

附表

表 4.1 調査対象者の属性

PV Site	La Paz				Oruro					Total
	Calteca	Sanfrancisco de Llallagua	Santiago de Hiruyo	Sub-Total	Iruma	Paria Pampita	Ancocota	Pazña	Sub-Total	
Age										
Less than 29 year	5	2	1	8	4	1	2		7	15
30-39	9	5	5	19	10	2		4	16	35
40-49	8	3		11	2	4	3	4	13	24
50-59	8		4	12	1	2	5	1	9	21
60-69	8			8	2			1	3	11
70 and more	2			2	1	1			2	4
Educational background										
No Education					2		3	2	7	7
Elementary school	4	10	2	16	9	7	5	6	27	43
Junior high school - level	17		4	21	6	3	2	2	13	34
Senior high school - level	19		4	23	3				3	26
University										
Main Occupation										
Farmer	4			4	3	1			4	8
Farmer + Herdsman	27	3	2	32	6	8	10	7	31	63
Farmer + Temporary work	4	7	4	15		1		3	4	19
Farmer + Private business	3		1	4						4
Farmer + Public sector			1	1						1
Farmer + Private sector			2	2						2
Farmer + Private business										
Private business	1			1						1
Salary worker in Private	1			1						1
Housekeeper					1				1	1
Total number of Interviewees	40	10	10	60	20	10	10	10	50	110

出典: JICA調査団

表 4.2 家計状況

PV Site	La Paz				Oruro					Total
	Calteca	Sanfrancisco de Llallagua	Santiago de Hiruyo	Sub-Average	Iruma	Paria Pampita	Ancocota	Pazña	Sub-Average	
Average Monthly Income	Bs. 277.4	Bs. 305.1	Bs. 348.5	Bs. 310.3	Bs. 246.0	Bs. 268.2	Bs. 110.4	Bs. 289.6	Bs. 228.5	Bs. 269.4
Average Monthly Consumption	Bs. 142.3	Bs. 293.3	Bs. 322.9	Bs. 252.8	Bs. 204.1	Bs. 217.1	Bs. 110.0	Bs. 253.8	Bs. 196.2	Bs. 224.5
- for Food	Bs. 97.9	Bs. 167.5	Bs. 241.4	Bs. 168.9	Bs. 172.5	Bs. 171.4	Bs. 100.0	Bs. 183.6	Bs. 156.8	Bs. 162.8
- for Energy	Bs. 24.6	Bs. 22.5	Bs. 27.8	Bs. 24.9	Bs. 22.9	Bs. 25.5	Bs. 15.9	PV installed	Bs. 21.4	Bs. 23.1

出典: JICA調査団

表4.3 農業・畜産経営の状況

PV Site	La Paz				Oruro					Average / Total
	Calteca	Sanfrancisco de Llallagua	Santiago de Hiruyo	Average / Sub-total	Iruma	Paria Pampita	Ancocot a	Pazña	Average / Sub-total	
Average Farmland Size	3.2 ha	5.3 ha	5.8 ha	4.7 ha	0.8 ha	4.4 ha	4.9ha	6.2 ha	4.0 ha	4.3 ha
Average Number of Livestocks										
- Cattle	1.7	3	3.6	2.8	2	2.9	3.3	5.4	3.4	3.1
- Sheep	14.7	24	32.5	23.7	15.9	44.4	30.8	42.4	33.4	28.6
- Poultry	2.9	4	2.3	3.1	4	0.3	1.7	2.6	2.2	2.6
- Pig	0.2			0.1					0	0.0
- Burro	0.7	2	0.9	1.2		1.8	2.7	1.2	1.4	1.3
- Llama	0.2			0.1	11.8	40.3	3.8	5.8	15.4	7.7
Number of households that have farmland and/or livestock animal										
- Farmland	37	9	10	56	17	9	10	9	45	101
- Cattle	31	10	10	51	1	8	9	8	26	77
- Sheep	33	10	10	53	9	9	8	9	35	88
- Poultry	16	9	4	29	1	1	0	2	4	33
- Pig	4	0	0	4	0	0	9	0	9	13
- Burro	16	7	4	27	0	9	7	5	21	48
- Llama	3	0	0	3	4	9	8	3	24	27
Total number of households	40	10	10	60	20	10	10	10	50	110

出典: JICA調査団

表 4.4 購入した電気製品

(Unit: households)

PV Site	La Paz				Oruro				Total
	Calteca	Sanfrancisco de Llallagua	Santiago de Hiruyo	Sub-total	Iruma	Paria Pampita	Ancocota	Sub-total	
<b>Existing appliances in a household</b>									
- Radio	26	3	3	32	8	1	3	12	44
- Radio-cassette recorder	8	3	2	13	6	7	2	15	28
- Radio + Radio-cassette recorder	3	2	5	10	2	1		3	13
- Radio-cassette recorder + TV set					1			1	1
- Radio + Radio-cassette recorder + TV set						1		1	1
- do not have any appliance	3	2		5	3		5	8	13
<b>Appliances desired after PV installation</b>								0	0
- Radio	2			2				0	2
- Radio-cassette recorder	4	2		6	5		3	8	14
- Radio + Radio-cassette recorder								0	0
- TV set	18	6	8	32	3	8	2	13	45
- TV set + Radio					1		2	3	3
- TV set + Radio-cassette recorder	3	2	1	6	1	1	3	5	11
- No idea or Do not buy any appliances	13		1	14		1		1	15
Total number of households	40	10	10	60	20	10	10	40	100

出典: JICA調査団

表 4.5 ケロシン・ランプの使用状況

PV Site	La Paz				Oruro				Average
	Calteca	Sanfrancisco de Llallagua	Santiago de Hiruyo	Sub-average	Iruma	Paria Pampita	Ancocota	Sub-average	
Price of a Lamp (Bs.)	1.4	1.8	1.6	1.6	2.4	3.0	1.8	2.4	2.0
Life of the Lamp (year)	1.2	1.5	1.6	1.4	1.0	1.0	1.0	1.0	1.2
Monthly Consumption of Kerosene (liter)	1.1	2.8	2.6	2.2	4.2	3.8	2.3	3.4	2.8
Fuel Price (kerosene 1liter)	2.4	2.2	2.5	2.4	1.5	1.6	1.8	1.6	2.0
Monthly Consumption of Kerosene (Bs.)	2.6	6.2	6.5	5.1	6.3	6.1	4.1	5.6	5.6
Lamp Usage Hours per Day	2.4	1.7	2.5	2.2	3.0	4.0	2.6	3.2	2.7

出典：JICA調査団

表 4.6 太陽光発電システムに関わる初期投資の源泉

	La Paz				Oruro				Total
	Calteca	Sanfrancisco de Llallagua	Santiago de Hiruyo	Sub-total	Iruma	Paria Pampita	Ancocota	Sub-total	
from savings	5			5	4			4	9
borrow from relatives or friends	1			1					1
credit	1			1	2			2	3
sell agricultural products						2		2	2
sell livestock animals	10	5	5	20	2	2	5	9	29
sell farmland									0
temporary work	4			4	10			10	14
sell agricultural products + temporary work					2			2	2
sell livestock animals + temporary work		5	2	7		5	5	10	17
sell agricultural products + livestock animals	8			8		1		1	9
from savings + remittance	1			1					1
from savings + sell agricultural products			1	1					1
from savings + sell livestock animals	8		1	9					9
from savings + temporary work	1		1	2					2
from savings + borrow form relatives or friends	1			1					1
others									0
Total	40	10	10	60	20	10	10	40	100

出典: JICA調査団

表 4.7 太陽光発電システムに関わる月支払料金の予定源泉

	La Paz				Oruro				Total
	Calteca	Sanfrancisco de Llallagua	Santiago de Hiruyo	Sub-total	Iruma	Paria Pampita	Ancocota	Sub-total	
from savings	11		1	12	3			3	15
borrow from relatives or friends	1			1				0	1
credit	1			1	1			1	2
sell agricultural products				0		2		2	2
sell livestock animals	8	3	5	16			3	3	19
sell farmland				0				0	0
temporary work	5	2	1	8	5	3	2	10	18
sell agricultural products + temporary work				0	1		2	3	3
sell livestock animals + temporary work		3	2	5		5	2	7	12
sell agricultural products + livestock animals	5	2		7			1	1	8
from savings + sell livestock animals	6			6				0	6
from savings + temporary work	1		1	2				0	2
from savings + borrow form relatives or friends	1			1				0	1
remittance	1			1				0	1
others				0				0	0
Total	40	10	10	60	20	10	10	40	100

出典: JICA調査団



表7.1 ラパス県支払い状況（2000年5月末）

(unit: Bs.)

Community	Installed Households		Initial Payment			Monthly fee		
	Original Installation	As of May 2000	Total amount (A)	Payment up to April	% (B/A)	Total amount (C)	Payment up to April	% (D/C)
Calteca	12	12	8400	1500	17.86%	1080	300	27.78%
Chiarumani	26	26	18200	1500	8.24%	2340	510	21.79%
Muruchapi	23	23	16100	1150	7.14%	2070	0	0.00%
Millo	37	37	25900	1850	7.14%	2220	0	0.00%
Catavi	12	12	8400	600	7.14%	720	0	0.00%
C.C. Alto	3	3	2100	150	7.14%	180	0	0.00%
Hiruyo	27	27	18900	1350	7.14%	2430	0	0.00%
Llallagua	14	14	9800	700	7.14%	1260	0	0.00%
Sipe Sipe	25	25	17500	1250	7.14%	2250	0	0.00%
Calacachi								
Stgo. De Llallagua								
Canuma								
Schools Sica Sica					-			
Removed								
Plaza Sica Sica			-	-				
VMEH	1	1						
Spare	20	20						
<b>Total</b>	<b>200</b>	<b>200</b>	<b>125300</b>	<b>10050</b>	<b>8.02%</b>	<b>14550</b>	<b>810</b>	<b>5.57%</b>

Source: JICA Study Team

表7.2 ラパス県支払い状況（2000年7月末）

(unit: Bs.)

Community	Installed Households		Initial Payment			Monthly fee		
	Original Installation	As of July 2000	Total amount (A)	Payment up to July 2000	% (B/A)	Total amount (C)	Payment up to July 2000	% (D/C)
Calteca	12	12	7200	2100	29.17%	1320	542	41.06%
Chiarumani	26	26	15600	1900	12.18%	2860	532	18.60%
Muruchapi	23	23	13800	1750	12.68%	2530	1276	50.43%
Millo	37	37	22200	1850	8.33%	3256	330	10.14%
Catavi	12	12	7200	600	8.33%	1056	528	50.00%
C.C. Alto	3	3	1800	550	30.56%	264	0	0.00%
Hiruyo	27	27	1350	1350	100.00%	4050	630	15.56%
Llallagua	14	14	700	700	100.00%	2100	330	15.71%
Sipe Sipe	25	25	1250	1250	100.00%	3750	1890	50.40%
Calacachi								
Stgo. De Llallagua								
Canuma								
Schools Sica Sica					-			
Removed								
Plaza Sica Sica			-	-				
VMEH	1	1						
Spare	20	20						
<b>Total</b>	<b>200</b>	<b>200</b>	<b>71100</b>	<b>12050</b>	<b>16.95%</b>	<b>21186</b>	<b>6058</b>	<b>28.59%</b>

Source: JICA Study Team

表7.3 ラパス県支払い状況（2000年12月末）

(unit:Bs.)

Community	Installed Households		Initial Payment			Monthly fee		
	Original Installation	As of Dec. 2000	Total amount (A)	Payment up to April	% (B/A)	Total amount (C)	Payment up to April	% (D/C)
Calteca	12	10	6000	2500	41.7%	2200	1182	53.7%
Chiarumani	26	6	3600	1350	37.5%	1320	440	33.3%
Muruchapi	23	22	13200	2700	20.5%	4840	1254	25.9%
Millo	37	30	18000	1450	8.1%	5940	858	14.4%
Catavi	12	12	7200	600	8.3%	2376	682	28.7%
C.C. Alto	3	3	1800	650	36.1%	594	220	37.0%
Hiruyo	27	19	950	950	100.0%	5700	3300	57.9%
Llallagua	14	14	700	700	100.0%	4200	1170	27.9%
Sipe Sipe	25	1	50	50	100.0%	300	120	40.0%
Calacachi		32	19200	13250	69.0%			
Stgo. De Llallagua								
Canuma								
Schools Sica Sica								
Removed		31		3150			6210	
Plaza Sica Sica		-	-	-			-	
VMEH	1	1						
Spare	20	19						
<b>Total</b>	<b>200</b>	<b>200</b>	<b>70700</b>	<b>27350</b>	<b>38.7%</b>	<b>27470</b>	<b>15436</b>	<b>56.2%</b>

Source: JICA Study Team

表7.4 ラパス県支払い状況（2001年4月末）

(unit: Bs.)

Community	Installed Households			Initial Payment			Monthly fee		
	Original Installation	As of Dec. 2000	As of April 2001	Total amount (A)	Payment up to April	% (B/A)	Total amount (C)	Payment up to April	% (D/C)
Calteca	12	10	10	6000	2600	43.33%	3080	1732	56.23%
Chiarumani	26	6	5	3000	1300	43.33%	1540	588	38.18%
Muruchapi	23	22	22	13200	2700	20.45%	6776	1254	18.51%
Millo	37	30	30	18000	1450	8.06%	8580	682	7.95%
Catavi	12	12	12	7200	600	8.33%	3432	726	21.15%
C.C. Alto	3	3	3	1800	650	36.11%	858	220	25.64%
Hiruyo	27	19	7	4200	350	8.33%	2156	1170	54.27%
Llallagua	14	14	4	2400	200	8.33%	1232	270	21.92%
Sipe Sipe	25	1	1	600	600	100.00%	308	300	97.40%
Calacachi		32	41	24600	16250	66.06%	3410	1914	56.13%
Stgo. De Llallagua		-	7	4200	1950	46.43%	462	330	71.43%
Canuma		-	13	7800	7800	100.00%	858	638	74.36%
Schools Sica Sica		-	5	3000	-	0.00%			0.00%
Removed		30	18		4300			12176	
Plaza Sica Sica		-	1	-	-		22	-	0.00%
VMEH	1	1	1						
Spare	20	20	20						
<b>Total</b>	<b>200</b>	<b>200</b>	<b>200</b>	<b>96000</b>	<b>40750</b>	<b>42.45%</b>	<b>32714</b>	<b>22000</b>	<b>67.25%</b>

Source: JICA Study Team

Plaza Sica Sica : 1 system installed in April 2001

Schools Sica Sica : 5 systems installed in April 2001, 5 systems installed in May 2001

Initial payment @Bs.600 x 10 = Bs.6000 paid in May from Sica Sica Municipality

Spare: 2 systems to be remained as spare before the end of August 2001

表7.5 オルコ県支払い状況（2000年5月末）

(unit: Bs.)

Community	Installed Households		Initial Payment			Monthly fee		
	Original Installation	As of May 2000	Total amount (A)	Payment up to May 2000 (B)	% (B/A)	Total amount (C)	Payment up to May 2000 (D)	% (D/C)
Paria Pampita	18	18	12600	2200	17.5	2160	630	29.2
Milluni	23	23	16100	1150	7.1	2760	0	0.0
Laguna Ancocota	44	44	30800	2200	7.1	5280	0	0.0
Minas	5	5	3500	1350	38.6	600	300	50.0
Removed								
Spare	10	10						
<b>Total</b>	<b>100</b>	<b>100</b>	<b>63000</b>	<b>6900</b>	<b>11.0</b>	<b>10800</b>	<b>930</b>	<b>8.6</b>

Source: JICA Study Team

表7.6 オルコ県支払い状況（2000年7月末）

(unit: Bs.)

Community	Installed Households		Initial Payment			Monthly fee		
	Original Installation	As of May 2000	Total amount (A)	Payment up to July 2000	% (B/A)	Total amount (C)	Payment up to July 2000	% (D/C)
Paria Pampita	18	18	10800	3400	31.5	2376	1092	46.0
Milluni	23	23	13800	2350	17.0	3036	990	32.6
Laguna Ancocota	44	44	26400	2600	9.8	5808	572	9.8
Minas	5	5	3000	2250	75.0	660	432	65.5
Removed								
Spare	10	10						
<b>Total</b>	<b>100</b>	<b>100</b>	<b>54000</b>	<b>10600</b>	<b>19.6</b>	<b>11880</b>	<b>3086</b>	<b>26.0</b>

表7.7 オルコ県支払い状況（2000年12月末）

(unit: Bs.)

Community	Installed Households		Initial Payment			Monthly fee		
	Original Installation	As of December 2000	Total amount (A)	Payment up to July 2000	% (B/A)	Total amount (C)	Payment up to July 2000	% (D/C)
Paria Pampita	18	16	9600	4520	47.1	3520	1327	37.7
Milluni	23	23	13800	6728	48.8	5060	3002	59.3
Laguna Ancocota	44	44	26400	11362	43.0	9680	3538	36.5
Minas	5	5	3000	2500	83.3	1100	1100	100.0
Removed		2		100				
Spare	10	10						
<b>Total</b>	<b>100</b>	<b>100</b>	<b>52800</b>	<b>25210</b>	<b>47.7</b>	<b>19360</b>	<b>8967</b>	<b>46.3</b>

Source: JICA Study Team

**表7.8 オルロ県支払い状況（2001年4月末）**

(unit: Bs.)

Community	Installed Households			Initial Payment			Monthly fee		
	Original Installation	As of Dec. 2000	As of April 2001	Total amount (A)	Payment up to April	% (B/A)	Total amount (C)	Payment up to April	% (D/C)
<b>Paria Pampita</b>	<b>18</b>	<b>16</b>	<b>18</b>	10800	<b>5830</b>	54.0	5544	<b>2063</b>	37.2
<b>Milluni</b>	<b>23</b>	<b>23</b>	<b>23</b>	13800	<b>7228</b>	52.4	7084	<b>3422</b>	48.3
<b>Laguna Ancocota</b>	<b>44</b>	<b>44</b>	<b>44</b>	26400	<b>12012</b>	45.5	13552	<b>4893</b>	36.1
<b>Minas</b>	<b>5</b>	<b>5</b>	<b>5</b>	3000	<b>2500</b>	83.3	1540	<b>1100</b>	71.4
<b>Removed</b>		<b>2</b>							
<b>Spare</b>	<b>10</b>	<b>10</b>	<b>10</b>						
<b>Total</b>	<b>100</b>	<b>100</b>	<b>100</b>	<b>54000</b>	<b>27570</b>	<b>51.1</b>	<b>27720</b>	<b>11478</b>	<b>41.4</b>

Source: JICA Study Team

**Spare: 2 systems to be remained as spare before the end of August 2001**



表 7.9 電気製品の1日当たり平均使用時間（単位:時間）

Department	La Paz						Oruro					
Community	Calteca			Muruchapi			Paria Pampita			Laguna Ancocota		
	Jun-00	Jan-01	May-01	Jun-00	Jan-01	May-01	Jun-00	Jan-01	May-01	Jun-00	Jan-01	May-01
Fluorescent lamp	2.4	2.5	2.5	2.8	2.9	2.8	2.9	3.1	3.2	2.6	-	2.8
Radio	1.5	1.4	1.6	1.9	1.7	2.2	2.7	2.4	2.5	2.1	-	2.4
Cassette recorder	rarely	rarely	rarely	rarely	rarely	rarely	rarely	rarely	rarely	rarely	rarely	rarely
TV	Not receivable						2.5	2.2	2.4	Not receivable		
Kerosene lamp	2.4	-	-	2.5	-	-	3.0	-	-	2.8	-	-
Total interviewees	5	6	6	15	7	9	14	12	12	8	-	6

Note: \* One TV channel from Oruro-city is available.

Source: JICA Study Team

表 7.10 初期投資及び月支払料金の源泉

Department Community	La Paz						Oruro					
	Calteca			Muruchapi			Paria Pampita			Laguna Ancocota		
	Jun-00	Jan-01	May-01	Jun-00	Jan-01	May-01	Jun-00	Jan-01	May-01	Jun-00	Jan-01	May-01
Selling agricultural products				5	2	3	2	2	3	2		4
Selling livestock animals	1	1	1	5	2	2	5	6	5			1
Selling agricultural products & livestock animals		1	1	2	1	2	2	1	1			
Selling livestock animals & Temporary works							1					
Temporary works	1	1	1		1	1	4	3	3			1
Savings				1								
Remittance	1	1	1									
Pension	1	1	1									
Charity	1	1	1	1	1	1						
Not yet paid				1						6		
Total interviewees	5	6	6	15	7	9	14	12	12	8	-	6

Source: JICA Study Team

表 7.11 利用者の生活変化

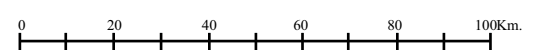
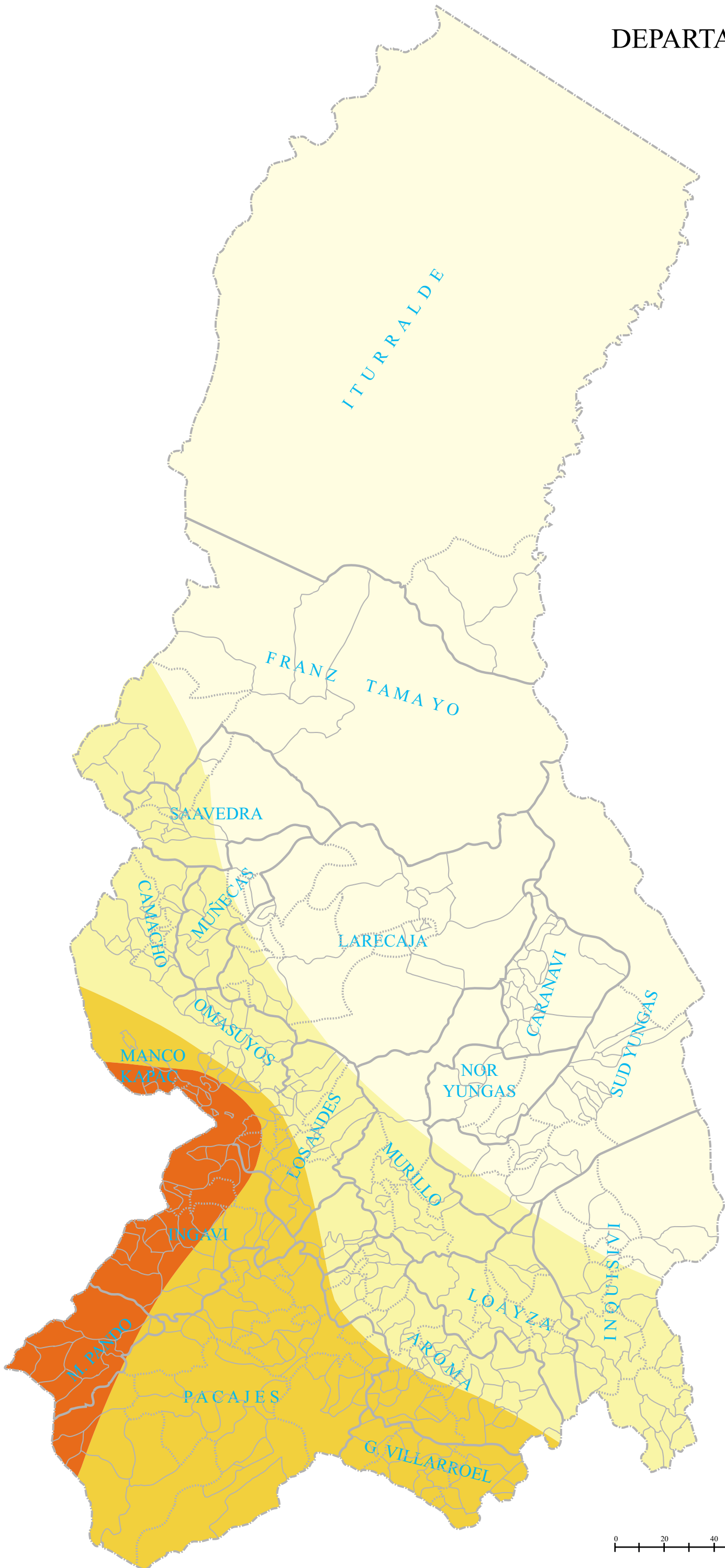
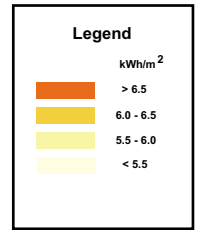
Department	La Paz						Oruro					
Community	Calteca			Muruchapi			Paria Pampita			Laguna Ancocota		
	Jun-00	Jan-01	May-01	Jun-00	Jan-01	May-01	Jun-00	Jan-01	May-01	Jun-00	Jan-01	May-01
Very well	1	1	1	2	2	2	2	2	2	0		1
Well	3	4	4	11	4	5	10	9	9	6		5
- to spend in a bright room at night	(4)	(5)	(5)	(13)	(6)	(7)	(12)	(11)	(10)	(7)		(6)
- to read a book at night	(2)	(3)	(2)	(8)	(3)	(3)	(5)	(5)	(4)	(3)		(4)
- to do school's homework at night	(2)	(2)	(3)	(7)	(3)	(3)	(5)	(4)	(5)	(4)		(3)
- to sew at night	(1)	(1)	(1)	(3)	(1)	(2)	(3)	(2)	(3)	(1)		(1)
- to take care of a baby at night		(1)	(2)	(2)	(1)	(2)		(2)	(1)	(1)		(2)
- to repair agricultural tools at night		(2)	(2)		(1)	(1)	(1)	(2)	(2)	(1)		(1)
- to converse with family at night	(1)	(1)	(2)	(5)	(2)	(3)	(3)	(3)	(4)	(2)		(2)
No change	1	1	1	2	2	2	2	1	1	2		2
Worse	0	0	0	0	0	0	0	0	0	0		0
Total number of Interviewees	5	6	6	15	7	8	14	12	12	8	-	7

Note: including plural answers

Source: JICA Study Team

付図

# DEPARTAMENTO DE LA PAZ

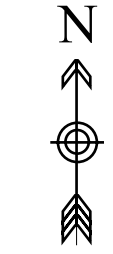
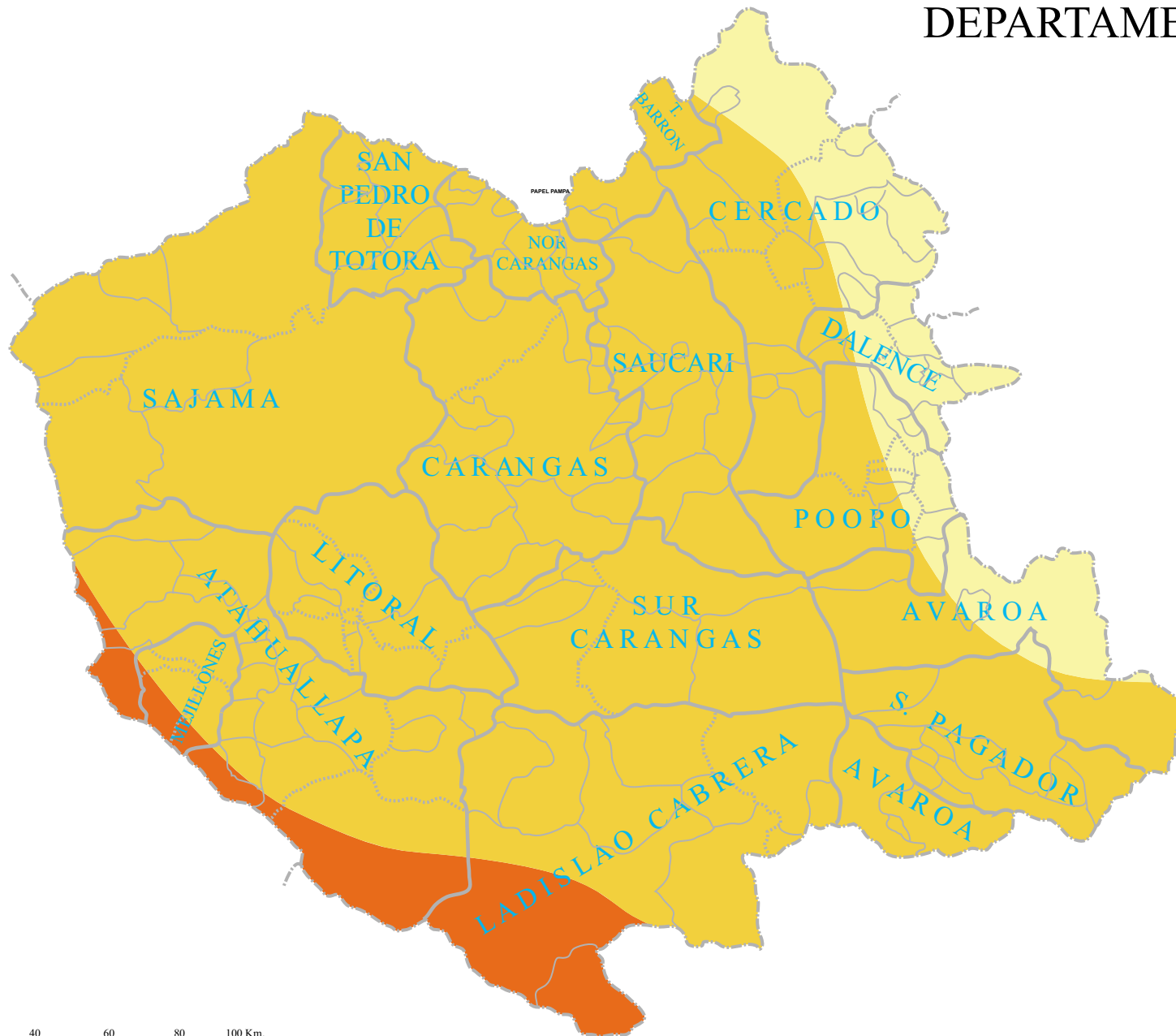


THE STUDY ON RURAL ELECTRIFICATION  
IMPLEMENTATION PLAN BY RENEWABLE ENERGY  
IN THE REPUBLIC OF BOLIVIA  
JAPAN INTERNATIONAL COOPERATION AGENCY

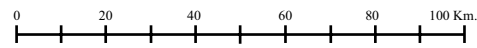
図 8.1

ラパス県太陽光発電ポテンシャル地図

# DEPARTAMENTO DE ORURO



Legend	
kWh/m <sup>2</sup>	
<span style="display:inline-block; width:15px; height:10px; background-color:darkorange;"></span>	> 6.5
<span style="display:inline-block; width:15px; height:10px; background-color:orange;"></span>	6.0 - 6.5
<span style="display:inline-block; width:15px; height:10px; background-color:lightorange;"></span>	5.5 - 6.0
<span style="display:inline-block; width:15px; height:10px; background-color:paleyellow;"></span>	< 5.5



THE STUDY ON RURAL ELECTRIFICATION  
 IMPLEMENTATION PLAN BY RENEWABLE ENERGY  
 IN THE REPUBLIC OF BOLIVIA  
 JAPAN INTERNATIONAL COOPERATION AGENCY

図 8.2 オルロ県太陽光発電ポテンシャル地図

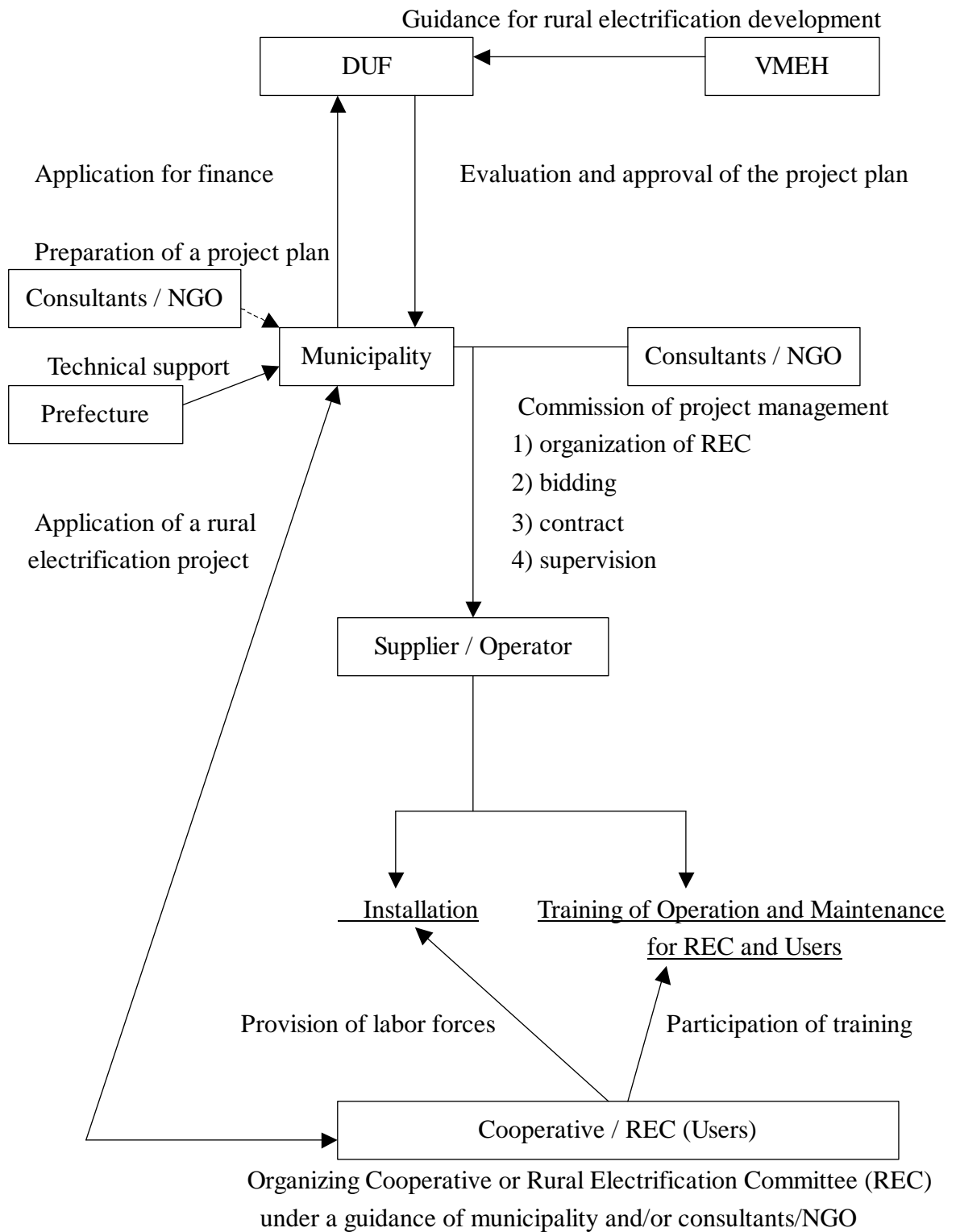


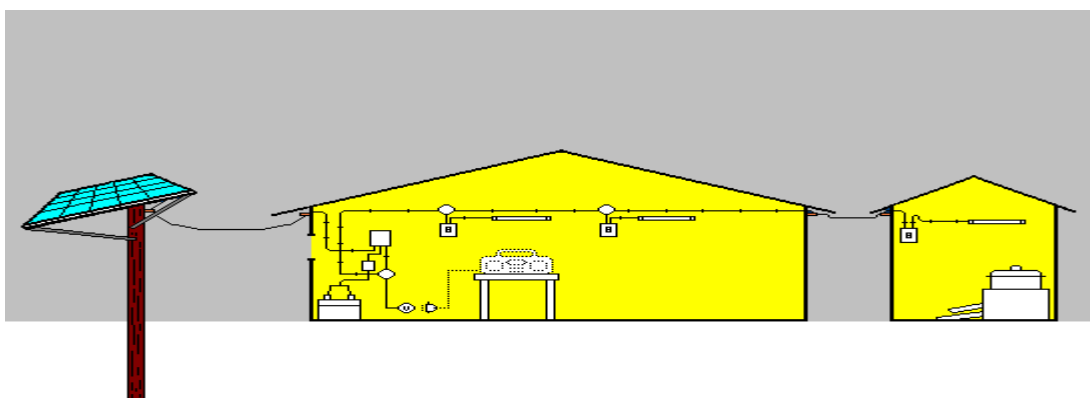
図 9.1 太陽光発電システムに関する事業実施構造

添付資料



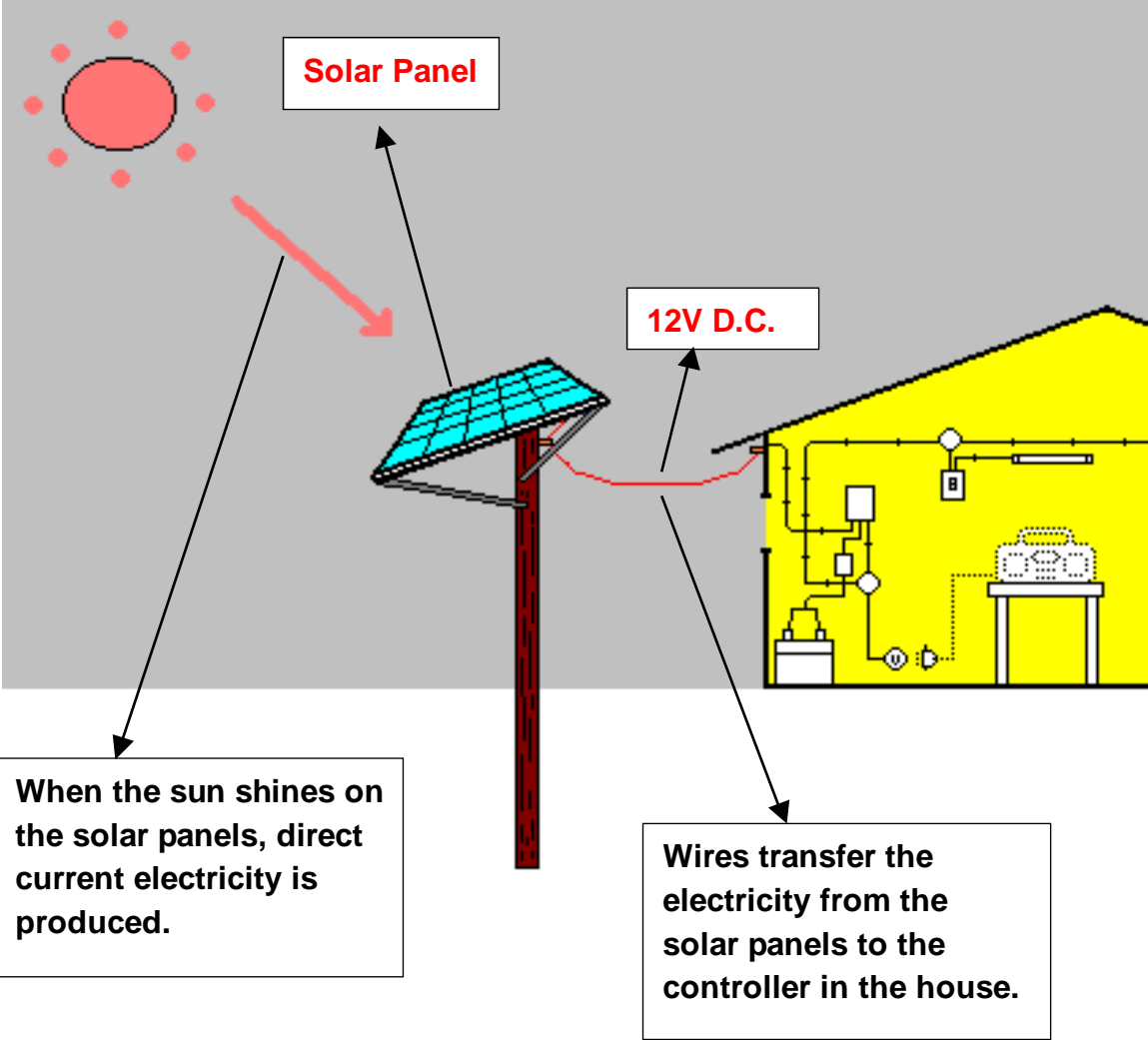
JAPAN INTERNATIONAL COOPERATION AGENCY  
THE STUDY  
ON  
RURAL ELECTRIFICATION IMPLEMENTATION  
PLAN BY RENEWABLE ENERGY  
IN  
THE REPUBLIC OF BOLIVIA

ソーラー・ホーム・システム  
のための  
利用者ガイド

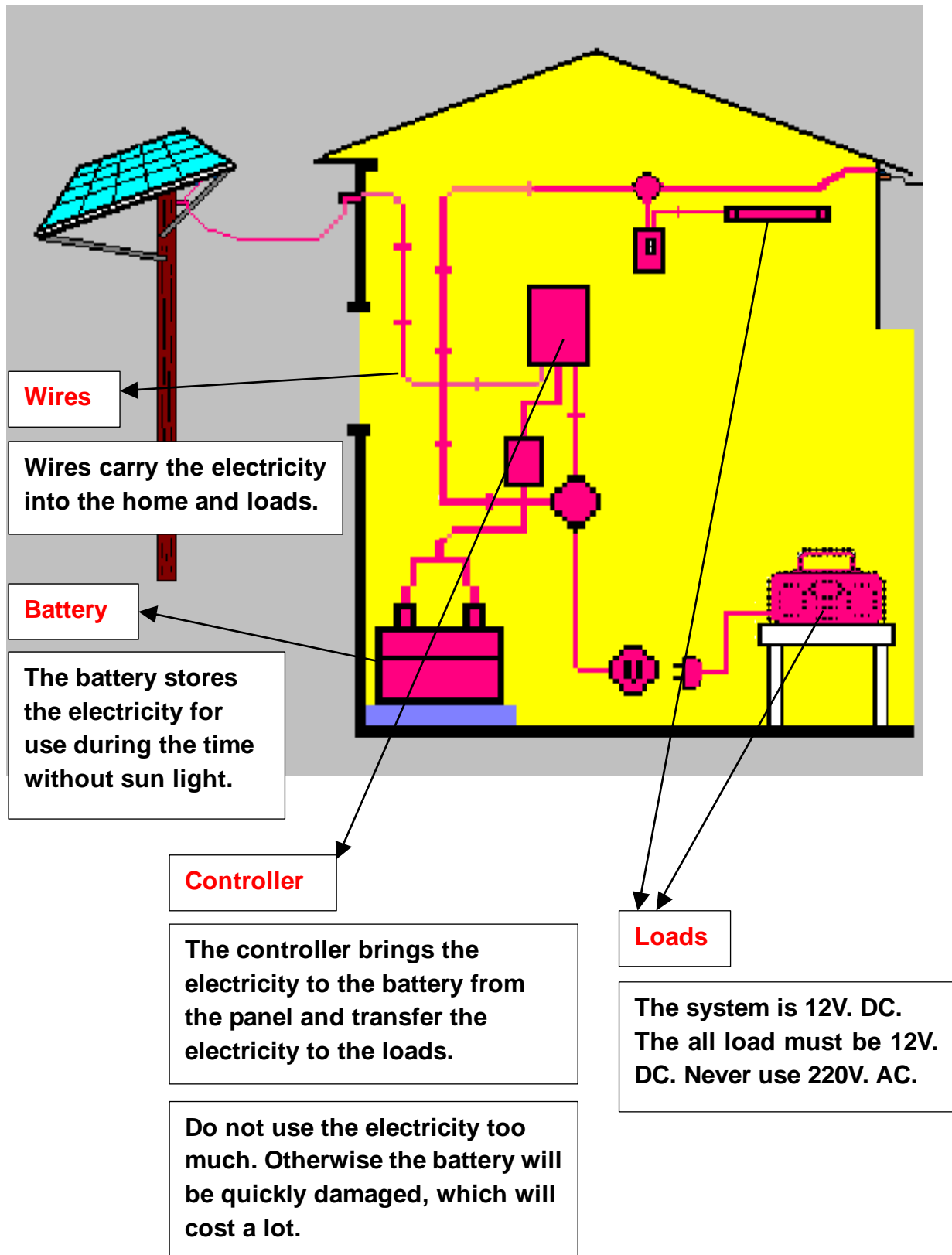


Revised on June 10th 2000

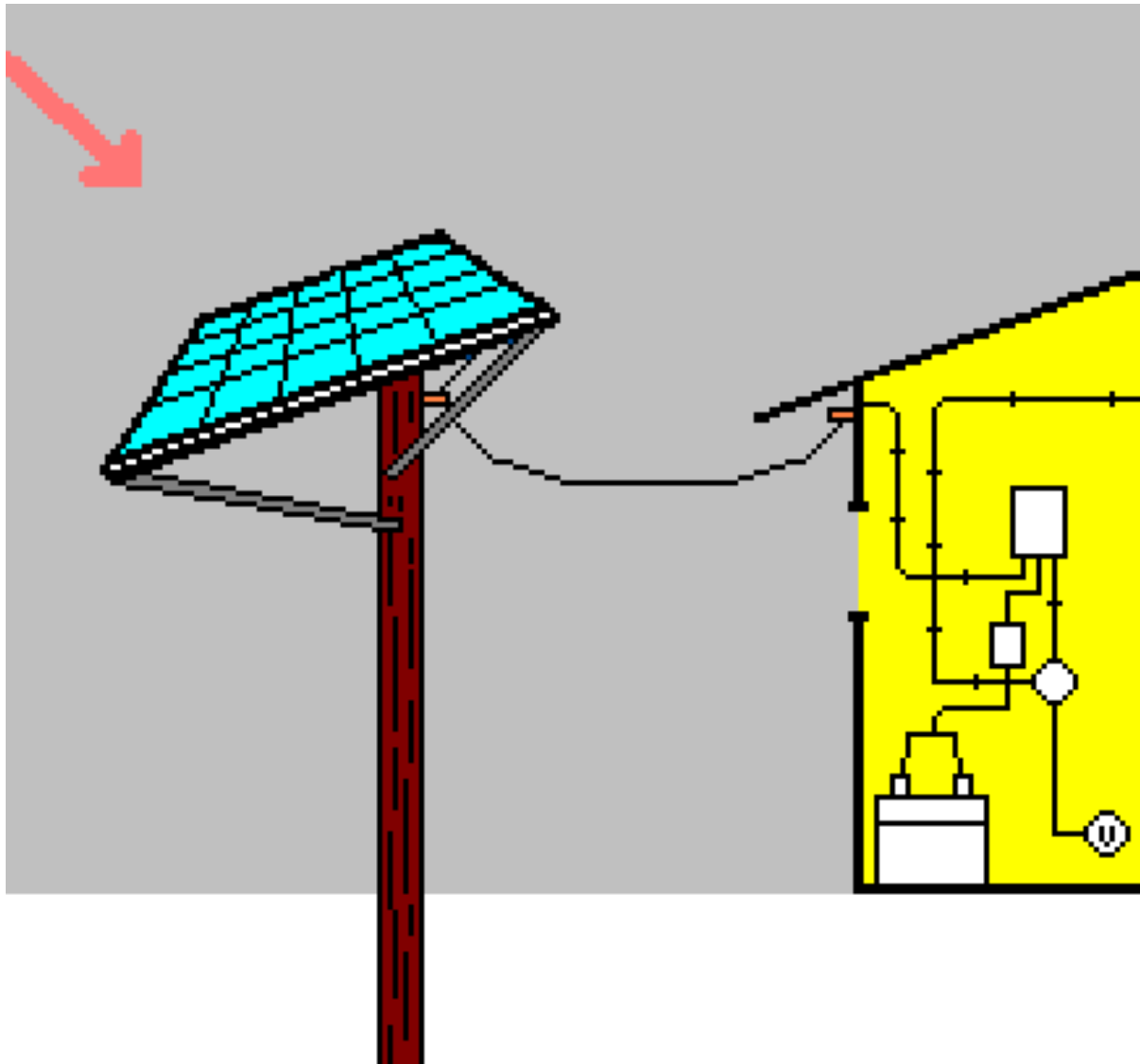
# Solar Electricity Power



# Functions of main appliances

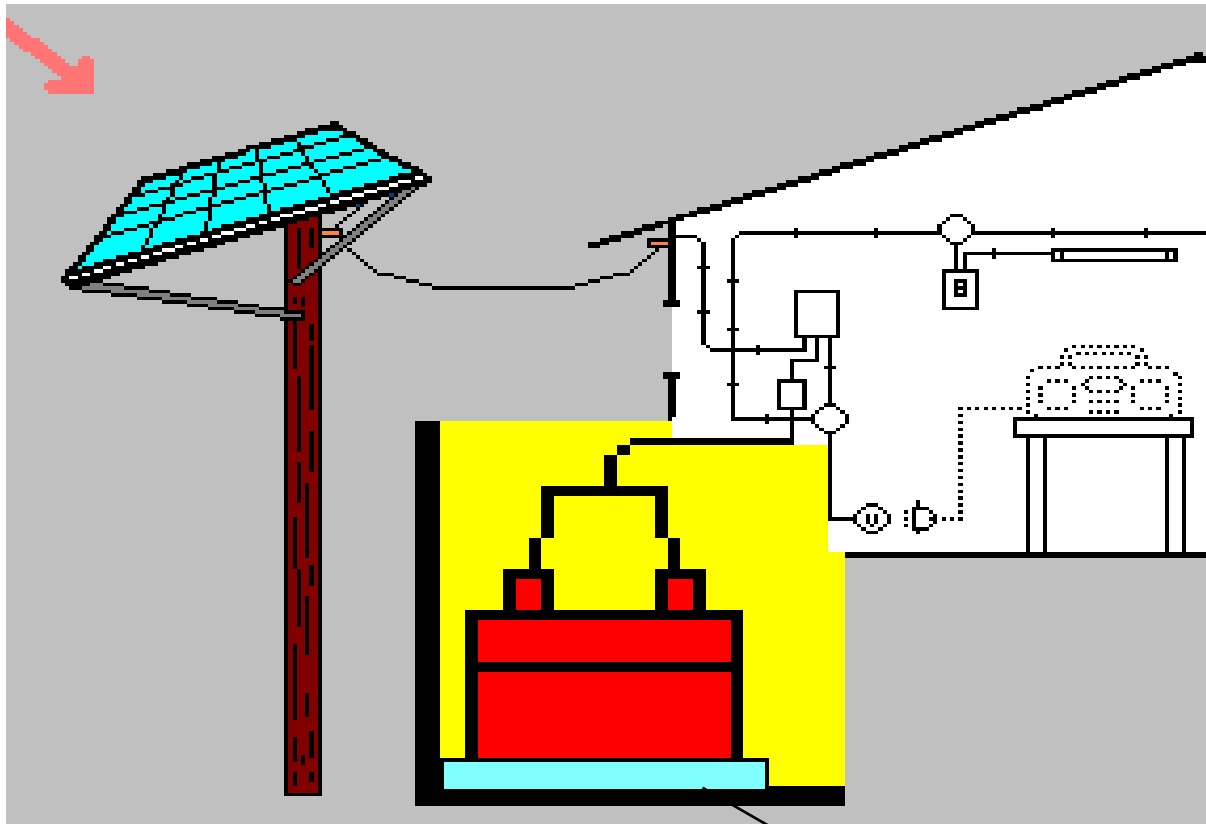


## Solar Panel = Photovoltaic



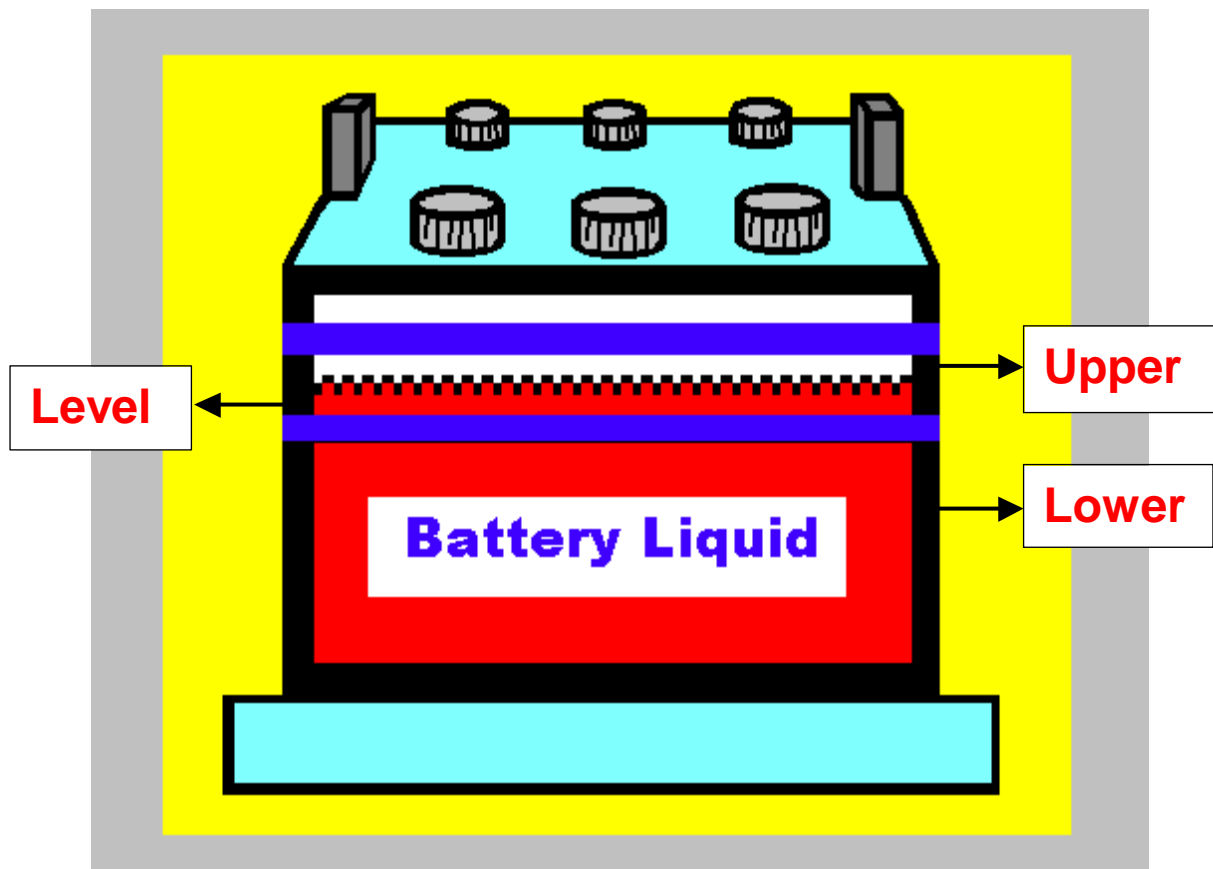
1. Do not remove the panel
2. Do not throw stones at the Panel
3. Do not hang anything on the cable

# Battery



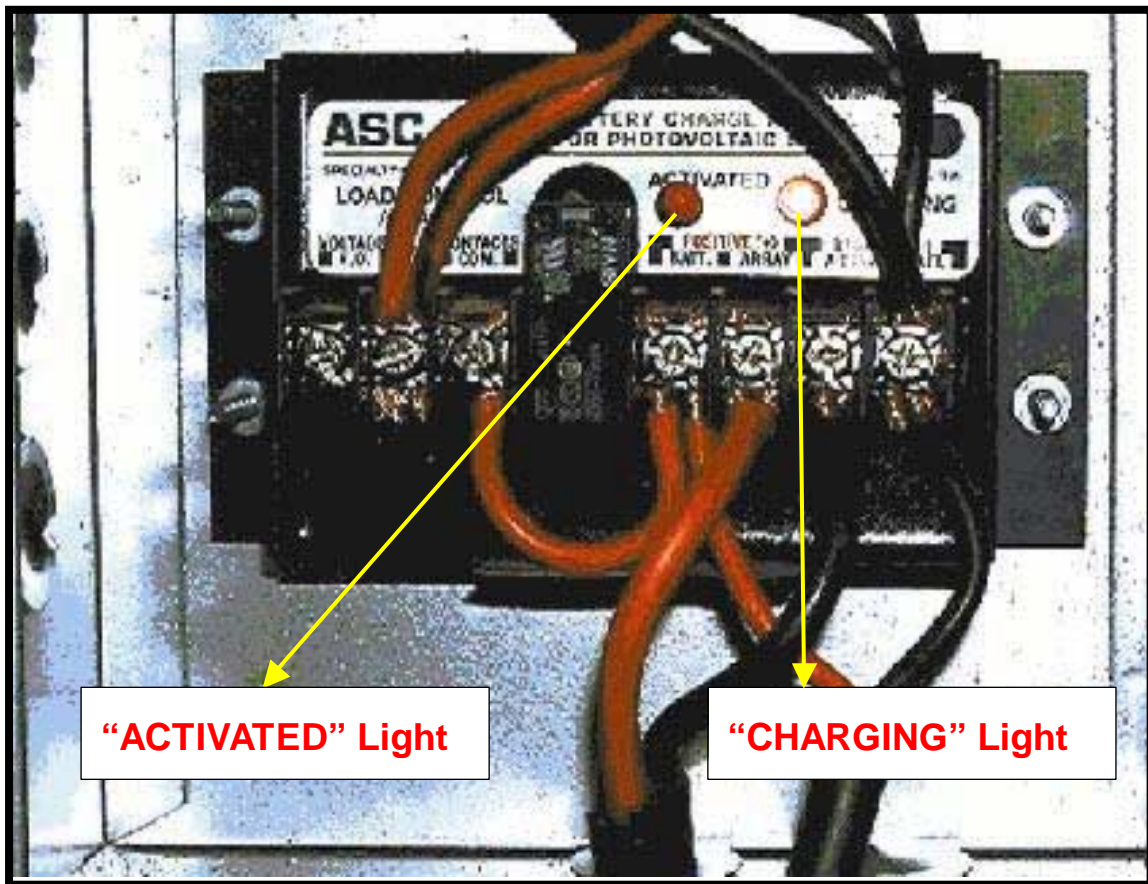
1. Put the Battery on flat base (wood or brick)
2. Battery contains harmful acid liquid
  - Open the window above the battery
  - Never let children close to the battery
  - Never keep livestock in the room
3. Do not touch nor move battery
4. Do not put anything on the battery
5. Do not put fire nor heat near the battery
6. Do not use the battery for other purposes

## Battery Check



1. Check the level of electrolyte on the vessel
  - The level should be between two lines
2. If the level is under lower line, stop using the Power and ask Operators to fill distilled water.

## Controller



**“ACTIVATED” Light**

**“CHARGING” Light**

### 1. CHARGING Light

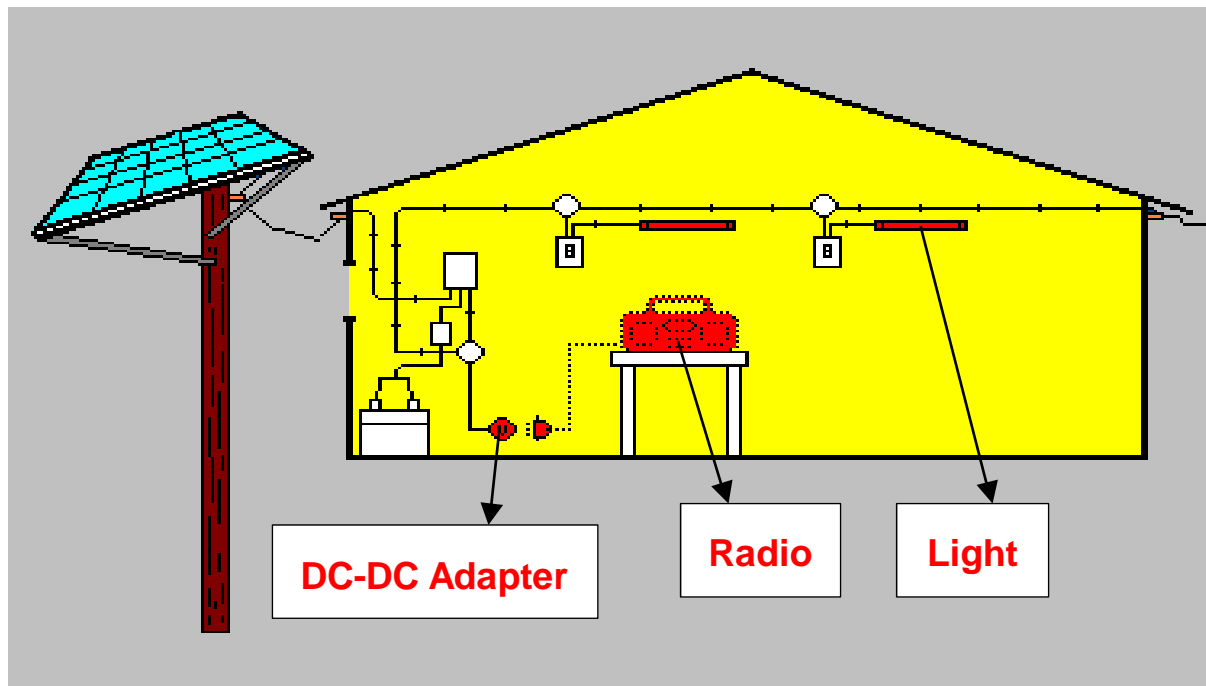
**ON : The battery is charging**

### 2. ACTIVATED Light

**ON : The battery is at a Low Voltage**

**: User can not use ANY LOAD at all.**

## Load



Loads must be **12V / DC**. **Not 240V / AC**

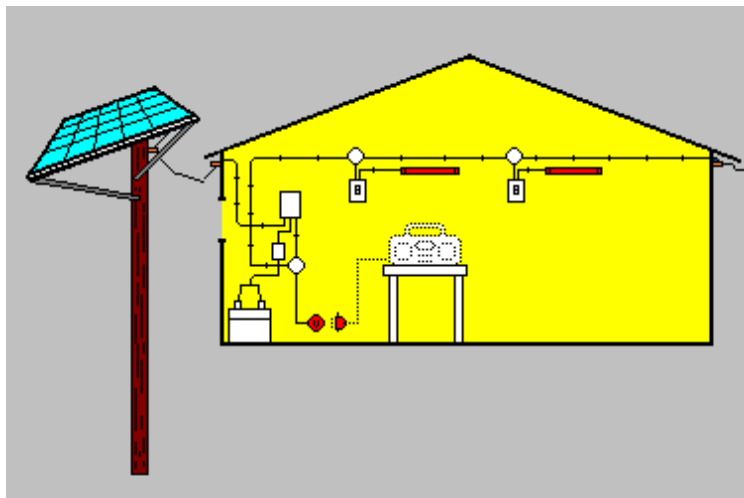
**Connect plug properly :**

**Use supplied plug & DC-DC Adapter only**

- 1. Bulbs to be clean**
- 2. Broken bulbs to be replaced**
- 3. In case of replacement of the lights and purchase of Radio / TV, ask Operator's advices for specification to purchase**



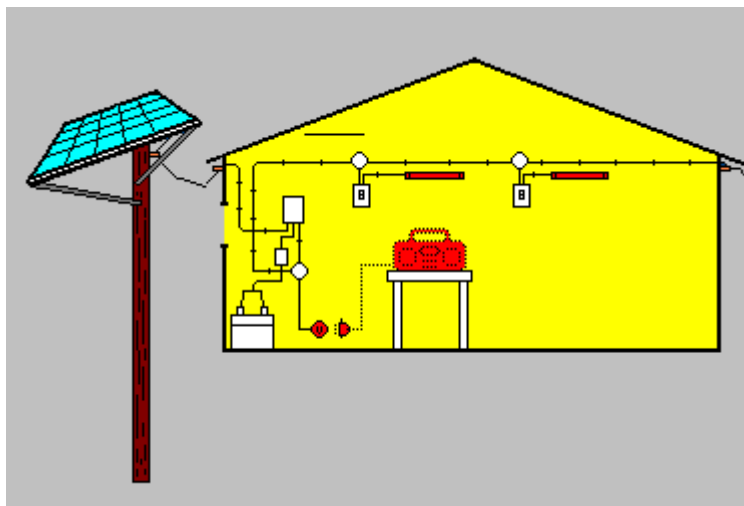
# Load Pattern



## Light

### Daily Use

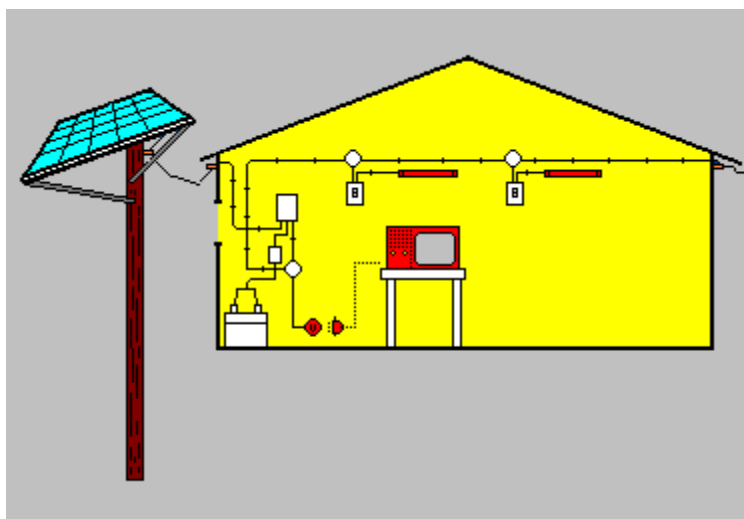
- One Light : 7 hours
- Two Lights : 4 + 3 hours
- Tree Lights : 3+2+2 hours



## Light + Radio

### Daily Use

- Two Lights : 3 + 2 hours
- Radio : 2 hours



## Light + B/W TV

### Daily Use

- Two Lights : 3 + 2 hours
- B/W TV : 1 hour

## General Rule for Users

- **Careful & Appropriate Manners for daily use**
- **Payment duty**
  - **Initial payment    Bs 700 / Total**
  - **Monthly charge    Bs 22 or 30/ Month**

### Do

- **Keep using PV System all the year in the same level of use (Battery must be charged constantly)**
- **Observe liquid level on the battery indication**
- **Keep the hours in use along to the following table**

LIGHT : 15 W  
 RADIO : 15 W / Max. 2 hrs  
 B/W TV: 20 W / Max. 1 hr.

### Pattern of Loads Use

LOADS USE	LIGHTS			LIGHT+RADIO	LIGHT+TV
	ONE	TWO	THREE		
POWER (W)	15	15+15	15+15+15	15+15+15	15+15+20
USE (hours)	7	4+3	3+2+2	3+2+2	3+2+1
TOTAL (Wh)	105	105	105	105	95

- **Using loads too much may cause inconvenience of load disconnected by controller at any time.**
- **Report the trouble to Technical staff and Chief of Community to inform to Operator**

## **Do not**

- **Do not touch and move anything except lights and switches**
- **Do not let children go closer to the battery**
- **Do not touch anything especially in case of trouble**
- **Do not come close to any part of the total system in case of the thunder lighting**

## **Punishment**

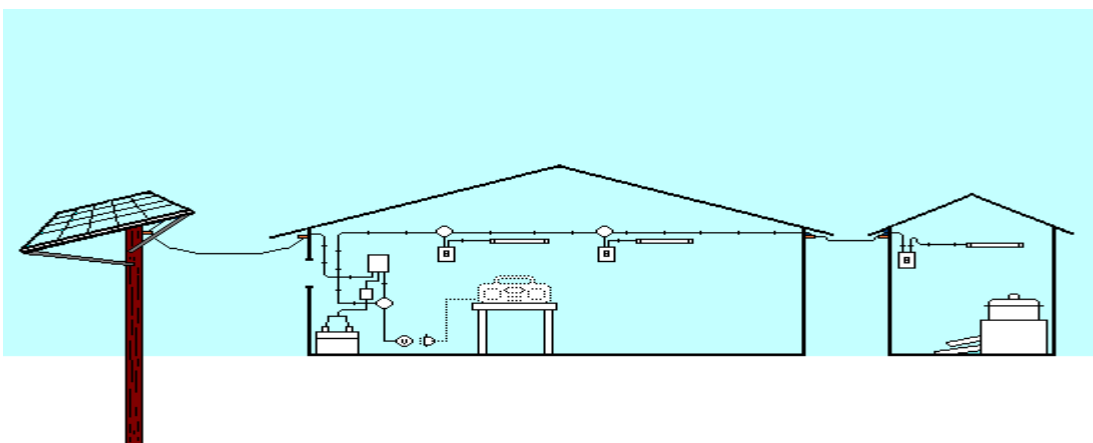
- **To remove the PV System in case of inappropriate Use**

## **System Transfer**

- **The system to be removed on the Prefecture's responsibility with Grid line connected**

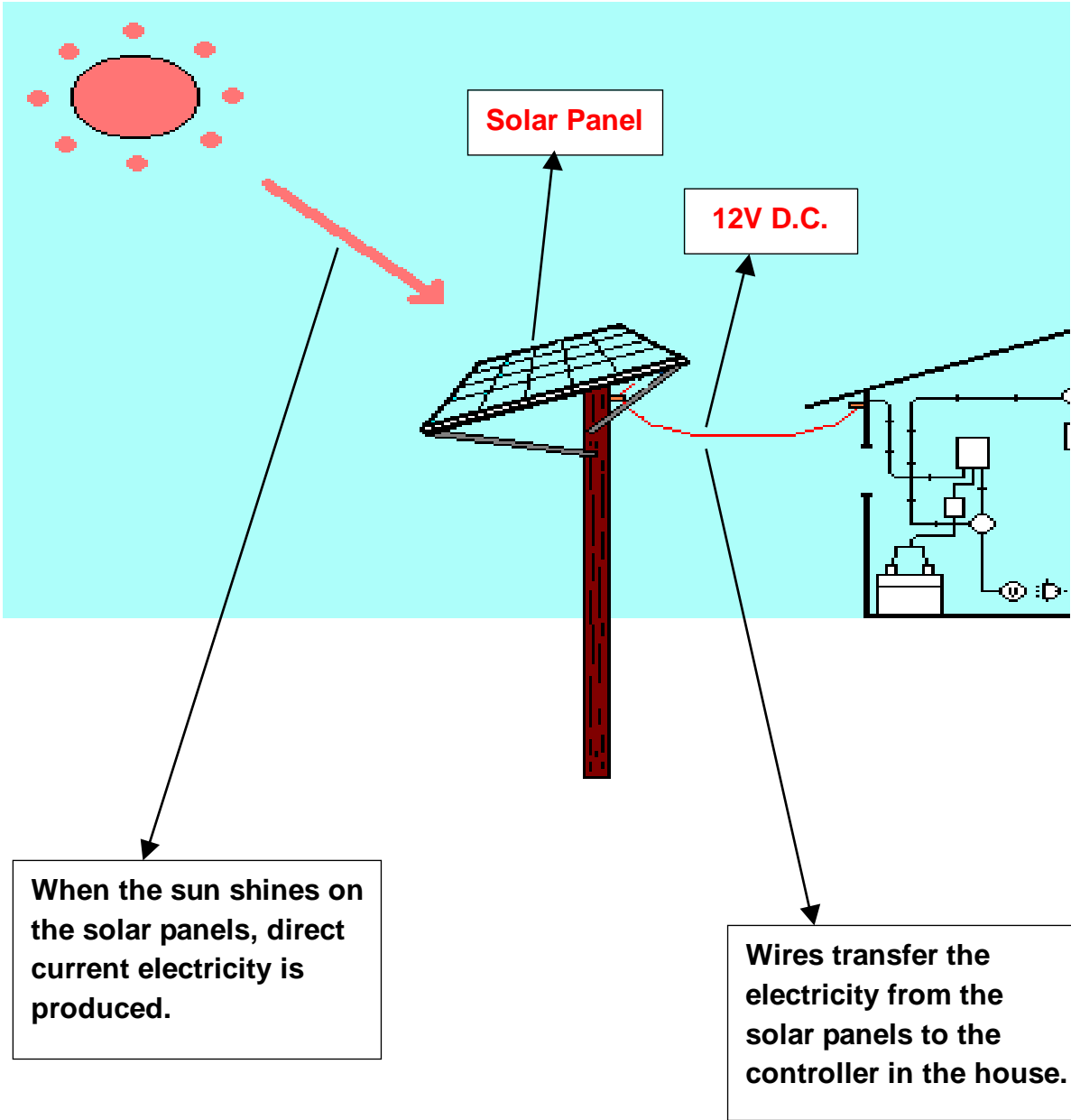
JAPAN INTERNATIONAL COOPERATION AGENCY  
THE STUDY  
ON  
RURAL ELECTRIFICATION IMPLEMENTATION  
PLAN BY RENEWABLE ENERGY  
IN  
THE REPUBLIC OF BOLIVIA

ソーラー・ホーム・システムのための  
維持管理マニュアル

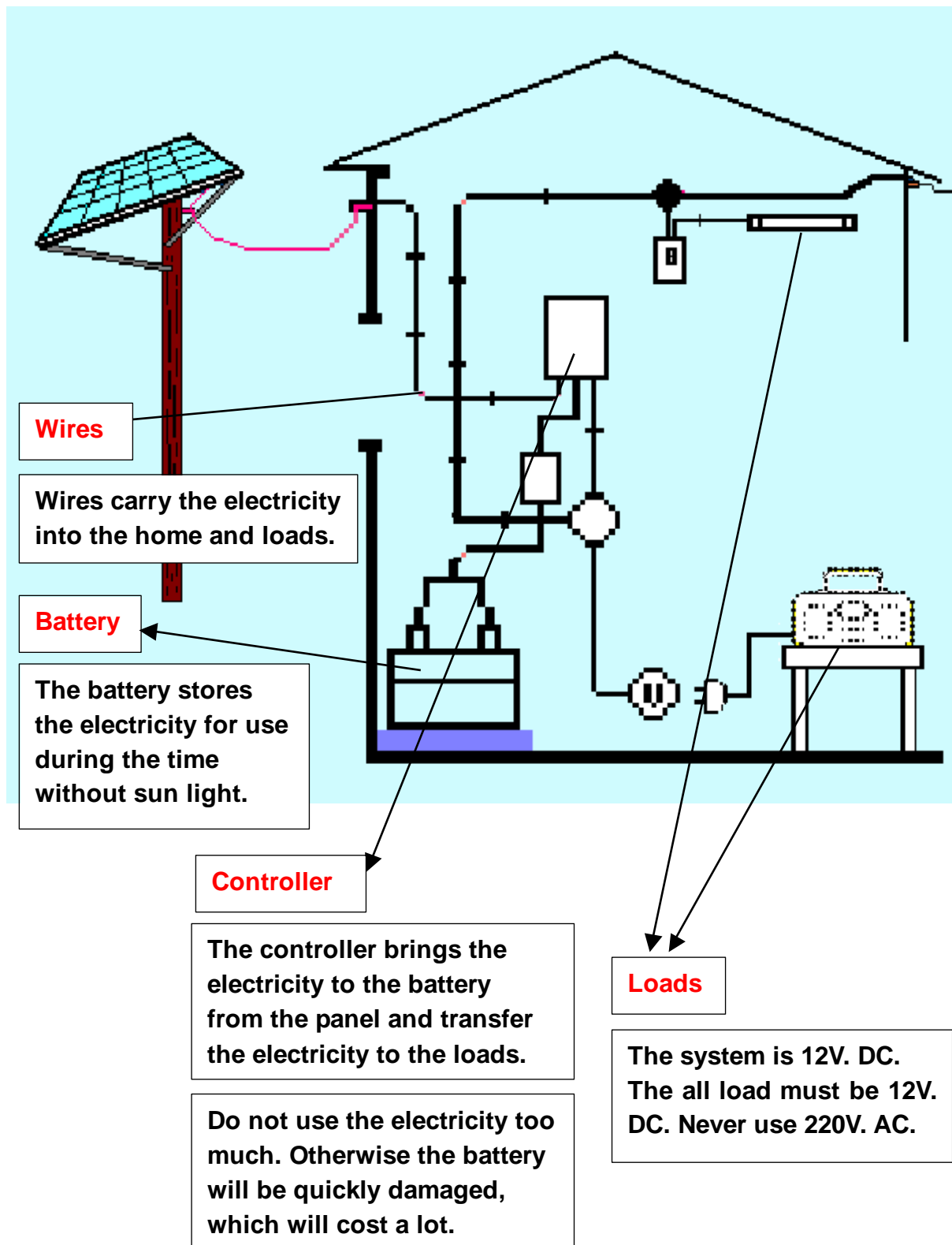


Revised on June 10th 2000

# Solar Electric Power



# Functions of main appliances



# Maintenance Schedule

## **Weekly : By Users**

- Observe battery water level

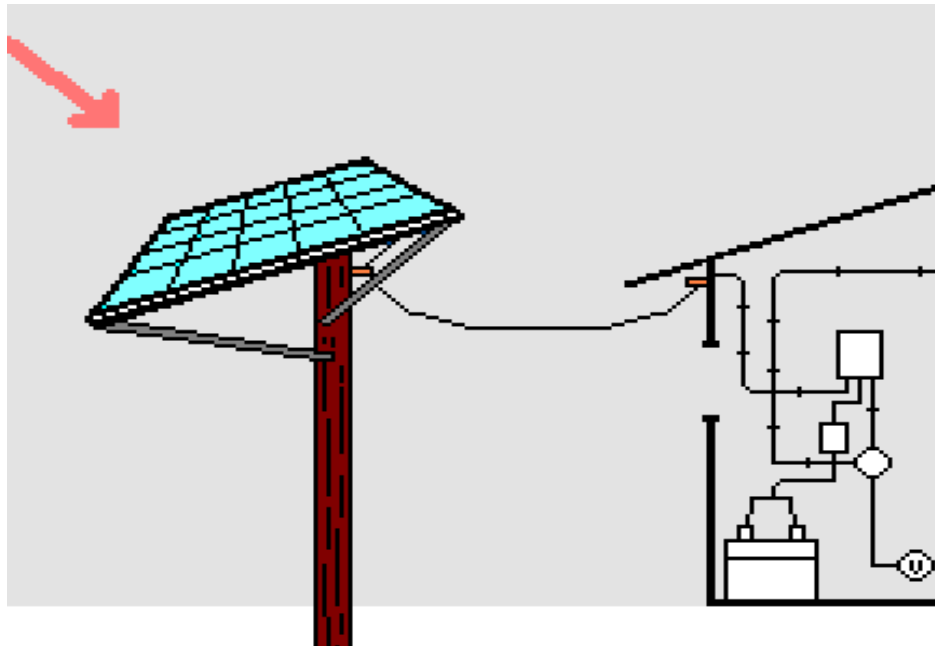
## **Monthly :**

- Wipe bulbs with dry cloth
- Inspect panel for broken
- Wash panel surface
- Check and add water to the battery electrolyte
- Wipe top of battery
- Equalize batteries in case that Specific Gravity difference seen between cells
- Inspect controller for proper light indication

## **Annually :**

- Check array wiring for physical damage, mounting hardware for tightness
- Inspect wiring for poor connections
- Inspect battery terminals for corrosion. Clean and put grease as needed

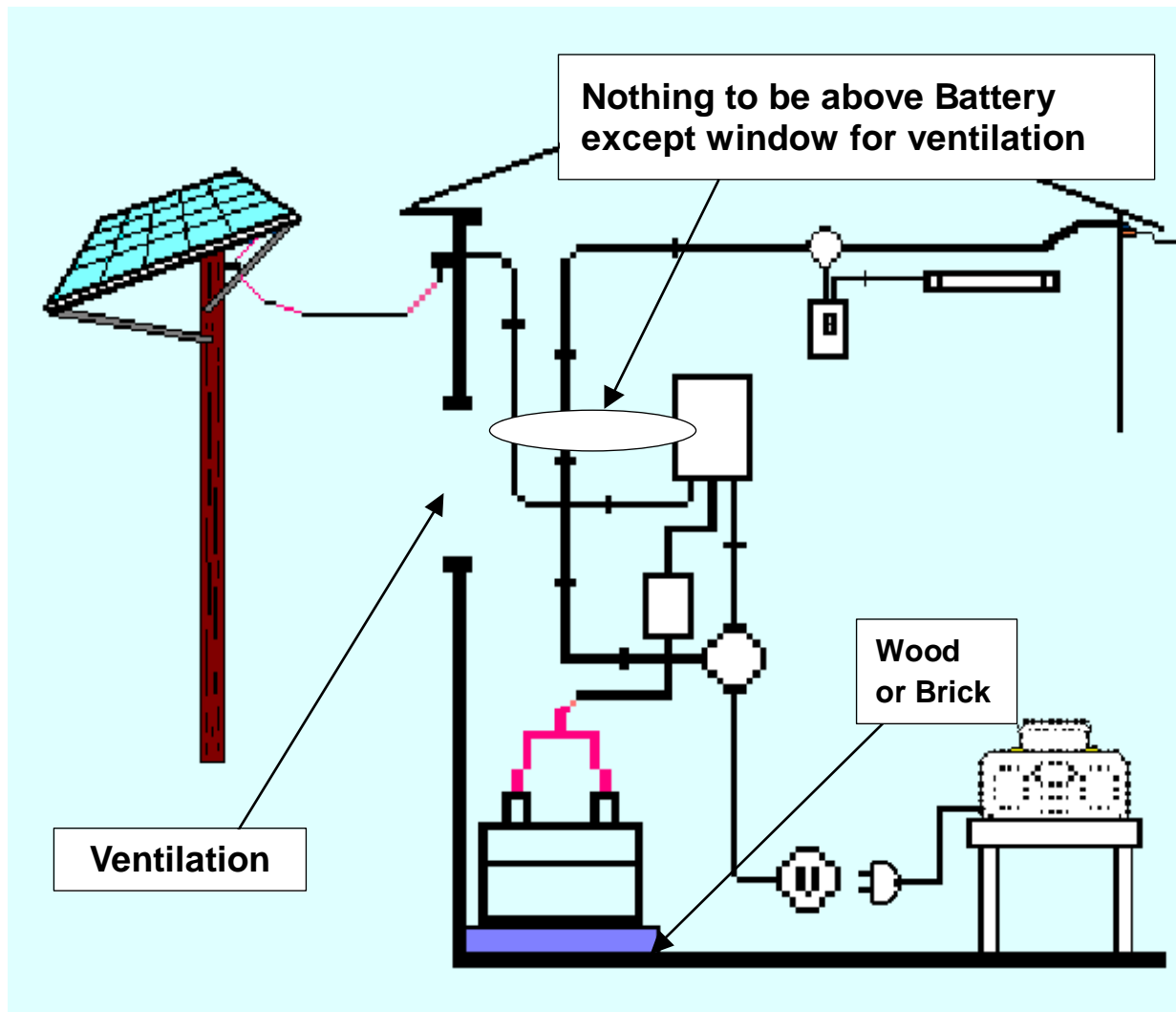
# Solar Panel



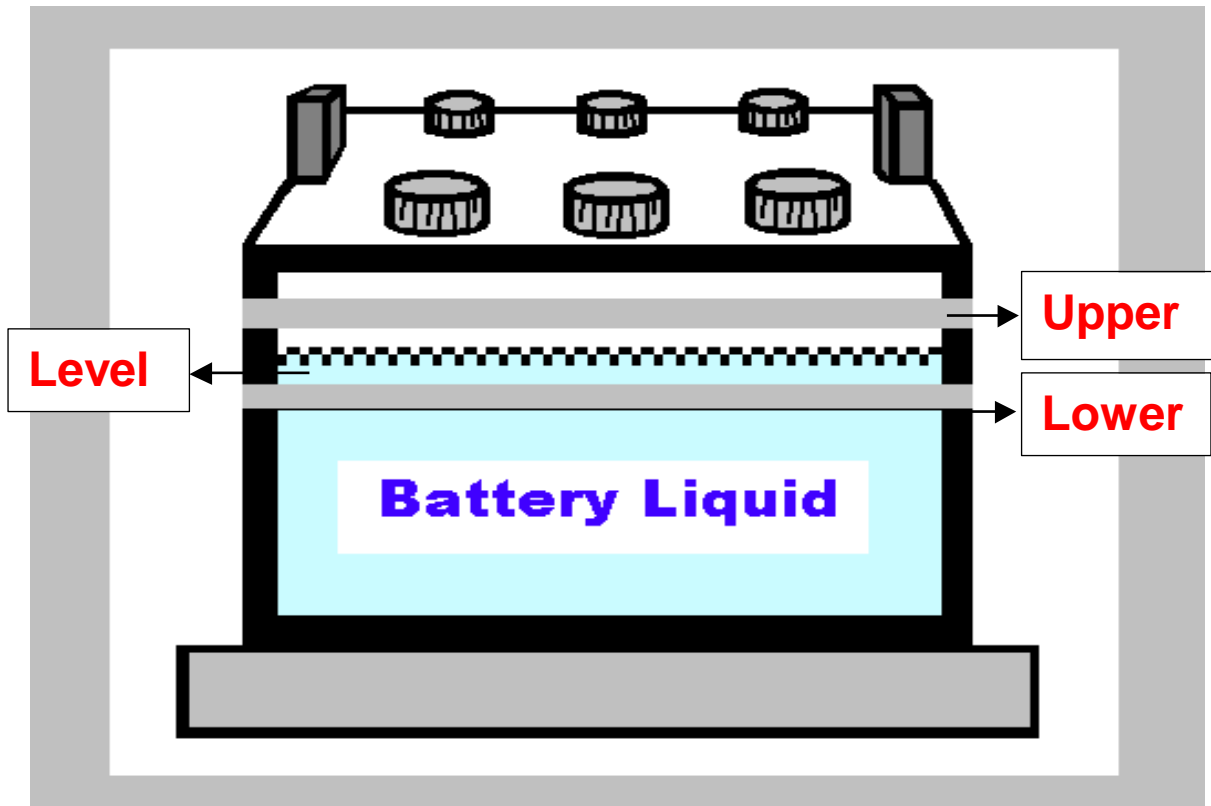
1. Check the glass on the PV is not broken
2. Wash module surface as needed using soft cloth and pure water
  - Clean in early morning or evening when the sun is below the horizon
3. Check that all bolts are secure and that the structure is well attached to pole
4. Examine all wiring connection for corrosion or looseness
  - Clean and tighten
5. Check that junction boxes are covered
6. Inspect module for cells condition



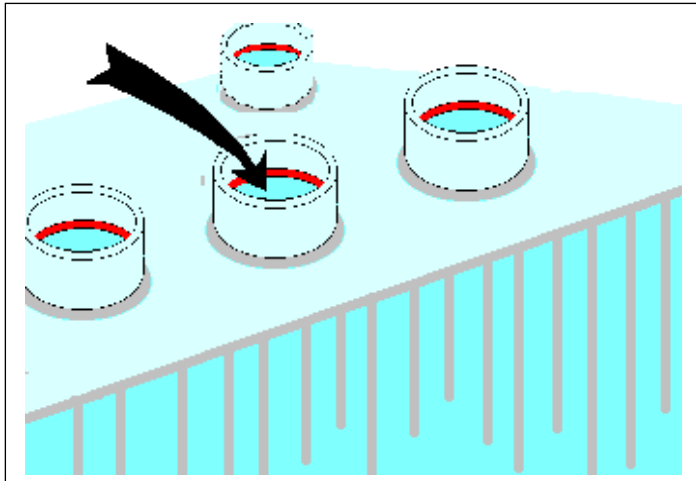
# Battery



1. Check the base to be under the battery. If not, tell and assist users to fix wood or brick
2. Make sure nothing to be above the battery
3. Check the ventilation function above the battery



4. Check the level of electrolyte
  - The level should be between two lines
  - Switch off all load in case of the level below the low line
5. Inspect terminals for corrosion and loosened cable connections
6. Clean and tighten as necessary



### **Caution**

- Do not get liquid on clothes, skin or eyes
- Wash any exposed skin or eyes with water for at least 10 minutes and see a doctor
- Do not wear metallic jewelry
- Do not sparks
- Do not bring burning materials (including cigarettes)

#### **7. Check battery every month**

- Select a calm day to prevent dust getting into battery
- Time is late morning on a sunny day

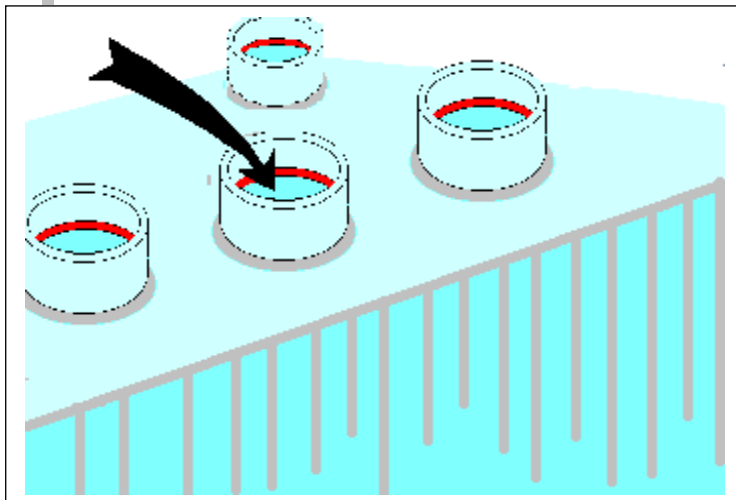
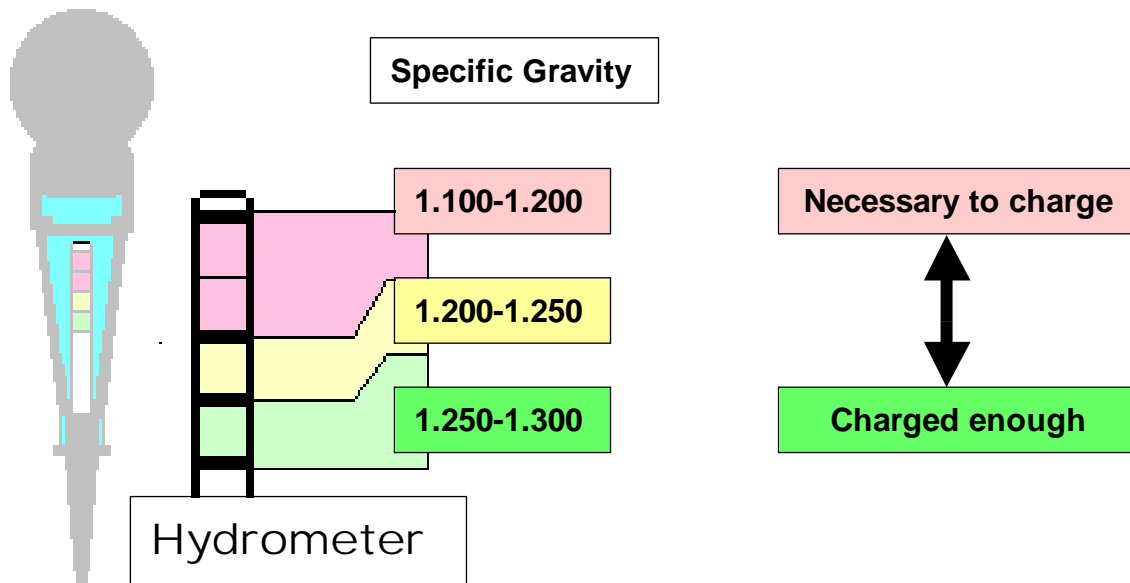
#### **8. Battery must be serviced only after charging and the acid inside is bubbling**

- Wear gloves & eye protector
- Turn off breaker
- Carefully remove battery cap

#### **9. Add the distilled water to the cells as needed**

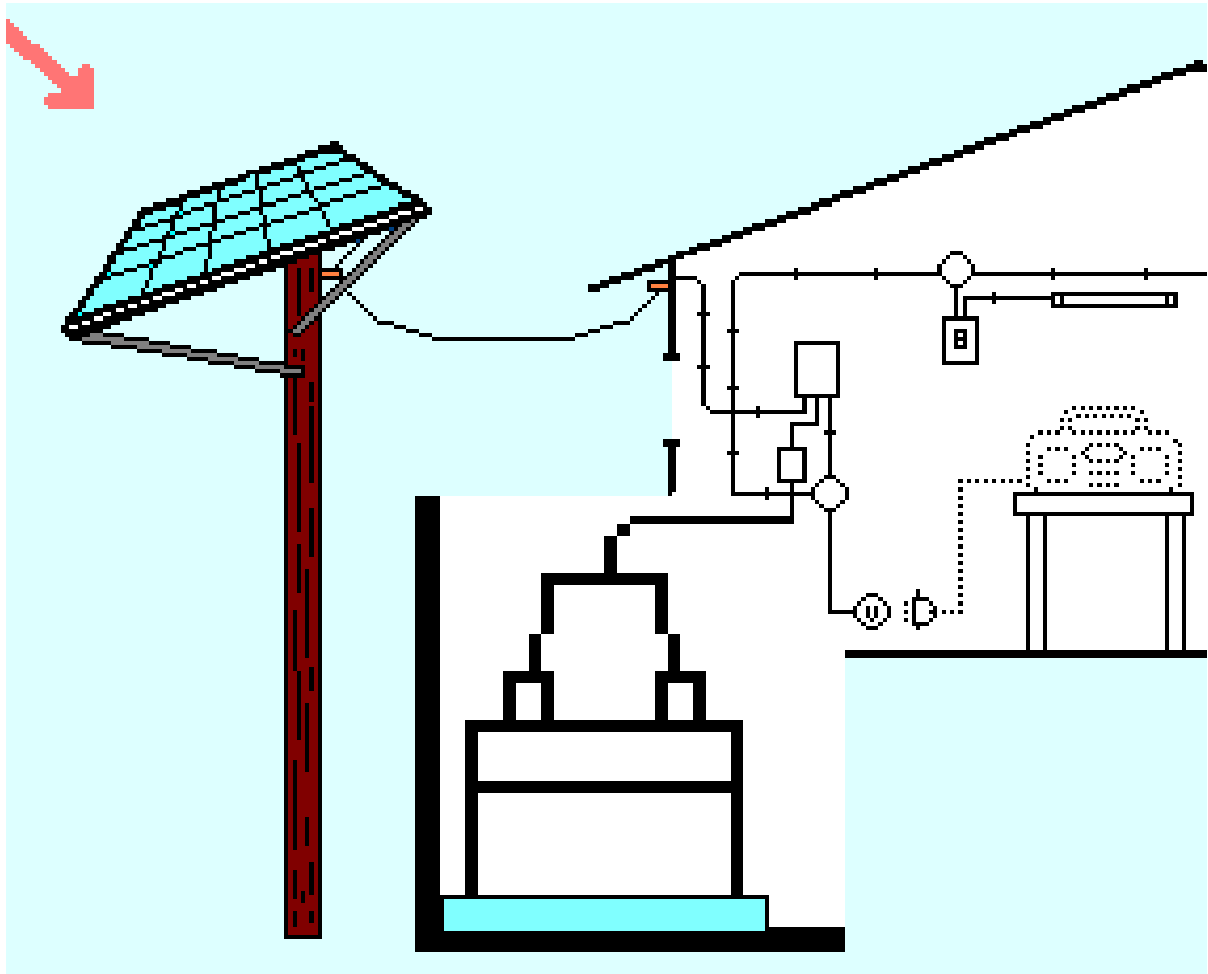
- Filling up to the inside ring marked in red above
- Use distilled water only
- Replace battery cap

#### **10. After filling the water anti-oxidant grease to expose wire and terminals**



### 11. Measure specific gravity of all cells using hydrometer

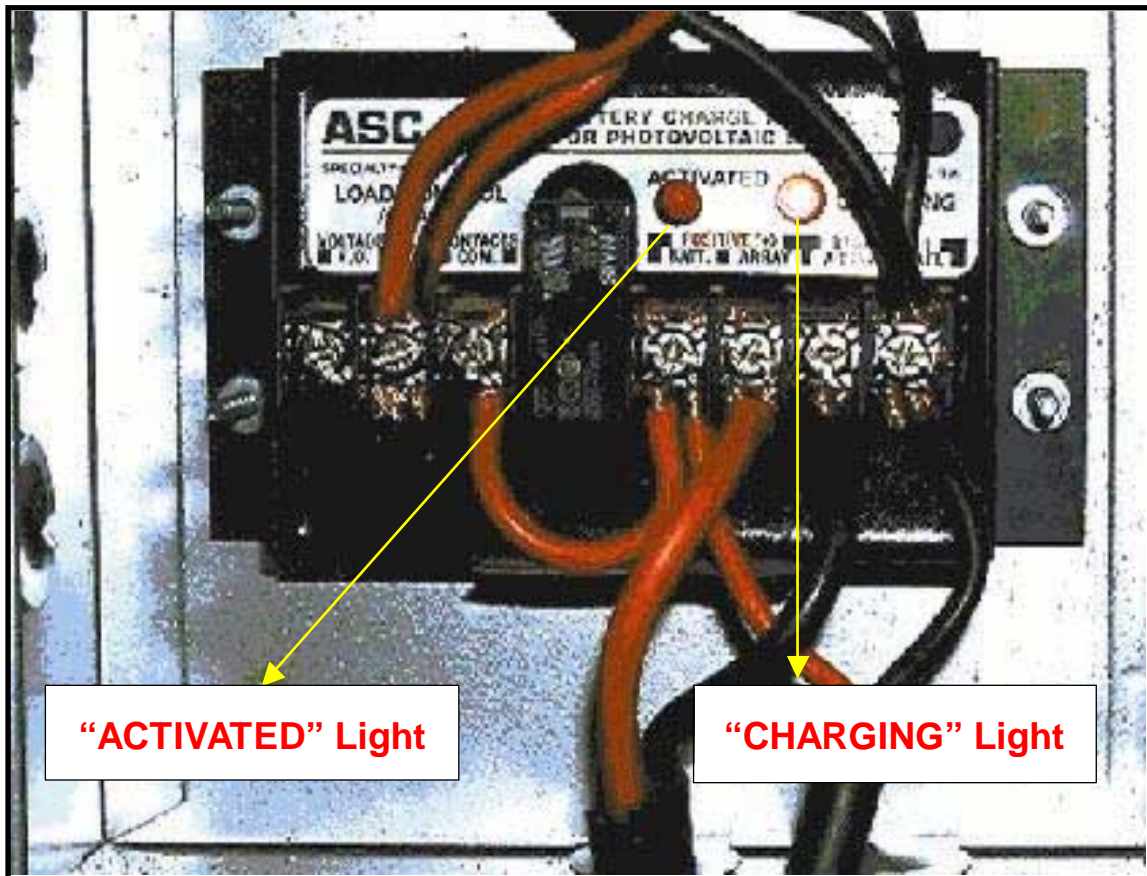
- **Specific Gravity**  
1.100-1.200 : Necessary to charged
- **Specific Gravity**  
1.250-1.300 : Charged enough
- **Equalize batteries in case that Specific Gravity difference seen between cells**



## 12. Check followings

- Never let children close to the battery
- Never keep livestock in the room
- Do not move battery
- Do not put anything on the battery
- Do not put fire nor heat near the battery
- Do not use the battery for other purposes

# Controller



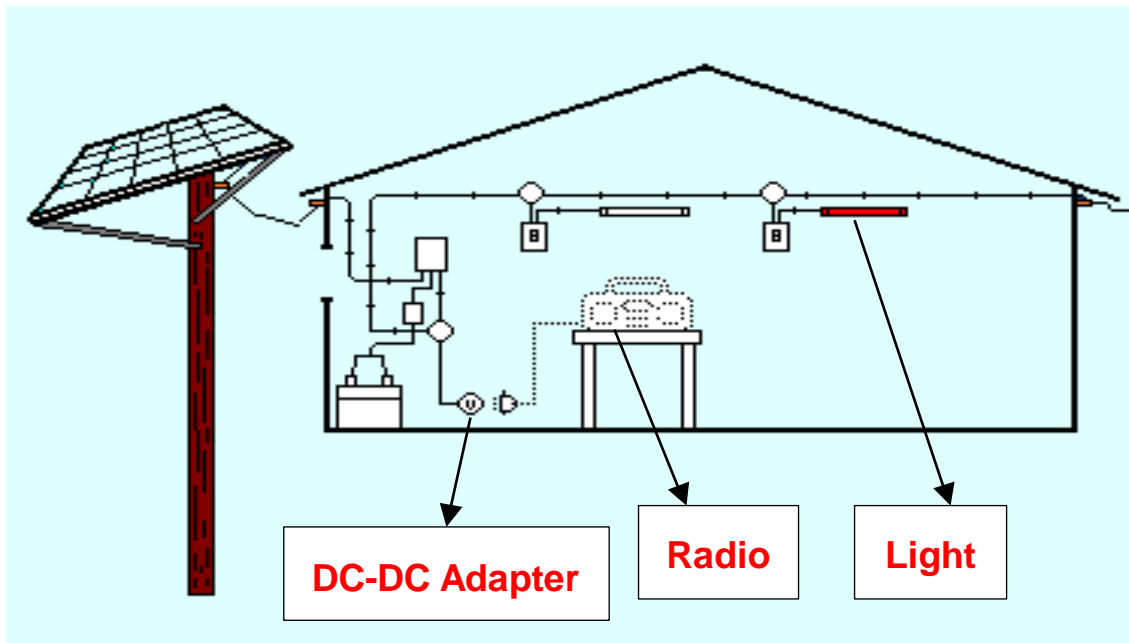
## 1. CHARGING Light

**ON :** The battery is charging  
**Check the battery is charging**

## 2. ACTIVATED Light

**ON :** The battery is at a Low Voltage  
**: Users can not use ANY LOAD at all**

## Load



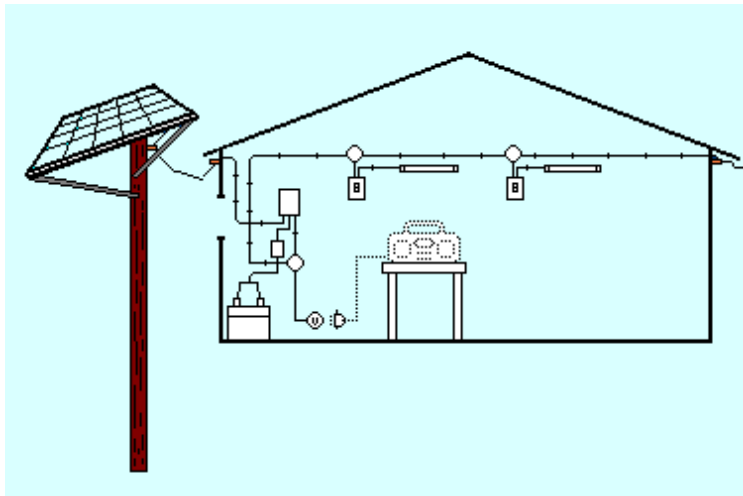
Loads must be **12V / DC**. **Not 240V / AC**

**Connect plug properly :**

**Use supplied plug & DC-DC Adapter only**

- 1. Bulbs to be clean**
- 2. Broken bulbs to be replaced**
- 3. In case of replacement of the lights and purchase of Radio / TV, ask Operator's advices for specification to purchase**

## Load Pattern ( Recommendation to users )



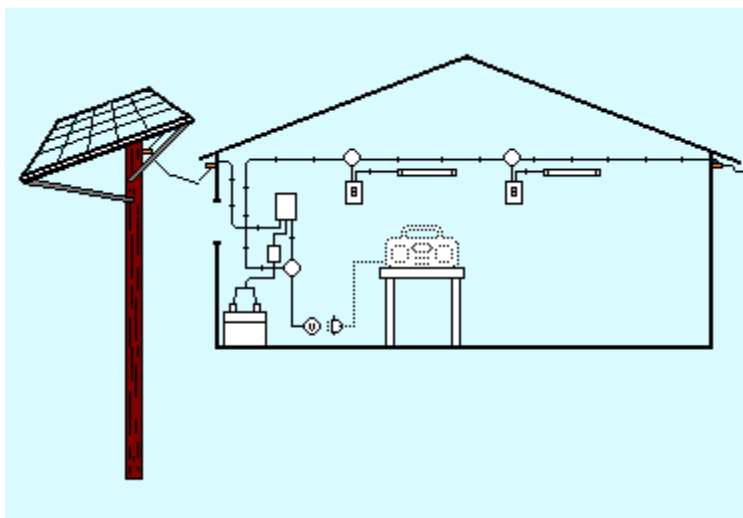
### Light

#### Daily Use

One Light : 7 hours

Two Lights : 4 + 3 hours

Tree Lights : 3+2+2 hours

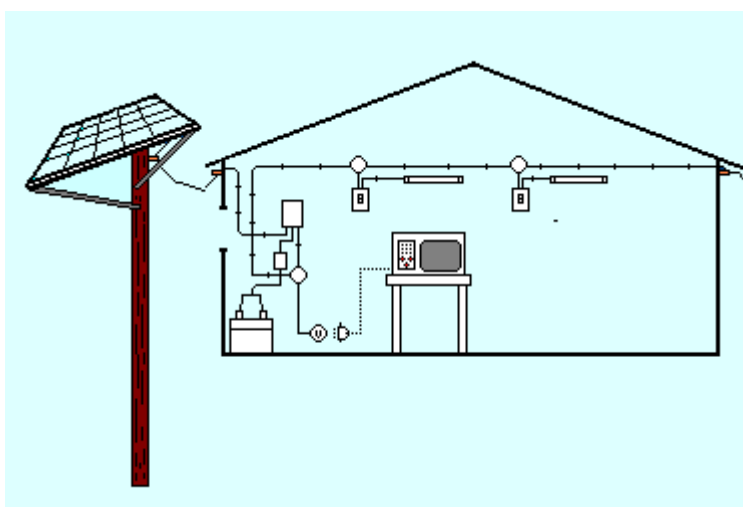


### Light + Radio

#### Daily Use

Two Lights : 3 + 2 hours

Radio : 2 hours



### Light + B/W TV

#### Daily Use

Two Lights : 3 + 2 hours

B/W TV : 1 hour



# Wiring & Fixtures

## Checking Points

- All appliances remain as the original
- Wiring connection for corrosion
- Wiring connection fastened tight
- Wire covering in normal
- Breakers function
- Switch function

## To be done

- Remove
- Clean
- Fasten
- Taping
- Repair or Replace
- Repair or Replace

## General Rule for Users

- **Careful & Appropriate Manners for daily use**
- **Payment duty**
  - **Initial payment Bs 700 / Total**
  - **Monthly charge Bs 22 or 30/ Month**

## Do

- **Keep using PV System all the year in the same level of use (Battery must be charged constantly)**
- **Observe liquid level on the battery indication**
- **Keep the hours in use along to the following table**

LIGHT : 15 W  
 RADIO : 15 W / Max. 2 hrs  
 B/W TV : 20 W / Max. 1 hr.

### Pattern of Loads Use

LOADS USE	LIGHTS			LIGHT+RADIO	LIGHT+TV
	ONE	TWO	THREE		
POWER (W)	15	15+15	15+15+15	15+15+15	15+15+20
USE (hours)	7	4+3	3+2+2	3+2+2	3+2+1
TOTAL (Wh)	105	105	105	105	95

- **Using loads too much may cause inconvenience of load disconnected by controller at any time.**
- **Report the trouble to Technical staff and Chief of Community to inform to Operator**

## **Do not**

- **Do not touch and move anything except lights and switches**
- **Do not let children go closer to the battery**
- **Do not touch anything especially in case of trouble**
- **Do not come close to any part of the total system in case of the thunder lighting**

## **Punishment**

- **To remove the PV System in case of inappropriate Use**

## **System Transfer**

- **The system to be removed on the Prefecture's responsibility with Grid line connected**

**太陽光発電システム・サービス契約書****初期投資に関する個別契約書**

Let it be clearly understood by the present Private contract that with the simple signature reconnaissance it will be able to be raised to public instrument and is subscribed **between PREFECTURA DE LA PAZ** represented by \_\_\_\_\_, who from this point will be called simply “**PREFECTURE**” and the subscriber Sr. \_\_\_\_\_ who from this point will be called “**USER**” declare and agree the following:

**FIRST.** - General Conditions of Equipment Supply. -

**PREFECTURE** will provide PV panel, pole and holder of PV panel, charge controller, battery, cable and related fixtures, which belong to the “**PREFECTURE**”, the maintenance for this equipment will be of the “**ADMINISTRATOR**” responsibility, “**PREFECTURE**” will also provide with three fluorescent lamps, cable and fixtures to be set inside the house, for which the “**USER**” will pay an “**INITIAL PAYMENT**” of Bs. 700

The items to be paid (three fluorescent lamps, cable and fixtures inside the house), belong to the “**USER**”, and the care and maintenance of them are his responsibility.

**SECOND.** - Payment conditions. -

Payment of Bs. 700 will be done by the “**USER**” to the “**PREFECTURE**”, according to the following schedule:

First Payment	on April 30, 2000	Bs. ....
Second Payment	on December 30, 2000	Bs. ....
Third Payment	on April 30, 2001	Bs. ....

**THIRD.** - Technical Assistance. -

The 55W Siemens SM55 PV System, Polarized Cable #10, the ASC Charge Regulator for PV Systems and the TOYO Battery will all be of entire responsibility of the “**ADMINISTRATOR**” regarding its maintenance. The “**USER**” will be responsible for the internal installations and must comply with the technical recommendations established by the “**ADMINISTRATOR**”.

**FOURTH.** - Payment method. -

The “**INITIAL PAYMENT**” will be carried out in national currency at the “**PREFECTURE**” office or at the account available for such purpose.

**FIFTH.** - Responsibilities. -

The “**ADMINISTRATOR**” will not assume any responsibility for the internal installations of the “**USER**”, and if the “**USER**” performs alterations or defective connections that can cause harm to the equipment that is responsibility of the “**ADMINISTRATOR**” he will be able to remove the equipment definitely from the household and will impose fines and sanctions established according to the law.

**SIXTH.** - Payment delay. -

If the “**USER**” doesn't pay, within 30 days of date, it will be in Delay without requirement by part of the “**ADMINISTRATOR**” and he will suspend the electrical energy supply without notice, removing at once the installations with all its accessories, which will remain to the disposition of the “**ADMINISTRATOR**” to be installed in other household that can comply with the acquired obligations, and will be able to initiate legal action for the debt, by the coercive way.

**SEVENTH.** - Validity. -

The present contract will come into force from the subscription date, being the “**USER**” able to demand the cancellation of the contract with an official notice to the “**PREFECTURE**” with at least one month of anticipation, leaving the “**PREFECTURE**” free of the obligation to reestablish the service again.

**EIGHTH** -Acceptation. -

As a signal of acceptance of all the clauses stipulated in this contract; we sign as the representatives authorized from the “**PREFECTURE**” and the “**USER**”.

**Prov. Aroma Dpto. La Paz, September 14, 1999**

**EMPRESA DE LUZ Y FUERZA AROMA  
PV SYSTEM SERVICE CONTRACT**

User..... Tariff.....RESIDENTIAL ACCOUNT.....  
ID..... Telephone.....  
Address.....

.....RESIDENTIAL.....  
Energy Usage

.....  
“**USER**”

.....  
**PREFECTURE REPRESENTATIVE**

**太陽光発電システム・サービス契約書**

**電気料金に関する個別契約書**

Let it be clearly understood by the present Private contract that with the simple signature reconnaissance it will be able to be raised to public instrument and is subscribed **between EMPRESA DE LUZ Y FUERZA AROMA S.A.** represented by its General Manager Ing. Lutgardo Alvarez Garay, who from this point will be called simply **“ADMINISTRATOR”** and the subscriber Sr. \_\_\_\_\_ who from this point will be called **“USER”** declare and agree the following:

**FIRST.** - General Conditions of Energy Supply. -

The **“ADMINISTRATOR”** will take care of all maintenance works on the PV system that supplies electrical energy at the **“USER”** point of consumption, which is enabled for such purpose. The energy supply will be 12V continuous current.

The energy supply will be continuous, except when power down occurs for reasons beyond of the **“ADMINISTRATOR”**s control, or when the **“ADMINISTRATOR”** considers that it is necessary to perform operations, maintenance or replacements in the installations.

The Power that is available to the **“USER”** is limited to three 15W lamps, one power outlet for a TV and/or radio, having the user to economize the energy when it is unnecessary. Before connecting any additional load to the PV System, the **“USER”** will have to consult the **“ADMINISTRATOR”** and it will be approved if there is enough power available from the system.

**SECOND.** - Limitations. -

The service under this category, is destined to users of residential type for PV Systems.

**THIRD.** -Measurement. -

The energy consumption is limited solely by the installed equipment capacity and the **“User”** shall pay a fixed tariff that is initially fixed at Bs. 30.00 (Thirty 00/100 Bolivianos.)

**FOURTH.** - Technical Assistance. -

The 55W Siemens SM55 PV System, Polarized Cable #10, the ASC Charge Regulator for PV Systems and the TOYO Battery will all be of entire responsibility of the **“ADMINISTRATOR”** regarding its maintenance. The internal installations will be responsibility of the **“USER”**, and the user must comply with the technical recommendations established by the **“ADMINISTRATOR”**.

**FIFTH.** - Tariff. -

As indicated in the third clause of the present contract, the fixed monthly tariff that the **“USER”** shall pay will be Bs. 30.00 (00/100 Bolivianos.)

This tariff can be readjusted annually according to the inflation registered in the Country.

**SIXTH.** - Payment method. -

The monthly payment will be carried out in national currency at the **“ADMINISTRATOR”** office or at the account available for such purpose.

If there is disagreement with the invoice, the **“USER”** must first pay before he can demand, establishing a 90-day period for the reception of the demand at the administrative office of the **“ADMINISTRATOR”** in Patacamaya.

**SEVENTH.** -Responsibilities. -

The **“ADMINISTRATOR”** will not be responsible for power downs of the electrical energy supply caused by fortuity reasons that are out of his control.

The **“USER”** will have to check its protection in the main feeder.

The “ADMINISTRATOR” will not assume any responsibility for the internal installations of the “USER”, and if the “USER” performs alterations or defective connections that can cause harm to the equipment that is responsibility of the “ADMINISTRATOR” he will be able to remove the equipment definitely from the household and will impose fines and sanctions established according to the law.

**EIGHTH.** - Payment delay. -

If the “USER” doesn’t pay the monthly service invoice, within 30 days of the invoice emission date, it will be in Delay without requirement by part of the “ADMINISTRATOR” and he will suspend the electrical energy supply without notice, removing at once the installations with all its accessories, which will remain to the disposition of the “ADMINISTRATOR” to be installed in other household that can comply with the acquired obligations, and will be able to initiate legal action for the debt, by the coercive way.

**NINTH.** - Validity. -

The present contract will come into force from the subscription date, being the “USER” able to demand the cancellation of the contract with an official notice to the “ADMINISTRATOR” with at least one month of anticipation, leaving the “ADMINISTRATOR” free of the obligation to reestablish the contract again.

**TENTH.** -Acceptation. -

As a signal of acceptance of all the clauses stipulated in this contract; we sign the representative authorized of the “ADMINISTRATOR” and the “USER”.

**Prov. Aroma Dpto. La Paz, September 14, 1999**

**EMPRESA DE LUZ Y FUERZA AROMA  
PV SYSTEM SERVICE CONTRACT**

User..... Tariff.....RESIDENTIAL ACCOUNT.....  
ID..... Telephone.....  
Address.....

.....RESIDENTIAL.....  
Energy Usage

.....  
“USER”

.....  
**ELFA S.A. REPRESENTATIVE**

Para JICA STUDY TEAM

FECHA: 01 / 11 / 2000

## Monitoreo para O. / Mantenimiento

MENSUAL

Hoja de Monitoreo - **Formulario A-b (REC)**

Reporte para el CER: CALTECA

Hecho por: Operador (ELFA S.A.) Nombre: Tec. Antonio Llusco

Revisado por: Prefectura (La Paz) Nombre: Ing. Carlos Lopez

### Inspeccion del Sistema y Artefactos

Problema: Adjuntar reporte detallado

<u>Sistema</u>	<u>Inspeccion</u>	<u>AGO</u>	<u>SEP</u>	<u>OCT</u>
A : FV	<u>Problema/ Inspeccion total</u>	<u>0/10</u>	<u>0/10</u>	<u>0/10</u>
B : Controlador	<u>Problema/ Inspeccion total</u>	<u>0/10</u>	<u>0/10</u>	<u>0/10</u>
C : Bateria	<u>Problema/ Inspeccion total</u>	<u>1/10</u>	<u>0/10</u>	<u>2/10</u>
D : Poste y Sujetador	<u>Problema/ Inspeccion total</u>	<u>0/10</u>	<u>0/10</u>	<u>0/10</u>
<u>Artefactos</u>				
A : Luz	<u>Problema/ Inspeccion total</u>	<u>1/10</u>	<u>0/10</u>	<u>1/10</u>
B : Luz	<u>Problema/ Inspeccion total</u>			
C : Luz	<u>Problema/ Inspeccion total</u>			
D : Radio	<u>Problema/ Inspeccion total</u>	<u>1/10</u>	<u>1/10</u>	<u>1/10</u>
E : R. Cassette	<u>Problema/ Inspeccion total</u>	<u>0/10</u>	<u>0/10</u>	<u>0/10</u>
F : B/N TV	<u>Problema/ Inspeccion total</u>			



Monitoreo para O. / Mantenimiento

MENSUAL

Reporte de Problemas – Formulario A - c

Nombre de la familia: Quispe Tola Miguel (Numero del Sistema: CL-S-007)

CER/ Canton / Comunidad: CALTECA / CALTECA / CALTECA

Revisado por: Operador (ELFA) Nombre : Tec. Antonio Llusco

Checked by: Prefecture (La Paz) Nombre : Ing. Carlos Lopez

Problema: Fecha del problema : 14 / 08 / 2000

Con el Sistema (Item : )

Con los artefactos (Item : )

Situacion	Motivo	Accion
Usual Instalation	Low level battery's water	Increase water

**Monitoreo para O. / Mantenimiento**

**MENSUAL**

**Reporte de Problemas – Formulario A - c**

Nombre de la familia: Quispe Vera Felix (Numero del Sistema: CL-S-012)

CER/ Canton / Comunidad: CALTECA / CALTECA / CALTECA

Revisado por: Operador (ELFA) Nombre : Tec. Antonio Llusco

Checked by: Prefecture (La Paz) Nombre : Ing. Carlos Lopez

Problema: Fecha del problema : 14 / 08 / 2000

Con el Sistema ( Item : \_\_\_\_\_ )

Con los artefactos ( Item : A: Luz )

Situacion

Motivo

Accion

One lamp work no good  
(on and off)

The ballast is no good

Change the ballast

**Monitoreo para O. / Mantenimiento**

**MENSUAL**

**Reporte de Problemas – Formulario A - c**

Nombre de la familia: De la Cruz Tola Juan (Numero del Sistema: CL-S-002)

CER/ Canton / Comunidad: CALTECA / CALTECA / CALTECA

Revisado por: Operador (ELFA) Nombre : Tec. Antonio Llusco

Checked by: Prefecture (La Paz) Nombre : Ing. Carlos Lopez

Problema: Fecha del problema : 24 / 10 / 2000

Con el Sistema ( Item : \_\_\_\_\_ )

Con los artefactos ( Item : A: Luz )

Situacion

Motivo

Accion

One lamp work no good  
(The unit was off)

The Lamp is no good

Change the lamp