2.5		
Length	(m)	Depending on a style of dwell (20~40m)					16			10	
Controller→Socket											
Size	(mm <sup>2</sup> )	2.5	2.5	2.5	2.5	2.5	2.5				
Length	(m)	Depending on a style of dwell (5~35m)					6				

PV system of 50Wp, 100Wp: DC is applied  
 PV system over 100Wp: AC is applied(Inverter is installed)

Bill of quantities;  
 15% complete spare sets is included for PV modules.  
 10% spare is bincluded in the other compoents.

## 2) Tender Scheme

The procurement of PV systems and the installation work for whole scope were packed in one Tender.

## 3) Qualification of Bidders

Bidders should be the PV company (companies) registered in Botswana, having sufficient experience in the past 5 years in designing, installation work of at least 50 sets of PV systems with larger size than 50Wp. Consortium formation was allowed by up to 3 PV companies.

This tender was announced in the major news paper in Botswana according to Tender announcing procedure of Botswana Government and BPC, presenting clearly the qualification of bidders.

Tender Document fee was free for the companies who came to collect the document to invite companies interested as many as possible to the tender while it was common case in Botswana to charge the Tender Document fee to the bidders.

## (2) Tender Schedule

Announcement (on Newspaper ) Tender Call	7 September, 2001 (Fri)
Closing date of Tender	28 September, 2001 (Fri)
	Actually, 3 October, 2001 (Wed)
Evaluation of Bidders' documents, Award, and Signing of Contract	5 October, 2001 (Fri)
	Actually 23 October, 2001 (Tue)
Completion, Taking-Over	31 January, 2002
	Actually 6 February, 2002 (Wed)

## (3) Condition of Taking-Over

Quantities/Quality of PV systems are to conform with specifications.

PV systems are to be installed in the proper places and proper installation method in conformity with specifications.

The function of PV systems is to be well inspected in accordance with specified testing procedure.

(4) Warranty and Guaranty

1) Warranty and Guaranty Security

Warranty and Guaranty period was to be 14 months after Taking-Over Date (the date when all properties are transferred to JICA from the Contractor). 10% of Contract price was to be secured in a reputable Botswana bank for said period by the Contractor.

2) Advanced Payment Security

Advanced payment (40% of Contract price) was to be secured by a bond issued by a reputable Botswana bank for the case of a breach of Contract.

3) Performance Security

Performance security was to be deposited in amount of 5% of Contract price in a reputable Botswana bank until Taking-Over in order to secure the performance of PV system.

4) Completion guaranty

The Contractor should pay the JICA 0.25% of Contract price for each day of delay of the completion of the works. Total aggregate amount was to be maximum 20% of Contract price. 8 days of grace period of payment is given to the Contractor due to the delay of issuing date of Letter of Award.

(5) Validity of Tender

60 days

(6) Documents to be submitted

Company brochure and reports on the financial status in the past 2 years

Envelop A (Power of Attorney, Consortium Agreement, Past experience on PV systems)

Envelop B (Tender Letter, Tender price schedule)

Envelop C (Equipment and facility specification, Work schedule plan)

(7) Opening and evaluation of Tenders

Following procedure was taken.

Documents submitted by bidders were opened by JICA and the Study Team at the presence of EAD, BPC and the representative of bidders.

The bidder who does not submit the documents required by the tender closing date is to be disqualified.

Firstly Envelope A will be opened. In case the documents are incomplete or inappropriate, the bidder will be disqualified and other envelopes will be returned unopened.

Next, Envelope C will be opened. The documents will be evaluated by the Evaluator according to Technical Evaluation Criteria. In case the documents are incomplete or inappropriate or unsatisfactory to Technical evaluation criteria, the bidder will be disqualified and Envelop B will be returned unopened.

All bidders who pass the above will be invited to participate in Tender opening (Envelope B) on the date, time and place designated by the Study Team.

The Study Team will invite only the successful bidder whose Envelope B shows the lowest price for further confirmation and negotiation. If the negotiations with the lowest bidder fail for any reason, the bidder with the second lowest price will be invited for negotiations.

(8) Payment terms

Advanced payment: 40% upon signing the Contract

Final payment: 60% upon the completion of the works

(9) Tax exemption

Import duty imposed on the imported goods for the Project will be exempted in accordance with SW.

However, the sales tax (10%) will be imposed on goods procured domestically and on construction expenditure in Botswana, which will not be exempted in the Project. Therefore, this is clearly described in the Tender documents.

## 15.5.2 Tender Progress

Tender was carried out in accordance with Tender procedure. Actual Tender progress is described as follows.

### (1) Announcement of Tender

Tender was announced in one of the major newspaper on 7 September 2001 in conformity with Tender procedure in Botswana. Ten Botswana companies came to collect the Tender documents to JICA/JOCV office in Botswana. Tender announcement is referred in Appendix Document Table 15.5-1.

### (2) Bidders

3 PV companies (Company A, B, C) among 10 companies only submitted their documents to the JICA by 3 October 2001 which was the closing date of Tender.

### (3) Forms of submitted documents and Technical evaluation

Envelope A and Envelope C of the bidder's documents were opened according to the Evaluation procedure at the presence of JICA/JOCV, EAD, BPC and the Study Team. We confirmed that all Envelope A were satisfactory with our requirement. Then, we evaluated Envelope C and additional technical clarification sheet requested to the bidders afterwards. As a result, the Company B was only qualified. The Company A and C were disqualified for the below reasons. This evaluation results was informed to the bidders on 12 October.

- \* It was found that the Prepaid system originally proposed by the Company A was still under development and would not exist when the installation work would be done. Since the Prepaid system is one of key items for the technical evaluation, the Company A was disqualified.
- \* Since a technical evaluation score of the Company C was less than 70 points, which was a passing mark, due to unclearness of the Technical proposal, the Company C was disqualified.

(4) Opening of Envelope B (Price schedule)

Opening of Envelope B was done on 12 October for the qualified bidder.

(5) Price negotiation

A further technical clarification and a price negotiation had been done since opening date of Envelope B. Both parties finally reached an agreement on the pricing on 17 October as follows:

P1,569,425

(6) Letter of Award

Letter of Award was issued on 18 October and the Contractor's duty on the delivery time was counted from this date.

(7) Signing the Contract

The Contract was signed by the Representative of JICA/JOCV office and the Representative of the Company with the witness signature by BPC on 23 October.

### **15.5.3 Installation Works**

(1) Installation work schedule

The Contractor submitted the work procedure to the Study Team after signing the Contract. Upon the approval by JICA, the Contractor placed an order for all materials and equipment at the beginning of November 2001. All materials and equipment were delivered to the Contractor in Gaborone except some which required long delivery time. Immediately the necessary materials and equipment were transported to the sites. It is a custom practice that construction companies in Botswana take long holidays from 20 December to 10 January. This is because construction labors of Botswana go back to their home town to stay with their family during Christmas and New Year time. Construction companies usually maintain construction machinery and equipment in this period because of a difficulty of performing of a construction business. There was no exception in this project as well. The actual proceeding had been suspended during the period.

Since we firstly instructed the Contractor to install PV systems to villagers who paid full amount of deposit money, definite bill of quantities of PV systems were fluctuated upon the actual progress of collection of deposit money. At end of December 2001, the number of PV systems (equivalent size of 50Wp) of full payers reached 109 sets, which was only about 65% of that in the Tender stage (total number was 185 sets except of Battery Charging Station). That of partial payers and non payers reached about 10% and 25% respectively. Installation works were in progress for 53 villagers (82 sets equivalent size of 50Wp) at end of December.

**Appendix Table 15.5-3 Status of Deposit Collection**

	Quantity in Tender	End of December, 2001	Status of Deposit collection		
			Full payer	Partial payer	Non payer
50Wp User Contract	101	88	47	12	29
100Wp User Contract	16	21	14	2	5
150Wp User Contract	4	3	2		1
200Wp User Contract	1	2	2		
250Wp User Contract	4	4	4		
50Wp Spare installation	16	0			
Total No. of installation	142	118	69	14	35
Equivalent to 50 Wp	185	167	109	16	42
50WpSpare set	10	28			
Total (Equivalent to 50Wp)	195	195			
Deposit Collection ratio to 185 set of 50Wp			65%	10%	25%

The Study Team proposed and reached an agreement on the following measures to break this situation to EAD and BPC.

- ① Deadline date of fixation of PV size and quantity installed in 3 villages  
As the obligation of the Owner, the Owner will fix the size and quantity of PV installation to the Contractor by 18 January 2002. The Contractor will complete installation works by the due date.
- ② No. of installation of PV system equal to 100wp or more:  
Because additional procurement for the PV system equal to 100Wp or more is difficult to keep the delivery date, any increase for these sizes will not be allowed as a rule.

- ③ Applicants who paid a partial deposit money  
Installation of PV system will be carried out even for the applicants who paid partial portion of deposit money. However, we will not make them use the PV system until the applicant pay full amount of deposit money.
- ④ Applicants who have not paid any amount of deposit money  
If he does not pay any money by Jan. 18, 2002, he will forfeit a right to participate in the Dissemination Project.  
If he pays a partial portion of deposit money, aforementioned process (above paragraph 3) will be applied.  
In order to promote the collection of deposit money, we will visit applicant's houses one by one.
- ⑤ Promotion of participants using 50wp PV system  
About 20 sets of PV system of 50Wp are still in stock. We will ask the chief to have a kgotla meeting to promote participation in the Dissemination Project (but only for 50Wp users)  
Closing date new applications from villagers: January 18, 2002 (Friday)

The Study Team, BPC and EAD visited 3 villages in according to the above directions and took necessary actions. Consequently, we got a remarkable progress on collecting deposit moneys from non payers and partial payers as well as some new applicants. However, it happened in Kudumatse that two applicants who were the shop owners and paid full amount of deposit money for 250Wp system and 200Wp system, wished to cancel the participation in the Dissemination Project because they had recognized the functional limitation of PV system that it was not suitable for large size of refrigerators. They were using "Gas-Refrigerator" in their shops. We explained that if an electric refrigerator was driven by PV systems, a capacity more than 2 or 3 times of rated power of refrigerator would be required for the PV system.

Appendix Table 15.5-4 shows a final list of participants of the Dissemination Project. (The detail to be referred in Appendix Table 15.5-5.)



**Appendix Table 15.5-4 Final List of Participants of the  
Dissemination Project**

	Tender stage	Motlhabaneng	Kudumatse	Lorolwana	Final results
50Wp SHS	101	22	30	35	87
100Wp SHS	16	8	8	4	20
150Wp SHS	4	1	2	1	4
200Wp SHS	1	0	1	0	1
250Wp SHS	4	3	0	0	3
Spare User(50Wp)	16	0	0	0	0
Equivalent to 50Wp	185	56	56	46	158 (85%)

The Contractor installed PV systems based on the above list in 3 villages. The Study Team and BPC's Technicians carried out witness inspections from the end of January to the beginning of February 2002 and confirmed that all PV systems were well functioned. JICA issued the Taking-Over Certificate on 6 February 2002. The as-built drawing and the operation manual were handed over to the Study Team on 5 March 2002.

**Appendix Table 15.5-5 Summary of BQ List and No. of Applicants**

Village Name DistrictName Sub-DistrictName	Mothabaneng Central Bobonong							Jan 30, 2002	
	Feb,2001	Jul 26, 2001	Aug 23, 2001	Tender	Sep 9, 2001	18-Jan-02	Distribution		
							No.	Distribution	
SHS 50Wp	20	23	23	23	25	23	22	(64.7%)	
100Wp	5	6	4	6	4	7	8	(23.5%)	
150Wp	2	2	1	1	1	1	1	(2.9%)	
200Wp					0	0	0	(0.0%)	
250Wp	2	2	3	3	3	3	3	(8.8%)	
spare user(50wp)				2	0	0	0	(0.0%)	
Total(No. of Users)	29	33	31	35	33	34	34	(100.0%)	
Q'ty Corresponding to 50Wp	46	51	49	55	51	55	56		
Public Facility 500WpCentral	1	0	0	0	0	0	0		
Battery Charger Station(1000Wp) Battery User Spare battery(inc BCS room)									
Q'ty Corresponding to 50Wp	56	51	49	55	51	55	56		
Spare complete sets of 50wp-unit	3	3	3	6	10	6	5		
Total Qty. inc. Spare sets	59	54	52	61	61	61	61		

Deposit Money			
Full Paid	Partly paid	Non Paid	Total
19	3	4	26
8			8
1			1
			0
3			3
31	3	4	38
53	3	4	60

①No. of HHs of the Village	178
②No. of SHS Participants	34
③Percent (②/①)	19%
④Est. Electrification Rate	60%
⑤Est. No. of Electrified HHs	107
⑥Percent (②/⑤)	32%

Village Name DistrictName Sub-DistrictName	Kudumatse Central Mahalapye							Jan 30, 2002	
	Feb,2001	Jul 26, 2001	Aug 23, 2001	Tender	Sep 9, 2001	18-Jan-02	Distribution		
							No.	Distribution	
SHS 50Wp	30	39	36	39	35	27	30	(73.2%)	
100Wp	14	10	5	7	5	9	8	(19.5%)	
150Wp	2	2	1	1	1	2	2	(4.9%)	
200Wp	2	1	1	1	1	2	1	(2.4%)	
250Wp	1	0	1	1	1	1	0	(0.0%)	
spare user(50wp)				8	0	0	0	(0.0%)	
Total(No. of Users)	49	52	44	57	43	41	41	(100.0%)	
Q'ty Corresponding to 50Wp	77	69	58	73	57	64	56		
Public Facility 500WpCentral	1	0	0	0	0	0	0		
Battery Charger Station(1000Wp) Battery User Spare battery(inc BCS room)									
Q'ty Corresponding to 50Wp	87	69	58	73	57		56		
Spare complete sets of 50wp-unit	4	4	4	2	18		19		
Total Qty. inc. Spare sets	91	73	62	75	75		75		

Deposit Money			
Full Paid	Partly paid	Non Paid	Total
30		4	34
8		1	9
2			2
1			1
			0
41	0	5	46
56	0	6	62

①No. of HHs of the Village	230
②No. of SHS Participants	41
③Percent (②/①)	18%
④Est. Electrification Rate	60%
⑤Est. No. of Electrified HHs	138
⑥Percent (②/⑤)	30%

Village Name DistrictName Sub-DistrictName	Lorolwana Southern Ngwaketse							Jan 30, 2002	
	Feb,2001	Jul 26, 2001	Aug 23, 2001	Tender	Sep 9, 2001	18-Jan-02	Distribution		
							No.	Distribution	
SHS 50Wp	42	47	36	39	44	36	35	(87.5%)	
100Wp	2	4	3	3	5	3	4	(10.0%)	
150Wp	1	1	2	2	1	1	1	(2.5%)	
200Wp					0	0	0	(0.0%)	
250Wp					0	0	0	(0.0%)	
spare user(50wp)				6				(0.0%)	
Total(No. of Users)	45	52	41	50	50	40	40	(100.0%)	
Q'ty Corresponding to 50Wp	49	58	48	57	57	45	46		
Public Facility 500WpCentral	0	0	0	0	0	0	0		
Battery Charger Station(1000Wp) Battery User Spare battery(inc BCS room)	1	1	1	1	1	1	1		
Q'ty Corresponding to 50Wp	41	42	35	37	30	29	29		
Spare battery(inc BCS room)	9	45	42	50	57	58	58		
Q'ty Corresponding to 50Wp	69	78	68	77	77	65	66		
Spare complete sets of 50wp-unit	3	3	3	2	2	14	13		
Total Qty. inc. Spare sets	72	81	71	79	79	79	79		

Deposit Money			
Full Paid	Partly paid	Non Paid	Total
24	11	10	45
4			4
1		1	2
			0
			0
29	11	11	51
35	11	13	59

①No. of HHs of the Village	136
②No. of SHS Participants	40
③Percent (②/①)	29%
④Est. Electrification Rate	60%
⑤Est. No. of Electrified HHs	82
⑥Percent (②/⑤)	49%
⑦Percent of BCS Users to ①	21%
⑧Percent of BCS Users to ⑤	36%

Village Name DistrictName Sub-DistrictName	Total							Jan 30, 2002	
	Feb,2001	Jul 26, 2001	Aug 23, 2001	Tender	Sep 9, 2001	18-Jan-02	Distribution		
							No.	Distribution	
SHS 50Wp	92	109	95	101	104	86	87	(75.7%)	
100Wp	21	20	12	16	14	19	20	(17.4%)	
150Wp	5	5	4	4	3	4	4	(3.5%)	
200Wp	2	1	1	1	1	2	1	(0.9%)	
250Wp	3	2	4	4	4	4	3	(2.6%)	
spare user(50wp)	0	0	0	16	0	0	0	(0.0%)	
Total(No. of Users)	123	137	116	142	126	115	115	(100.0%)	
Q'ty Corresponding to 50Wp	172	178	155	185	165	164	158		
Public Facility 500WpCentral	2	0	0	0	0	0	0		
Battery Charger Station(1000Wp) Battery User Spare battery(inc BCS room)	1	1	1	1	1	1	1		
Q'ty Corresponding to 50Wp	41	42	35	37	30	29	29		
Spare battery(inc BCS room)	9	45	42	50	57	58	58		
Q'ty Corresponding to 50Wp	212	198	175	205	185	120	178		
Spare complete sets of 50wp-unit	10	10	10	10	30	20	37		
Total Qty. inc. Spare sets	222	208	185	215	215	140	215		

Deposit Money			
Full Paid	Partly paid	Non Paid	Contract Total
73	14	18	105
20	0	1	21
4	0	1	5
1	0	0	1
3	0	0	3
0	0	0	0
101	14	20	135
144	14	23	181

①No. of HHs of the Village	544
②No. of SHS Participants	115
③Percent (②/①)	21%
④Est. Electrification Rate	60%
⑤Est. No. of Electrified HHs	326
⑥Percent (②/⑤)	35%

(2) PV system

Technical evaluation is referred to Appendix 8 in this report.

1) Cost of PV systems

The Costs of PV systems were evaluated based on the contract price of the Dissemination Project as follows. Regarding to the installation cost, as the Contractor's quoted cost is lump-sum basis for all systems, the installation cost for each system is based on the assumption of the Study Team. This is detailed in Appendix Table 15.5-7.

**Appendix Table 15.5-6 Cost of PV Systems**

Unit: P

	50WpSHS system	100WpSHS system	150WpSHS system	200WpSHS system	250WpSHS system	BCS System	Battery for BCS users
Facility	3,534	6,393	12,247	14,834	17,219	77,713	1,043
Installation	2,400	2,880	7,200	9,600	12,000	154,000	
Total	5,934	9,273	19,447	24,434	29,219	231,713	1,043

Major materials and equipment used in the Project were procured in South Africa. Accordingly, the material and equipment cost had been added not only 10% of import taxes but also the transportation cost from South Africa to Botswana.

**Appendix Table 15.5-7 PV Rural Electrification Program in Botswana/  
Purchase Order Price for Each PV System**

Items	Unit Cost	Unit	Solar Home System					B.C.S	
			50Wp User	100Wp User	150Wp User	200Wp User	250Wp User	Battery Charging System	BCS User
PV Module (50Wp)	1,561	(pce) (P)	1 1,561	2 3,122	3 4,683	4 6,244	5 7,805	20 31,220	
Controller									
for 50/100wp (Shell Power House)	540	(pce) (P)	1 540	1 540					
for BCS(EB20)	600	(pce)						60	1
for Battery Box	150	(P)						36,000	150
for 150Wp or more(Prepaid + EB20)	1,141	(pce)			1	1	1	2	
for BCS room	600	(P)			1,141	1,141	1,141	1,200	
Battery									
for Capacity with 102Ah	491	(pce) (P)	1 491	2 982	3 1,473	4 1,964	5 2,455	3 1,473	
for Capacity with 45Ah	348	(pce) (P)							1 348
Battery Box									
for Capacity with 102Ah	246	(pce) (P)	0 0	1 246	2 492	3 738	4 984	2 492	
for Capacity with 45Ah	123	(pce) (P)							1 123
Fuse & Breaker for Battry	62	(pce) (P)							1 62
Inverter(DC→AC 250VA)	738	(pce) (P)			1 738	1 738	1 738	2 1,476	
DC Lighting apparatus									
Light (11W)	122	(pce) (P)	2 244	4 488					1 122
Socket and Plug	123	(pce) (P)	0	1 123					1 123
AC Lighting Apparatus									
Light(11W)	185	(pce) (P)			6 1,110	6 1,110	6 1,110	4 740	
Switch	25	(pce) (P)			6 150	6 150	6 150	4 100	
Socket and Plug	43	(pce) (P)			2 86	3 129	3 129	2 86	
Distribution Board	738	(pce) (P)			1 738	1 738	1 738	2 1,476	
Pole and supporting structure for PV Module		(set) (P)	1 348	1 431	1 836	1 1,082	1 1,169	1 2,450	
Lightning Rod and Building work		(P)						80,000	
Wiring and Installation work									
Cable		(P)	350	461	800	800	800	1,000	176
Installation work		(P)	2,400	2,880	7,200	9,600	12,000	74,000	
<b>Total</b>		<b>(P)</b>	<b>5,934</b>	<b>9,273</b>	<b>19,447</b>	<b>24,434</b>	<b>29,219</b>	<b>231,713</b>	<b>1,043</b>

No. of PV	117	16	4	1	4	1	87
Subtotal(1000P)	694	148	78	24	117	232	91
Sub Total							1,384
Spare						10	32
Others							150
Total(1000P)							1,566

## 2) Prepaid Card System

The Prepaid card system named "Shell Solar Power House" was adopted, which had been jointly developed by Shell Solar and Conlog.

Shell Solar Power House (hereinafter referred to as "Power House") has a plastic-made round pyramid shape and contains a battery, controller and a reader of a Prepaid card. Power House is equipped with the Smart Switch in case of the combination with 50Wp Shell solar panel. A unique number is given to each Power House and 50Wp Shell solar panel for an user and this Smart Switch does not allow other users to use this solar panel and Solar House. It is said that Smart Switch is workable to prevent a theft of solar panels. We adopted a solar panel generating the output of 60Wp at standard conditions (25°C Cell temperature) since we specified that the minimum output at 55°C cell temperature is not less than 50Wp in the Tender. Therefore, solar panels used in the Project are not equipped with Smart Switch. If a user intentionally opens Power House, the system will become malfunctioned so called "Tamper mode". When a user inserts a Prepaid card to a slot of Power House and a Prepaid card is accepted, a user will hear a clicking sound "grrrrrrk". However, it was found that after trying to insert a card several times, a card was accepted at last when we did owner's witness inspection for PV systems installed. It is likely that users should become proficient in inserting a card to a slot of Power House. An instruction for how to insert might be a first job of a Monitoring agent assigned in each village. The temperature inside of Power House may go up due to the radiation of heat from a battery because Power House has no air intake holes on the casing. Therefore, we instructed the Contractor to open small holes on the casing for the ventilation air inside.

## 3) Lighting

11W DC lamps with pull switch and 11W AC lamps with wall switch were furnished to users with 50Wp and 100Wp and users with 150Wp or more.

As for AC lighting, the interior wiring was conformity with Botswana Standard. Since a 11W DC lamp was hung by its own cable, we judged that a lamp fixture having a pull switch would be unable to withstand a long life use. We instructed the Contractor to fit an additional rope to a lighting fixture to carry a load instead of its own cable and to drill a small hole on a lampshade to pass a pull switch string.

#### 4) BCS

Solar panels (20 sets of 50Wp) were installed on an independent structure at the back side of Battery Charging Station (BCS) while these were planned to be installed on the roof of BCS. This structure was surrounded by a fence for preventing a theft.

## 15.6 Operation Structure for the Dissemination Project

### 15.6.1 Outline

The operation structure of BPC, the Implementation Body, is illustrated in Appendix Figure 15.6-1. (refer to Appendix Document 15.6-1 Project Implementation Manual) The Project Team has been formed under the Management Committee, which consists of Directors and Managers of BPC. The Project Team is consisting of Project Manager, Project Engineer and Commercial officers etc. The Project Team was formed in the 3rd Site Survey time (July 2001) and since then, BPC's commercial officers have visited 3 villages with the Study Team and explained at Kgotla meeting what was the Dissemination Project and the contracting conditions for participants. BPC prepared a contract form (refer to Appendix Document 15.6-2) for the participants for the Dissemination Project. BPC Depot in Selibe-Phikwe took care of signing a contract, collection of deposit money and dispatching technicians to Motlhabaneng where the Dissemination Project would be carried out. BPC Depot in Mahalapye did the same for Kudumatse and BPC head office did the same for Lorolwana.

Two technicians for each village selected in November 2001 and received a two days training course (both lectures and practices) by the Contractor.

The operation units in 3 villages are shown in Appendix Figure 15.6-1.

#### ① Collection of deposit money

BPC assigned a person in charge for collecting deposit money upon deliberation with VAC (Village Advisory Committee) in July or August 2001. Their main duties were to collect deposit money from participants and store the moneys until a Commercial officer comes to collect. They were very familiar with villagers and had full confidences from villagers because they kept villagers money with them. All of them were female. Not only such duties, but they guided the exact places of participants in the villages for the Contractor and rendered great services for the Study

Team and BPC at the middle of January 2002 for finalizing participants list for the Project. They contributed much to the Project. Moreover they worked gratis. BPC's commercial officers often visited the villages to press participants to pay deposit money and received the collected money from them.

② Sales of Prepaid Cards and System Maintenance

The Study Team had requested to BPC the assignment Prepaid Card Sales Agent and System Monitoring Agent as soon as possible so that they could prepare necessary works by the commencement of the Dissemination Project. Especially it was important to let System Monitoring Agents work with the Contractor, in other words, to train Monitoring Agents on the job training basis, since they would play a role to monitor and maintain PV systems and to inform the exact situation to BPC technicians in case they could not handle troubles.

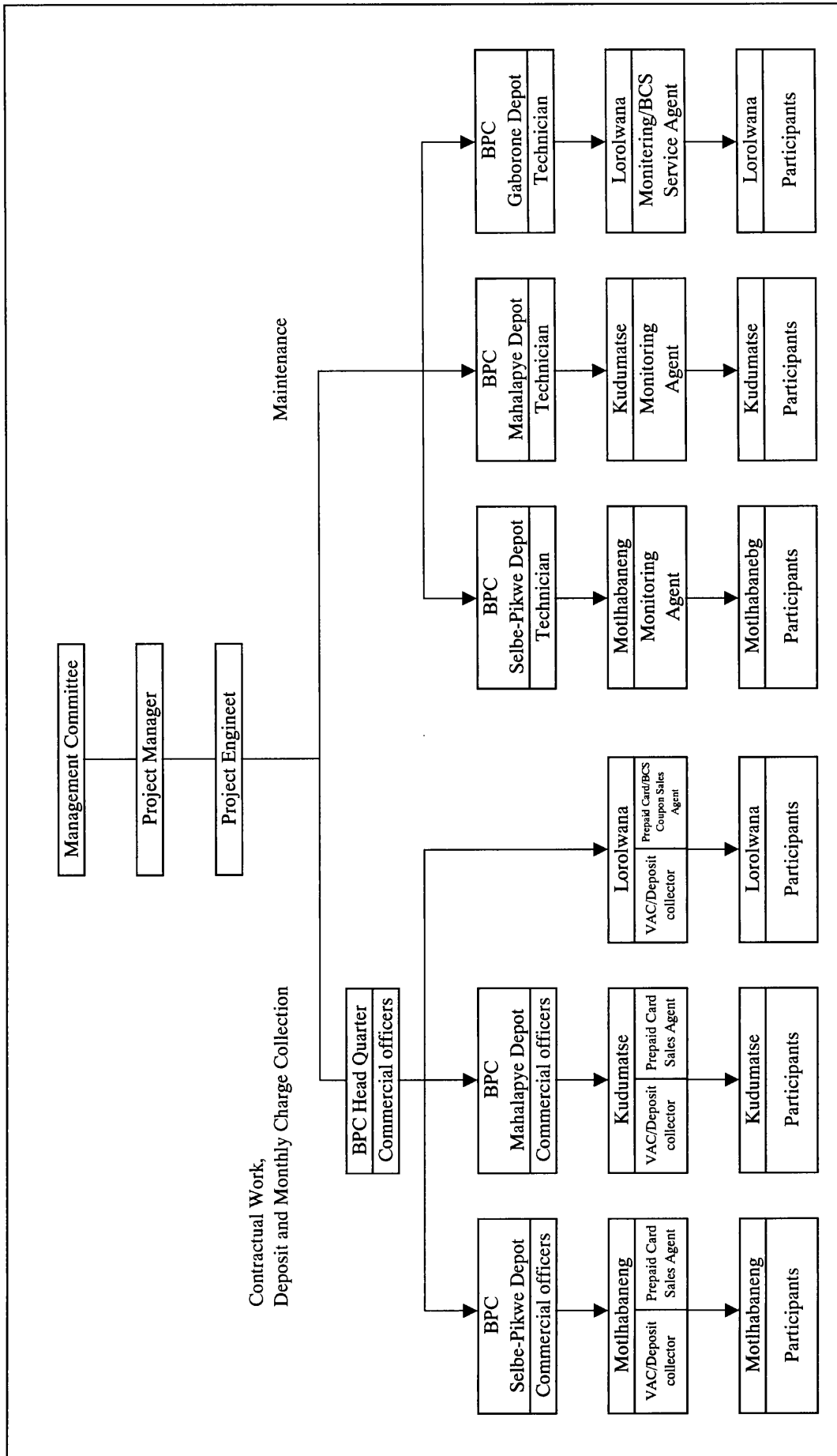
BPC prepared a contract form for the Agents, which was approved by the board of BPC at the beginning of February and then BPC started to enter into an agreement with the Agents. The Prepaid Card Sales Agent and the System Monitoring Agent in each village were assigned formally at the middle of February 2002.

The Prepaid Sales Agent in Lorolwana handles not only prepaid cards but BCS coupons booklet for BCS users. One BCS coupon booklet has 10 coupons(one coupon costs P1.5, total P15). System Monitoring Agent checks whether a used battery box from a BCS user has no damage or trouble. If not, he can lend a full charged battery box to the BCS user. He will keep a book to check how often BCS users come to charge batteries.

Remuneration for Prepaid Card Sales Agent and System Monitoring Agent are as follows;

**Appendix Table 15.6-1 Remuneration**

	Motlhabaneng	Kudumatse	Lorolwana
Prepaid Card/BCS Coupon Sales Agent	150P/m (Prepaid Card)	150P/m (Prepaid Card)	150P/m (Prepaid Card/BCS Coupon)
Monitoring Agent	500P/m	500P/m	750P/m



**Appendix Figure 15.6-1 Operation Structure for the Dissemination Project**