Attachment-8
Point for daily maintenance and check sheet (Note on Maintenance)

NOTE ON MAINTENANCE

(1) Introduction

Maintenance is necessary to keep the system good condition. Maintenance can be classified roughly into two type; Periodic Maintenance and Routine Maintenance.

Routine maintenance is an operator's activity and the supplier carries out the periodic big maintenance as per the request of the customer. Generally, the routine maintenance doesn't always need the measurement of system. Basically the routine maintenance is carried out only with the visual check method. Therefore, a rough bordering for those maintenance is:

a) Routine Maintenance; Visual Inspection Only, monthly

b) Periodic Maintenance; Visual Inspection and Verification of System Through Measurement, typically semi-annually or annually (The period of execution depends on the contract between the organizer and the executor.)

A summary of maintenance activities is shown in table 8.2. Routine and Periodic Maintenance checklist are shown in figure 8.1 and 8.2, respectively. They look similar but they will have to be applied properly according to the operation policy of the organizer. Since items of maintenance mentioned below is a bit technical, the inspector needs a certain level of training and needs to be skilled. It is necessary to make users understand what the maintenance activities mean when the inspector accomplishes these maintenance activities. It is preferable for users to do simple and basic maintenance by themselves in the future.

Both routine and periodic maintenance should be accomplished in the daytime of a sunny day.

(2) Weather Condition Report

When evaluating the state of SHS, it is necessary to consider the weather condition for past few days. The more sunshine SHS gets, the more SHS provides energy.

Record the weather condition of the day and of the past few days when the maintenance is carried out.

(3) PV Module and Support Structure

1) Cleanliness of PV Module Surface

Check cleanliness of the glass surface. If the glass was dirty with dusts, sands or bird droppings, instruct users to clean up the surface. However, if it is difficult for users to prepare appropriate tool like ladder to climb the roof and clean the surface, arrange to prepare ladder for the users and leave it to Village Users Association (VUA).

2) Conditions of PV Module Glass

Check if there is no breakage or crack on the surface of PV module. In case any breakage is found, see any water infiltration into the PV module occurs or not. In dry season, the water infiltration will rarely occur. However, in rainy season, if the breakage is serious, the water infiltration will easily occur. Watch the performance of the PV module by checking open circuit voltage and short circuit current. The water infiltration will cause the short circuit inside the PV module and result in the breakage of the PV module.

3) Corrosion of PV Module Frame

Check if the frame of PV module gets any corrosion. Although every corrosion won't get the PV module damaged, a serious corrosion will result in a water infiltration into the PV module. Thus, a careful inspection is required for the corrosion.

4) Wiring Tightness

Check the tightness of wiring between the PV module and the Charge Controller. Check the tightness of the junction box of the PV module, also. In case any looseness of wiring is found, ask the technician to repair it with clips. In case any breakage of wire is found, ask the technician to replace the line.

5) Corrosion of the Support Structure

Check if the support structure gets any corrosion. A careful watch on the corrosion of support should be paid. In case any corrosion is found, brush the rust off and paint the brushing track again.

6) State of Fittings

Check the tightness of all joints of the support structure. In case any looseness of the support structure fixation is found, re-tightening up will be required. Or reinforcing the wall may be required if the wall is not resist enough for the retightening.

7) Condition of Surroundings

Check if there is any obstacles that shade on the PV module surface. When any shading obstacles are observed, the inspector should remove them. One of the largest possibilities of shading in the future is growing trees. The inspector may ask users to cut the top of tree where shades the PV module.

8) Voltage and Current Generated by PV Module

Measure the off-line voltage (open circuit voltage) and off-line current (short circuit current) generated by PV module during daytime: record those values and the time of execution. Also measure the on-line voltage of PV module. Checking those value enables to see the performance of PV module and the charge controller.

(4) Battery

1) State of Battery Body

Check cleanliness of battery body and also check if there was any breakage, any crack or any transformation on the tub or on the cell cap. Dusts deposits on the terminal may cause short circuit. If any damage on the battery is found, the battery needs replacement.

2) State of Wiring

Check the tightness of connection between the battery terminal and cable. Power Losses are often caused by the looseness of cable.

3) Terminal Cleanliness

Check the battery terminals are enough greased up. Greasing up the battery terminal protect them from corrosion. Pay attention on spilling distilled water or splash of electrolyte when pouring distilled water. When a temperature sensor for the purpose of temperature compensation of the charge controller is equipped on the battery terminal, be aware not to add too much grease. Greasing too much may cause the insensitivity of temperature capture.

4) Electrolyte Level

Check whether the electrolyte level is between the maximum and minimum level indicated on the battery tub. If the electrolyte level is too low, the sulfation may occur because lead sulfate cannot be converted back to charged material from excessive water loss (The sulfation occurs when the battery is left discharged for a long period). In order to know the water loss of the battery, recording the amount of distilled water added to the battery is useful. Although the water consumption of battery depends on the frequency and the rate of charging, the older the battery, the more water the battery consumes. Monitoring water consumption of a new battery allows determining the average water consumption of the battery. Comparing the water consumption recorded through routine maintenance with the average value helps recognizing failure of batteries. The check sheet needs revision from this point of view as well. Overfilling also should be avoided because the hot ambient temperature may cause the electrolyte to expand and overflow.

5) Terminal Voltage

Measure and record the battery terminal voltage. It is necessary to measure both on-line and off-line terminal voltage. The on-line value measured informs the condition of charge controller behavior by comparing that value with the technical information of the charge controller. The value measured off-line (open circuit terminal voltage) gives information of the battery health. If the open circuit voltage is lower than the value expected by the equation below, the battery may have problem in charging.

$$E = S + 0.84 \sim 0.85 \qquad \text{Eq (8x.1)}$$

Where,

E: Open Circuit Voltage of Each Cell at 25 degC

S: Electrolyte Density at 20 degC

It is necessary to sum up the calculated voltage with the equation 8.1 to make a reference value of open circuit voltage.

6) Electrolyte Density and Temperature

Measure and record the electrolyte density of each cell with densimeter. At the same time, measure and record the electrolyte temperature.

The value measured need to be converted according to the following equation.

$$S_{20} = S_t + \frac{7}{10000}(t - 20) \qquad \text{Eq (8.2)}$$

Where,

S_{20}: Converted Density at 20 degC

S_t: Measured Density at t degC

t: Measured Electrolyte Temperature

The value S20 should be applied to equation 8.1.

Electrolyte density is also a good parameter to see the battery state of charge.

The inspector must measure the electrolyte density after a certain time has passed because the electrolyte density measured soon after watering will not be accurate. These electrolyte density measured are inaccurate because the added water has not been properly mixed with the existing electrolyte and there will exist layers.

(5) Charge Controller

1) Fixation of Body

Check whether the housing of the charge controller is fixed tight on the wall.

2) LED Condition

Check if the LED indicator is working. LED is the major indicator to see the working condition without any measurement. When it is broken, the inspector has to check another parameters of the system condition like PV module voltage and

battery voltage, and has to spend 1 or 2 days to check how the value changes as time passes by. When the charge controller works well, those parameters of system changes appropriately. It is necessary to ask the manual by the manufacturer or the supplier in order to know the appropriate values.

3) Cable Connection

Check cables are connected tightly. Tighten up if any looseness is observed.

4) Measurement at Terminals

As described above, normally an inspector takes the on-line and off-line voltage of the PV module and the battery. Since the method and purpose has been described above, here they are omitted.

(6) Lamps

1) Cleanliness of Tubes and Body

Check whether there are any dusts deposited on the lamp surface and any insect inside the body of fluorescent lamps. There tend to be lots of insect bodies inside the cover of the fluorescent lamp. The lighting efficiency of F/L lamps would decrease because of insect bodies. Instruct users removing the bodies of insect.

2) Condition of Bulbs

Check if any blackening is observed at ends of fluorescent lamp tubes. The blackening phenomenon is commonly observed at the aged tubes. Blackening is accelerated by frequent on and off or by defective rapid start ballast. An inappropriate wiring to the lamp can also cause defectiveness of the ballast. Thus the inspector has to take an appropriate action for the phenomenon.

a) If the ballast is wrong, the ballast has to be replaced to better ones.

b) If the input voltage to the ballast is too low because of too long wiring, the cables have to be replaced thicker ones to ease the voltage drop.

As for other type of lamps, voltage drop and materials in poor quality can make the lifetime of bulbs short. The inspector has to make careful investigation when that kind of phenomenon is observed.

3) Conditions of Installation

Check if there is any damage on fixation of lamp body and cable connections.

(7) Switches

1) Contact Conditions and Fixation

Check the contact state of switches. Check also the fixation of switch boxes. Tighten up if necessary.

(8) Outlets for TV and Radio

1) Contact Conditions and Fixation

Check the wiring to the sockets. Check also the fixation of outlets. Fix or tighten up if necessary.

2) Measuring Output Voltage

Measure the voltage at the outlet to check the contact state of outlets. Detect the cause of bad contact if any.

a) Open the box of outlet and check the conductivity of the outlet inside.

b) Check the conductivity of the components of upstream

(9) Cables

1) Cable Fixation

Check whether all cable pegs are fixed tightly and properly. Check also if there is any breaking of wire. Loose cables allow users to hook something on the cable. This kind of behavior may get the cable damaged.

When any looseness of cable is observed, peg the cable up with clip in an appropriate interval (every 25 cm).

When any breaking of cable cover is observed, replace the line.

(10) Trouble Shooting

Table 8.1 shows a general problems and actions for the problem. Ask the manual by the manufacturer or by the supplier of each component for further information.

Table 8.1-1 Trouble Shooting

PROBLEM	CAUSE	HOW TO FIX
Battery voltage is too low or Electrolyte density is too low even after enough charging period	There is no solar charge	Check and fix connection to module
	Bad connection to control terminal	Check for broken wires or loose connection
	Bad Battery	Check electrolyte density of each battery cell. If there is a significant difference between battery cells, replace with new electrolyte
	Loose or corroded battery terminal	Clean and tighten battery terminals
	Dusty modules	Clean modules
	Overuse of system	Leave appliances and lamps 'OFF' for a week to allow recharging or recharge battery by other means
	Battery cannot be charged any more	Find out age and history of battery. Replace if old, or if ruined by careless use.
	Voltage drop between module and battery is too high	Check voltage drop. Replace cable with larger diameter if required.
	Defective controller	Check operation of controller with the supplier. Replace if necessary.
	Broken fuse, if there is any fuse	Replace fuse
There is no charge obtained by the PV module	Short circuit along wires to modules	Detect and repair short circuit
	Loose connection in wires connecting battery to the control	Detect and repair loose connection
	Dirty module surface	Clean module with soft clothes. Use clean water if available.
	Broken module	Check for broken cells, broken glass, or poor connection inside module. Check off-line voltage and current of the PV module. Replace the PV module if necessary.
	Broken fuse, if there is any fuse	Replace fuse

Table 8.1-2 Trouble Shooting

PROBLEM	CAUSE	HOW TO FIX
Appliances or lamps do not work Lamps	The lamp bulb may be dead	See blackening of the ends of the bulb before replacing. Replace if necessary.
	Bad connection in wire or tube	Check loose wire or loose bulb
	Switch is 'OFF'	Turn switch 'ON'
	Bulbs have very short lifetimes	Check voltage of system: too low or too high? (Voltage is always lower when load is ON)
	Bad switch contact	Check contact state of switch. Repair or replace if necessary
Appliances	Bad connection in wire	Locate broken or loose wire and repair
	Switch is 'OFF'	Turn switch 'ON'
	Bad outlet	Check connection of outlet. If bad, replace
	Appliance is broken	Try appliance with good power supply: Replace or repair
Battery consumes water at high rate	Heavy use of the system	Instruct users to manage the energy consumption
	The battery may be about to break	Check voltage drop after charging. If the voltage drops quicker than usual the battery is almost broken. Replace with the new one.
	Dry up due to high temperature	Try to relocate the battery to cool place. Avoid direct sunshine.

Table 8.2-1 Sort of Routine and Periodic Maintenance

Association		Operator		Supplier	
In-spector		Local Technician		Skilled Technician	
		Routine Maintenance (Monthly)		Big Maintenance (By Contract)	
		Inspection	ACTION	Inspection	Action
1	PV Module and Support Structures	*Visual Check* 1) Wiring 2) Cleanliness 3) Obstacles (Shading) 4) Fixation	1) Tightening up 2) Instruction or help of Cleaning for Users 3) Tightening up Whenever failures are found, the inspector will call the supplier.	*Visual Check* 1) Wiring 2) Cleanliness 3) Obstacles (Shading) 4) Fixation *Measurement* 5) Voltage on-line and off-line 6) Current on-line and off-line	1) Tightening up 2) Instruction or help of Cleaning for Users 3) Tightening up 4) and 5) Record and Verification
2	Battery	*Visual Check* 1) Electrolyte Level Measurement 2) Voltage on-line	1) Filling Distilled Water 2) Measuring voltage is option. But it is recommended to see SOC roughly.	*Visual Check* 1) Electrolyte Level **Measurement** 2) Voltage on-line and off-line 3) Electrolyte Density	1) and 2) Record and Verification 3) Filling Distilled Water
3	Charge Controller	*Visual Check* 1) LED Indicator	Will call the supplier when unusual symptoms are observed.	*Visual Check* 1) LED Indicator	The inspector should check if the controller regulates charg-ing and discharging process well.

Table 8.2-2 Sort of Routine and Periodic Maintenance

Association		Operator		Supplier	
Inspector		Local Technician		Skilled Technician	
		Routine Maintenance (Monthly)		Big Maintenance (By Contract)	
		Inspection	Action	Inspection	Action
4	Other Components and Cables	1) Visual Check of Working Condition 2) Visual Check of Wiring (Check of Unauthorized Refurbishment)	1) Will call the supplier when unusual conditions are observed. 2) Will tell users when lamp tubes are dead. 3) Will fix an easy breakage or looseness of wiring. 4) Will report the operator when an unauthorized refurbishment is observed and will warn the user	1) Visual Check of Working Condition 2) Visual Check of Wiring (Check of Unauthorized Refurbishment)	1) Will fix easy problems. Otherwise the supplier will discuss how to settle the problem with the operator. Will report the operator when an unauthorized refurbishment is observed and will discuss actions to take with the operator.

Worksheet for Routine Maintenance

Date _____ Time _____ Customer _____

			
Weather Condition			
Weather Condition of Past Few Days			

PV Module/ Support Structure

1	**Cleanliness of Surface**	Clean		bad		Instruct users to clean		
2	**Shadow on PV Module**	No-shade		shading		Remove shadings		
3	**PV Module Facing/ Tilt Angle**	Good		bad		Adjust facing/tilt		
4	Voltage on-line **(Optional)**	V	6	Current on-line **(Optional)**				A
5	Voltage off-line (Voc) **(Optional)**	V	7	Current off-line (Isc) **(Optional)**				A

Remarks

Battery

1	**Terminal Cleanliness**	Good		bad		greasing				
2	**Electrolyte Level**	Good		bad		Fill distilled water				
3	**Amount of Distilled Water Filled**		l							
4	Voltage on-line **(Optional)**	V	5	Voltage off-line (Open Circuit) **(Optional)**						V
6	Electrolyte Temperature **(Optional)**		degC							
7	Electrolyte Density **(Optional)**	b+								b-

Remarks

Charge Controller

1	**Led Condition**	Working		No-work		Investigate the cause
2	**Cable Connection**	Good		Bad		Tighten up

Remarks

Other Components

1	**Condition of F/L Lamps**	Good		Bad		Instruct users how to purchase
2	**Condition of LED Lamps**	Good		Bad		Instruct users how to purchase
3	**Condition of Switches**	Good		Bad		Arrange replacement
4	**Condition of *DC/DC* Converter**	Good		Bad		Arrange replacement
5	**Condition of Outlets for TV and Radio**	Good		Bad		Arrange replacement
6	**Condition of Fuse**	Good		Dead		Arrange replacement
7	**Wiring Condition**	Good		Bad		Arrange replacement

Remarks

Service Provided

Date Of Breakage	Symptoms
Task Achieved	

Figure 8.1 Routine Maintenance Check Sheet

Worksheet for Periodic Maintenance

Date _____ Time _____ Customer _____

			
Weather Condition			
Weather Condition of Past Few Days			

PV Module/ Support Structure

1	Cleanliness of Surface	Clean		bad		Instruct users to clean		
2	Shadow on PV Module	No-shade		shading		Remove shadings		
3	PV Module Facing/ Tilt Angle	Good		bad		Adjust facing/tilt		
4	Voltage on-line	V	6	Current on-line				A
5	Voltage off-line (Voc)	V	7	Current off-line (Isc)				A

Remarks

Battery

1	Terminal Cleanliness	Good		bad		greasing				
2	Electrolyte Level	Good		bad		Fill distilled water				
3	Amount of Distilled Water Filled				t					
4	Voltage on-line	V	5	Voltage off-line (Open Circuit)						V
6	Electrolyte Temperature				degC					
7	Electrolyte Density	b+								b-

Remarks

Charge Controller

1	Led Condition	Working		No-work		Investigate the cause	
2	Cable Connection	Good		Bad		Tighten up	

Remarks

Other Components

1	Condition of F/L Lamps	Good		Bad		Instruct users how to purchase	
2	Condition of LED Lamps	Good		Bad		Instruct users how to purchase	
3	Condition of Switches	Good		Bad		Arrange replacement	
4	Condition of DC/DC Converter	Good		Bad		Arrange replacement	
5	Condition of Outlets for TV and Radio	Good		Bad		Arrange replacement	
6	Condition of Fuse	Good		Dead		Arrange replacement	
7	Wiring Condition	Good		Bad		Arrange replacement	

Remarks

Service Provided

Date Of Breakage	Symptoms
Task Achieved	

Figure 8.2 Periodic Maintenance Check Sheet

Attachment-9
Specification sheet of PV System Components

PV Module

Brand name		
Maker		
Type		
Number of cells in series .		
Nominal power of the module (1000 w/m², 25°C AM 1.5)	.....	Wp
Vco, Open circuit Voltage	.....	V
Icc, Short circuit current	.....	A
Imax, Intensity of maximum power	.....	A
Vmax, Voltage at maximum power (25°C)	.....	V
Vmax, Voltage at maximum power (40°C)	.....	V
Vmax, Voltage at maximum power (60°C)	.....	V
I-V Characteristics		
NOCT, Nominal operation temperature of cells	.....	°C
Electrical class		
Maximum voltage accepted :		
Life span	.....	years
Period of commercial guarantee	.....	years
Structure support :		
Material		
Antitheft system		

Supply installation diagrams (for ground mounting and (roof) ? mounting

Battery

Brand name	
Type	
Structure of positive pole	
Antimony content of the plates	
Nominal voltage	V
Nominal Capacity	Ah
Structure of plates :	
C100, 100 hours discharge capacity	Ah
C20, 20 hours discharge capacity	Ah
C10, 10 hours discharge capacity	Ah
Electrolyte density	g/cl at 20°C
Electrolyte quantity per element	l/element
Operation temperature ranges	°C
Self discharge rate	month
Energy output	%
Ampere output	%
Admissible discharge rate %Cn	%
L x l x H mm dimension.	

Technical sheet of maker

Provide characteristics curves

Provide the information relating to:

- the admissible charge and discharge current

- long term performances

Charge Controller

Brand name

Reference of supplier

Nominal voltage V
Maximum current from the module..... A
Maximum current to the loads ..... A

Operation system (PWM, All or nothing, SOC algorithm)

Type of charge controller (series, shunt,)

self consumption (under any operation conditions) ..... mA

Values and role of the various voltage thresholds:
1 V
2 V
3 V
4 V

Type of protection against reverse polarity

Type of protection against excessive intensity

Type of protection against transitional excessive intensity

Temperature Compensation ..... YES NO

Coefficient of temperature compensation ..... mV / °C

Gassing starting system
Frequency ..... days

Voltage V

Life span ..... Hours

Period of commercial guarantee.

Ballast and Lamps

Brand name
Maker
Type

Ballast

Material of body
Type of connection
Marking
Power
Nominal Voltage : V
Input current ..... A
Input voltage ranges..... V
Starting voltage V
Operation temperature ranges ..... °C
Operation frequency ..... kHz
Preheating system ..... Yes No
Protection against short circuit ..... Yes No
Protection against reverse of polarity ..... Yes No
Protection contre extraction lamp..... Yes No

Lamps (Tube)

Type
Power
Output (ballast-lamp set) ..... %
Luminous efficiency ..... Lm/W
Life span ..... Hours
Period of commercial guarantee

The technical sheet and any information that is considered to be necessary is to be appended

Attachment-10
Justification of the Proposed Quality System

10.1 Evaluation of Quality Control on PV Modules

The modules have to be certified in conformity with the CEI 61215 standards or equivalent standards.

The certificates issued by international control institutes will be enough to appreciate the quality of the modules.

ASER is reserving the right to get an authorized laboratory to test certain performances of the modules.

10.2 Evaluation of the Quality Control on Batteries

If the Project promoter issues certificates of conformity to the specifications drawn by ASER, those certificate should at least include the following results, in conformity with the prescriptions of NFC58-510 standards or equivalent:

- Nominal capacity Cn in Ah;
- Designed capacity Crt (for discharge rate of 10h; 100h;
- Number of cycles correlated to the depth of discharge rating at 40% that must be equal to a minimum 400 cycles ;
- Number of cycles correlated to the depth of discharge rating at 20% that must be equal to a minimum 400 cycles ;
  - 1500 cycles for open batteries with tubular plates;
  - 900 cycles for sealed batteries fitted with valves with flat plates;
- Ampere output that must equal to a minimum 90% ;
- Resistance test on battery tubes: the tube should not show any distortion after 4 hours endurance test at 60°C;
- The life span of the batteries must exceed 200 cycles at 25°C for an average depth of discharge of 75%;

- The maximum auto discharge must be 10% per month;

In the case no conformity certificated cannot be submitted by the Project Promoter, the results of the tests conducted in the laboratory of CERER could be considered.

10.3 Evaluation of the Quality Control on Charge Controllers

If the Project Promoter issue a certificate conformity to the standards commonly accepted, that certificate should include the following minimum results:

- Nominal voltage: the nominal voltage of the charge controller must be 12(24) V ;
- The regulation mode can be either:
  - PWM, or
  - According to the state of charge.
- The life span that is estimated at 10 years needs to be confirmed;
- For reference the regulation thresholds at 20°C and the electrolyte density rate at 1.24 Kg/l will be:
  - The peak regulation voltage (protection against excessive charge) 2.30 V/element;
  - Reconnection voltage: 2.25 V/element ;
  - The lowest regulation voltage (disconnection of the loads): 1.90 V/element;
  - Reconnection voltage 2.10 V/element.
- If the charge controller is fitted with temperature compensation of the voltage at end of charge, the temperature coefficient must be comprised between –4 to 5mV/°C/element;
- If loads disconnection is temporised, the waiting time should not exceed 1 to 2 Seconds;
- When testing the level of consumption without loads, the result should not exceed 10 mA ;

- The results of the mechanical performances of the charge controller must be in conformity with the prescriptions of the CEI 60068-2-6 standards;
- The charge controller must have bioelectronics resistance corresponding to 500V;
- The charge controller must be fitted with electromagnetic immunity, in conformity with the prescriptions of the EN 55011 or CEI CISPR 11 standards.

In the silence of the evaluation of the results of the tests on charge controllers, the technical minima in Volume II of ASER's Procedure Manual will be referred.

10.4 Evaluation of the Results of the Quality Control on Electronic Ballasts

The quality of the ballast inverter is critical to the luminous performances. If the Project Promoter submits a certificate of conformity with the common standards admitted, the certificate should show the following minimum results:

- The results of mechanical resistance test must be in conformity with the prescriptions of the CEI 60068-2-6 and CEI 60068-2-27 standards ;
- The results relating to minimum security must be in conformity with the CEI 60924 standard;
- The resistance of the ballast to accidents must be in conformity with the CEI 60924 standard;
- The electromagnetic immunity of the ballast must be in conformity with the prescriptions of the EN 55013 ;55022 and CEI CISPR 13 and 22 standards.

In the silence of the prescriptions of the evaluation of the results of the quality control on electronic ballasts, the technical minima in the ASER's Procedure Manual will be referre.

Attachment –11
Check Sheets for Acceptance

Annex 3 Approval Certificate of PV Modules

	Values/Measures	Conformity	Observations/Remarks
Module	Peak capacity		
	Technology		
	Number		
	Manufacture		
	Reference		
	Aspect		
	Sealing of connection box		
	Bypass diode		
Assembly	Orientation		
	Inclination/horizontal		
	Shadowing		
Structure	Type of structure		
	Material		
	Mechanical resistance		
	Material of screw and bolt		
	Theft protection		
	Quality of fixations		
	Earthing		
Cabling	Type of cable		
	Section		
	Length		
	Proof of water dripping		
	Protection of the connection		
	Fixation of the connection		
Junction box	Number of box		
	Characteristics of diodes		
	Control of diodes		
	Sealing of box and passage of cable		
	Tightening of the connector blocks		
	Quality of the terminals		
Mesures	Voc and Icc		
	Connection 1		
	Connection 2		
	Connection 3		

Annex 4 Approval Certificate of Battery

	Values / Measures	Conformity		Remarks/Observations
Type	Type of battery Manufacturer			
Characteristics and situation	Nominal voltage			
	Capacity par element			
	Number of element			
	Situation of connections			
	Level of electrolyte			
	Visibility of level			
	Existence of deposits in the vat			
	Marking			
Measures	Voltage and specific gravity of Each element	**Volt**	**Dens.**	**Temperature:**
Accessories	Existence of hydrometer			
	Existence of thermometer			
Location of battery	Location and access			
	Type of battery box			
	Ventilation of battery box			

Annex 5 Procedure of the Pre-charging of Batteries

The pre-charging of batteries must be done according to the following procedure.

(1) Preparation of Battery

1) Measure the electrolyte density
2) Fill the batteries up to the low level marking
3) At least two hours wait after filling up electrolyte
4) Adjust the electrolyte at its nominal level, if necessary
5) Measure battery voltage
6) Measure density of electrolyte
7) Measure temperature of electrolyte
8) If the temperature of the electrolyte is higher than 55°C or if its density drops down to 1.20 kg/l, postpone pre-charging until the following day.

(2) Charging

The charging source shall not be connected to charge control apparatus to avoid early stop of charging. The battery should be connected directly to the module or to a generator.
The battery shall be charged as follows:

1) Constant current should be used in the first stage till the gassing, if possible
2) After this stage, the value of the current will be reduced to nearly 2.5A
3) In case the above procedure cannot be respected, the battery will be charged during 24 hours
4) Measure voltage, and electrolyte density every 30 minutes after gassing starts
5) It is considered that the battery is full charged;
   a) During constant current charging, when voltage and electrolyte density do not show any variations higher than the accuracy of the measuring instrument for duration of two hours and considering the variations of temperature of the electrolyte;
   b) During constant voltage charging, when the recorded current and electrolyte density don't show any variations higher than the accuracy of the measuring instrument for duration of 2 hours, considering the

electrolyte temperature variations, except for when maker provides a specifics.

6) The measured peaks shall be recorded in an appropriate form. The gap between the measured peaks should not exceed 0,005V for the voltage and 0,01kg/l for the density by each cell.

7) At the end of the charging process, the level of electrolyte must be adjusted at the maximum mark of each cell.

Consign Preliminary Charge of the Batteries

Date: **Site:** **Type of the system:** **Type of the source for charging :** · PV generator : · Other sources :			
Density of the électrolyte before filling : **Current during the charge:** **Time start of charge :** **Time finish of charge :** **Date start of charge :** **Date finish of charge :**			
Density of 2hr after filling tension : V Temperature : °C	**Density par element**	**Value**	**Observations**
	element 1.		
	element 2.		
	element 3.		
	element 4.		
	element 5.		
	element 6.		
2hr after finish of initial charge : Tension : V Température : °C	**Density par element**		
	element 1.		
	element 2.		
	element 3.		
	element 4.		
	element 5.		
	element 6.		

Annex 6 Approval Certificate of the ChargeCcontroller

	Information	Values/Measure	Conformity	Remarks/ Observations
Place of installation	- Location and access - Visibility - Ventilation of the box			
Type	- Manufacturer - Reference: - Nominal voltage - Series number - Type of controle - Location of the connector block			
Charge control	- Maximum admissible current - - Cut-off voltage - Reconnection voltage - Existence of indicator for high cut-off			
Discharge control	- Maximum admissible current - Limitation voltage - Existence of indicator for low limit cut-off - Existence of alarm for approach to low limit			
Visualizations	- Measure for module current - Measure for load current - Measure for battery voltage - Measure for generated Ah - Measure for consumed Ah			
Measures	- Voltage of PV module - Voltage of battery voltage - Voltage of load			
Remarks				

Annex7 Reception of Internal Installations

USAR: .....

DATE: .....

Spécifications	Values/Measures	Conformity	Remarks/ Observations
Cables · Type · Section · Installation · Alignment · General situation · Distance of connection box · Connections · Positions of fasteners			
Switches · Type · Installation · Position · Connections			
Outlet · Type · Installation · Position			
Luminaries · Type · Capacity · Installation · Position			
General situation			

Annex 8 : Contents of the Monitoring Sheet of Maintenance

DATE OF THE INTERVENTION _____

NAME OF USER _____ NAME OF TECHNICIAN _____

PV MODULE and SUPPORT	CLEANLINESS OF SURFACE						COVER GLASS					
	good		bad		To be cleaned		good		bad		to be replaced	
	TALLY RUST						LOOSENESS OF THE FIXING OF THE CABLES					
	good		bad		To be cleaned		good		bad		To be tightened	
	PV VOLTAGE V		temps :				MODULE CURRENT A		temps :			
	IRRADIATION W/m²											
	SUPPORT RUST						SITUATION OF INSTALLATIONS					
	good		bad		To be cleaned		good		bad		To be fixed	
	REMARKS											
BATTERY	STATE OF THE CONTAINER OF BATTERY						SITUATION OF CABLE					
	good		bad		To be cleaned		good		bad		To be tightened	
	CLEANLINESS OF THE TERMINALS						LEVEL OF THE ELECTROLYTE					
	good		bad		To be cleaned / greasing		good		bad		Refill the distilled water	
	VOLTAGE BETWEEN TERMINALS V						TEMPERATURE OF THE ELECTROLYTE °C					
	DENSITYOF THE ELECTROLYTE	cell 1 kg/l		cell 2 kg/l		cell 3 kg/l		cell 4 kg/l		cell 5 kg/l		cell 6 kg/l
	REMARKS											
CHARGE CONTROLER	CLEANLINESS OF THE APPARATUS						FIXATION OF THE APPARATUS					
	good		bad		To be cleaned		good		bad		To be tightened	
	SITUATION OF THE LED						CONNECTION OF THE CABLE					
	good		bad		To be replaced		good		bad		To be tightened	
	REMARKS											

Attachment-12

Format of Annual Report Date of issue

Name of project					
Name of concession					
Name of project promoter/operator					
1. Situation of system operation					
1.1 Number of working system					
Capacity of system (Wp)	Number at initial	Number of installed	Number of damaged	Number of operation at end	
Total					
1.2 Situation of maintenance work					
Number of local technician					
Number of visit per year to users system					
Maintenance work of local technician					
1.3 Number of renewed system components					
Name of component	Number of renewal	Average life of renewed components	Remarks		
PV module					
Battery					
Charge controller					
FL inverter					
Others					
1.4 Use of electric appliances by sample family					
User A	Lamps	Radio	Radio cassett	TV B/W	TV color
Number					
Capacity					
Use hours/day					
System capacity					
User B	Lamps	Radio	Radio cassett	TV B/W	TV color
Number					
Capacity					
Use hours/day					
System capacity					

User C	Lamps	Radio	Radio cassett	TV B/W	TV color
Number					
Capacity					
Use hours/day					
System capacity					
1.5 Training of local technician					
Contents of training					
1.6 Education of users					
Contents of education					
2. Main causes of system failure and counter measures of repair for them					
Causes of failure					
Counter measure					
Causes of failure					
Counter measure					
Causes of failure					
Counter measure					
Causes of failure					
Counter measure					
3. Personnel to be engaging the project operation					
Personnel	Monthly payment	Number of engaged	Share of working		
Project manager					
Accountant					
PV engineer					
Assistant					
External engineer					
Local technician					
Others					
4. Financial situation of the project					
4.1 Income		Budget	Result		
Fee collection					
Initial contribution					
Total income					

4.2 Expenses		
Renewal cost		
Management cost		
Maintenance cost		
Total expense		
4.3 Fund		
Fund for renewal of components		
5. Comment or request from users		
Comment or request		
Reply to users by project promoter/operator