第4章　政府関連機関のマニュアル

セネガルの地方電化計画については、ASER が実行機関となって PPER によるコンセッション方式、および ERIL によるプロポーザル方式の電化計画により推進が予定されており、2000 年度にその実施のためのマニュアルが策定されて,2001 年の 3 月にはダカールにおいてマニュアルについての説明会が開催された。

そのマニュアルはコンセッション方式をベースとしてグリッドの延長や独立電源によるミニグリッドによる電化、および PV 電化も含めた地方電化推進の為のマニュアルであり,PV を特に重点的に取り扱ったものではない。

セネガルにおける新しい政策による電化計画の展開の中で PV を利用した電化の方向を予想すると、民間セクターと地方組織を母体として電化を推進しようとする ERIL 方式による電化計画に PV が採用される可能性が高い。

ここでは ERIL のプロジェクトに対する、PV による地方電化計画実施に焦点をあてたマニュアルを策定した。マニュアルはプロジェクトの事前評価およびプロジェクト実施期間中のチェックとモニタリングの 2 項目で構成されている。

ERIL プロジェクトの実行について ASER のプロセスに関する留意点

ERIL プロジェクトは地域の草の根的な組織が主導するプロジェクトであり、PPER プロジェクトのように地域全体の計画が先行するものではなく、ボトムアップにより個々に実施されるものである。ただし、パイロット・プロジェクトの経験からも、民間セクターの信頼できるサプライヤー/オペレーターは必要である。

ERIL プロジェクト推進のために、ASER は定期的に ERIL プロジェクトのプロポーザル提出の呼びかけを行うこととなっている。
提出されるプロポーザルの趣旨は：

- 地方電化を地域の主導で推進することの意思表示
- 地域の組織が民間セクターと協調し、実行が可能な、地方電化計画を準備するための支援を得ること、およびその実行に必要な資金の支援を得ること、にある。

ERIL プロジェクトには、SENELEC および PPER のコンセッション地域外で実施される、PASER に示される地方電化のすべての技術的な方法を利用したプロジェクトが含まれる。

ERIL プロジェクトとして採択されるための必要な要件

- ASER のプロジェクト提出呼びかけの範囲に含まれていること
- 提案者がプロジェクトプロモーター（上記のサプライヤー/オペレーター等）としての資格が認められており、出資能力の有ることが保証されていること
- プロジェクトに対し、その地域の組織および住民が賛成していることの証拠があること
- プロジェクトプロモーターが必要な資金負担を行うことを確約すること、などがあげられる

4.1 プロジェクトの事前評価

プロジェクトの事前評価はプロジェクトのプロモーターからASERに対して提出されるプロポーザルに対して行われる。

(1) プロポーザルに記載されるべき項目、または提出すべき資料

プロポーザルとして提出される資料には以下の事項が含まれる

- その地域における LEP(Local Electrification Plan)に関する調査結果、地方電化に関する情報や知識普及活動の内容
- プロジェクトの概要およびプロジェクトプロモーター／オペレーターの特長
- ASER またはその他の資金供給者から資金援助を得るための財務分析および資金計画、などで詳細は以下に記す。

1) プロジェクト対象地域

- プロジェクトの対象となる地域
- 対象となる地域を選定した理由

2) プロジェクトプロモーター／オペレーター

- プロジェクトプロモーターの名前／組織名
- プロジェクトプロモーターのバックグラウンド

- 組織の形態、主なメンバー、パートナーまたは株主
- 短期、および長期的な目標
- 活動の形態
- 本プロジェクトに割り当て可能な組織の要員
- プロジェクトオペレーターの名前／組織名(プロモーターと異なる場合)
- オペレーターが実施する作業内容
- オペレーターの運営能力
- オペレーターの技術的能力
- 所属要員の教育訓練目標
- PV 機器のメンテナンスやシステム設置にかかわった経験

3) LEP (Local Electrification Plan) に関する調査結果

- その地域を含む 5 万分の 1 の地図、または孤立した地域であれば都市化した地域へ到達できるまでの地図のセット。
- 対象地域の社会経済的なデーター、住民の職業、収入、支出、所有機器類等
- 利用者数の推定、および将来の展開予測
- 対象地域に存在する組織／機関
- 地域の産業、地域の開発計画、他のプロジェクトの有無
- 社会経済階層別のエネルギー需要の分類
- 供給が必要な電力についての記述
- PV システムによる電力供給が採択される理由
- その電力を供給する PV システムの概要
- Fee for service に対する電気料金制度の提案、など

4) 利用者との間で取り交わした情報や意識向上キャンペーン、交渉などに使用した資料等

これらの情報や意識向上キャンペーンの目的は

- 対象となる住民のプロジェクトに対する受容を確認する
- 対象となる住民をプロジェクトにおける電化方法、資金計画、運営方法の選択に参加させる

- 地方の組織を選択してプロジェクトに協力し参加させることにある
  対象となる住民を提案した電力供給サービスの内容を理解させ、特にその供給の限界を理解させることが目的となる。

地域コミュニティや地域組織との間で交わした PV システム導入サポートなどに関する同意書などの原案などがあれば添付する。.

5) 提供を予定するサービス内容の提案

提案されるサービスの内容は LEP の調査で得られた要求を満たしていること

- 目標とする電力需要のレベル
  需要レベルは LEP で示された社会経済階層別の需要に対応していること
- 提供する PV システム容量の範囲
  複数の異なった容量のシステムを提供することも可能であるが、最大でも 3 レベル程度が望ましい
- システム容量を設定した理由
  容量を設定した理由については技術面からと需要者の支払能力の両面から説明が必要である
- 提案された PV システム構成機器の技術的仕様
  ERIL プロジェクトで採用されるシステム構成機器について、その技術仕様は ASER のマニュアル Vol-II Technical minima に準拠する。
  主要な機器の技術仕様シートを Attachment-9 として添付する。

6) 提案されたシステム利用による環境への影響

設置されるシステムは環境に対し悪い影響を与えるものであってはならない。

プロジェクトプロモーターは環境に影響を与える恐れがある機器の回収方法についての提案を付記することが望ましい。(特にバッテリー、電子機器など)

7) プロジェクト実行計画の提案

- 普及方法の選択と選択理由
- PV システムの調達、設置、運営、保守、および料金回収方法の提案
  - PV システムの調達についてプロジェクトプロモーターは機器の受入検査の場所、方法についての提案を行う

– システムの設置についてプロジェクトプロモーターは設置計画、設置担当組織、および派遣者、設置作業記録方法の提案を行う

– 検収方法についてプロジェクトプロモーターは以下の確認を行うが、最終の検収承認は ASER が契約するコンサルタントが行うことになる

  * 使用方法が計画と同じであること
  * 提供されるサービスが計画と同じであること
  * 使用機器が計画と同じであること
  * 標準や規則に合致していること

– メンテナンスとオペレーションについてプロジェクトプロモーターは運営計画およびメンテナンスの担当者とメンテナンス記録の方法を提案する
メンテナンスには機器の通常使用による破損を修理すること、および機器の早期劣化を防止し計画した期待寿命を保持するための種々の作業が含まれる。

– 料金徴収についてプロジェクトプロモーターは次のような項目の提案を行う

  * 料金徴収方法
  * 料金収集担当者
  * 収集した料金の保管・管理方法
  * 料金の収集・管理に関する費用の説明

– プロジェクトのタイムスケジュール

8) 財務分析の結果

- 料金設定の計算
PV システムによる電気料金には

– 交換部品の費用

– 運営管理の費用

– メンテナンスの費用、が含まれる
交換部品の費用計算には部品の価格とその合理的な耐用年数が推定される必要がある。
運営管理の費用には、利用者管理費用と料金の収集および資金の運用に関する費用が含まれる
メンテナンスの費用には、現場技術者の費用、外部技術者の費用、プロジェクトオペレーター技術者の費用、予備品の費用などが含まれる

- 長期キャッシュフローの計算
  オペレーターマニュアル 3.1.16 参照、長期的に安定した運営が可能であることの証明を行う

9) 資金計画

- プロジェクト実施に必要な資金調達方法
  資金調達方法についての提案を行う。
  - 自己資金
  - 利用者の初期投資負担金
  - ASER からの補助金
  - 金融機関からの借り入れと借り入れ条件
- 補助金申請理由の説明、補助金には次のような役割がある
  - プロジェクトの初期投資必要資金の軽減
  - 利用者の電化計画への参加促進
  - 利用者の支払い可能範囲となる料金設定を実現
- 補助金申請額のレベル
  - 補助金は初期投資に対して適用し運転資金には適用しない
  - 電気料金の最高額が利用者の支払い可能レベル範囲内となるような補助金額
  - コンセッションの期間中その料金レベルを維持することにより妥当な投資利益の回収が可能となるような補助金額
- 補助金支払い時期
  プロジェクトプロモーターは補助金の支払い時期について提案を行う

(2) プロポーザルの評価

1) プロジェクト対象地域

- PV 電化地域としての妥当性

  SENELEC および PPER のコンセッションとの関係を評価する
  電化手法として PV が選択されたことの妥当性を評価する

2) プロジェクトプロモーター／オペレーター

- プロモーターの適格者
  地方の行政組織、共同組織体、地方電化オペレーター、地方開発企業体、資金供与組織、NGO などがある。オペレーターとしては、地方電化オペレーター、PV システムサプライヤー、PV エキスパート、NGO などがある。
- プロジェクトプロモーター／オペレーターの組織制度
  組織図や組織の構成などからプロモーター／オペレーターがプロジェクトの運営に適しているかどうかを評価する。
- 組織の主な活動歴
  プロモーター／オペレーターの活動分野やこれまでの活動歴がプロジェクトの運営に適しているかどうかを評価する
- プロモーター／オペレーターの経験
  プロモーター／オペレーターが PV 地方電化や、村落開発に関する経験をもっていることが望ましい
- プロジェクトマネージャーの経験
  プロジェクトマネージャーまたは中心となる要員が PV 地方電化の経験をもつことが望ましい。
- 要員の訓練、利用者の教育計画
  組織の要員の訓練計画、利用者の教育／指導計画があることが望ましい

3) LEP 調査の結果

- LEP 調査の結果がプロポーザルに反映されていること
- その地域に PV システムの導入が最適であることの説明がされていること
- これらの調査結果を ASER が準備している GIS のデータ-ベースと比較して大きな差異が無いことの確認を行う。
- その調査の結果により提案された需要や適用されるシステムについて、PV システムの能力などを考慮して妥当であることの確認を行う
- 他のプロジェクトの関係
  その地域で実施中あるいは実施が予定されているプロジェクトが有れば、そのプロジェクトとの関係が述べられていること。

4) 利用者との間で取り交わした情報や意識向上キャンペーン、交渉などに使用した資料等の確認

- 地域団体等との共同活動計画
  プロジェクトの実施に関して地域の団体等と共同活動について交渉し、地域団体の支援が受けられることが予定されているプロジェクトが望ましい。
- 地域住民または予想される利用者との交渉内容
  地域住民への説明内容と、想定利用者の選定方法が妥当であること
- 利用者との契約（導入合意書）原案
  契約案の内容をチェックして ASER が予定している電化計画の内容とずれが無いことの確認

5) 提案された提供サービスの内容

- システム容量の評価
  想定した電力需要量の妥当性確認と供給する PV システム容量算定方法のチェック、容量算定方法の前提として

− PV モジュールの効率	:	95%
− バッテリー充放電の効率	:	80%
− チャージコントローラーの効率	:	90%
− 無日照日	:	3 日間
− バッテリーの放電深度	:	40〜50%
− 日射量	:	5.5kWh/m^2/Day とすると

  たとえば以下の電気需要に対するシステム容量は：

日間電力需要量：	PV システム容量／バッテリー容量	
2 ないし 3 ランプ	100Wh／day：	30Wc/50Ah
4 ないし 5 ランプ、ラジカセ/白黒 TV	170Wh／day：	50Wc/85Ah
4 ないし 5 ランプ、ラジカセ/カラーTV	250Wh／day：	70Wc/125Ah

  程度となる
- 設置する PV システム機器の仕様の評価
  設置を予定する PV システムを構成する機器の仕様が妥当であることの評価。評価の基準は ASER マニュアル Vol-II ” Technical Minima” に記載されている。
  品質評価の詳細基準について Attachment-10 に記載した

- 調達についての評価
  調達先および購入予定価格の妥当性について評価。調達は原則として競争入札方式となるが、プロモーター／オペレーターが PV システムのサプライヤーである場合など指名調達の場合もありうる。ASER としては調達価格の妥当性を評価するために PV システム構成機器の市場価格(国内／国際とも)を常に把握しておく必要がある。

- システム機器交換プロセスの評価
  システム機器交換の時期、交換の方法、交換機器の調達、保管、交換済み機器の処理方法などをチェックする。

6) 環境影響に対する評価

- PV システムを設置することによる環境への影響を考慮しているかどうかをチェックする。参考として ASER のマニュアル Vol-II "Regles environnementales" がある。

  特に使用済みバッテリーの回収計画のチェックが必要

7) プロジェクトの実行計画

- プロジェクトの実行計画が時間的に妥当であることの確認

- プロジェクトの実行担当者／機関の確認
  PV システムの供給、設置、保守、運営、料金徴収等の担当者、または機関がはっきりと明示されており、遂行能力があると認められること

  設置されたシステムの検収を行うときのチェックリストの例を Attachment-11 に添付した

8) 財務分析

PV システムの導入が Fee for service 方式に従って行われる場合について

- 料金計算の前提
  電気を供給するための"料金"は以下の費用を回収できるものであること：

  - 機器の更新費用
  - システム運営管理費用
  - システムの保守費用、
  - 適正な利益を含む投資の回収

料金計算の前提として、初期投資、更新機器の単価、更新機器の寿命、運営管理費用、保守費用、借入金の借り入れ条件などがあるが、その妥当性をチェックする。

- 料金計算の方法

  料金計算の方法についてはいくつかの方法があるが、JICA 調査団が行った計算の方法をオペレーター向けマニュアルに示した。 (3.1.16)

  計算例として利用者 300 システムで、機器更新の耐用年数をそれぞれ、PV モジュール：20 年、チャージコントローラー：10 年、バッテリー：4 年、その他：20 年とすると 55Wp のシステムで初期投資額が 450,000CFAF／ユニットとすれば、初期費用 45,000CFAF 及び電気料金として 4500～6000CFAF／月程度となる。

- 他のプロジェクトにおける料金との比較

  他の地域で実施されている ERIL 方式での PV システム利用料金と比較して、あまり大きな差がないことが望ましい。

  提案された料金レベルは電力規制委員会（CRSE:Commission de Regulation du Secteur Electrique）によって認可される。

- 長期間のキャッシュフロー試算

  料金設定のときに計算したキャッシュフローで長期間(15 から 20 年)のプロジェクト運営が順調に出来ることを確認する。

- 持続可能性の確認

  プロジェクトの前提が崩れたとき、たとえば料金の回収率が悪くなったときでも、プロジェクトを継続するための手段が準備されているなど。

- 料金回収方法と回収した料金の管理方法

  * 料金回収方法：プロジェクトにより方法は異なるであろうが、できるだけ料金回収のために必要となる費用が少ない方法が望ましい。
  * 料金未払い者に対する罰則：料金未払い者に対する罰則(たとえば PV システムの撤去等)が明確になっていること
  * 回収料金の管理方法：回収した料金は運転管理、保守費を除くと定常的に支出されるものではないので、更新機器の購入に備えて利息がつく預金口座で管理されることが望ましい。

料金収集コストが小さくなるケースとして以下のようなシステムが考えられる。

- プロジェクトの地域で収集し、その地域で管理する
- 可能であればその地域にある金融機関に貯金する
- 機器更新の費用は別の口座として確保する

- 口座の残高は定期的に ASER に連絡される
- オペレーターは年間の財務勘定の結果を年報の付属資料として ASER に提出する

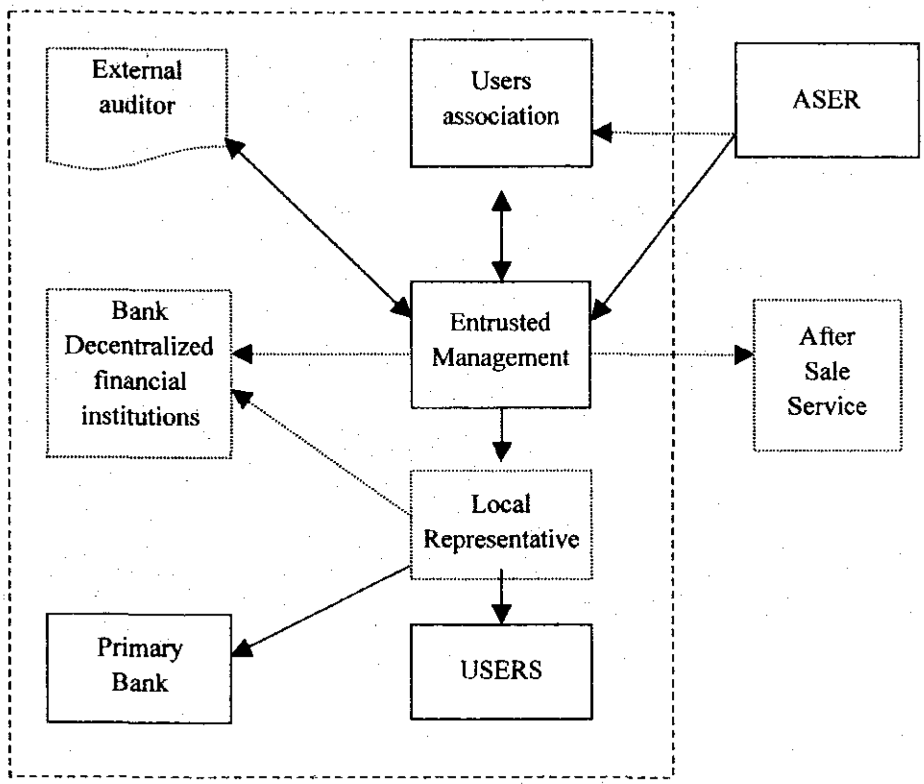

図 4.1.2-1　料金収集システムのモデル

9) 資金調達計画

- 補助金支給の要因
  - 原則として補助金は少ないことが望ましい
  - 補助金のレベルはプロジェクトの最低利益のレベルに連動する
  - 補助金のレベルはオペレーターの利益とともに利用者の収入のレベルも考慮されねばならない
  - 補助金の配分はプロジェクト実施の時期的な要因も考慮される

- 補助金支給の妥当性評価

  ＊ 補助金支給の対象：補助金は初期投資資金に対して支給し、運転資金への支給は行わない。初期投資には PV システムの運搬費、設置工事費も含む。

  ＊ 補助金の金額、または比率：補助金の金額／比率に関してはさまざまな議論がされている。たとえば、

    a) システムの容量にかかわらず 1 基あたり一定額の補助金を支給する

    b) 初期投資に対し一定比率の補助金を支給する

    c) 年度により補助額、または補助比率を変える。
    システム導入地域によって補助金の比率を変える。すなわち、電化が困難な地域への補助金比率を高めることにより、プロモーター／オペレーターの導入意欲を高める。

    d) 採用する電化手法により補助金の比率を変える、などが考えられる。
    補助金については、ASER のマニュアル Vol-III で詳しく検討されており、それによれば補助金の比率は初期投資の 35%以下としているが、今後再検討が必要である。なお、財務モデルでは、標準ケースとして 50%を対象に検討している。補助金の比率については、今後の主要検討課題の一つである。

- 補助金支給の時期
  補助金支給の時期については、利用者のところに PV システムの設置が完了したことを確認した後に支払うことになる。システム設置の完了は ERIL プロジェクトごとに検査担当員"Control Entity"が選任されてシステム設置の確認を行うことになっている。複数年度にわたりシステムが設置される場合は年度末にその年度に設置され検査に合格したシステム数をプロジェクトプロモーターが報告して補助金を申請する。

- 資金調達計画の評価
  資金調達については、自己資金の内容(自己投資、援助資金がある場合はその契約)、利用者の負担金、補助金、銀行から借り入れる場合はその借り入れ条件と貸し出し約束を確認する。

  資金配分の目標としては、ASER の作成したマニュアルでは自己資金と利用者の初期投資負担金で 20 から 30%、補助金が 30 から 35%で残りが銀行からの借り入れ資金となっているが、援助資金があれば自己資金に充当し、借り入れ資金を少なくすることができる。これらの値については、今後の更なる検討が必要であろう。

4.2　実施段階の評価　チェックおよびモニタリング

(1)　システム構成部品納入時の品質チェック

1)　品質チェックの方法

ASER のマニュアルではシステム納入時の品質検査とシステム設置作業のチェックをASER が委託した第３者 "bureau de control" または "control entity" と呼ばれる専門家に委託するようリコメンドしている。

以下の作業はプロジェクトオペレーターと検査員が共同で行うことになる。

入荷した機材は設置サイトに輸送する前に荷受人の倉庫で検査を行い、品質を確認した上で現地に輸送する。

2)　品質検査表のチェック

納入された製品には、検査表が添付されているので、その検査結果が発注仕様を満たしていることの確認を行う。

3)　セネガルにおける品質検査

将来実施されるであろう国際的な品質認証制度が実現するまでは、幾つかのサンプルを製品から取り出し、セネガルにおける試験設備のあるラボ（CERER）で実際の品質検査を実施すべきである。その費用は "control entity" が実施するチェック作業に含まれる。

認証制度が実現すればその認証ラベルのある製品はそのまま受け入れるが、認証ラベルのない製品については抜き取り検査を実施する。

また CERER で測定された検査結果は発注者と供給者にとって最終決定データーとする。

(2)　システム設置作業のチェック

1)　設置作業のチェック方法

"Control entity" がプロジェクトオペレーターとともにチェック作業を行う

2)　設置作業のチェック項目

設置作業のチェックの目的は

- システムが計画どおりに使用できること
- 提供されるサービスが計画どおりであること
- 使用機器が計画と同じであること
- 設置作業が標準や規則に合致していることの確認にある。

システム設置作業のチェック項目に関しては、オペレーターのシステム運用マニュアルに記載されている。(添付資料-6 または添付資料-11)

3) 修正箇所の指摘

"Control entity" は設置作業における修正箇所を見出したときは、その内容を記録してプロジェクトオペレーターに提示して修正を求める。

4) システムの検収

指摘した修正箇所の修正が完了したと確認したときは "Control entity" はシステムの検収に同意する。

"Control entity" の同意がある検収されたシステムに対して ASER は補助金を支払う。

5) 複数年度にわたるプロジェクトのケース

PV システムによる電化の場合には 1 度に利用者全部の設置作業を完了させるだけではなく、多年度にわたってシステムの設置を行うケースもある。

"Control entity" はプロジェクトオペレーターの提示した設置スケジュールに合わせてシステム設置に立会い検査をするが、集中的な設置作業が行われない場合は年間 2 回程度にまとめて検査を行っても良いこととする

(3) システム運営時のモニタリング

モニタリングを行う目的は

- ASER が提供する補助金によるプロジェクトが正常に稼動していることの確認
- システム運営管理の状況を把握する
- システム性能の把握を行う
- 機器運転の経験から最適な運転条件を見出す

- システム機器の信頼性の把握を行う
- ASER が計画を評価したり、システムを設計し設置するための経験を蓄積する

a) モニタリングの方法

プロジェクトオペレーターが定期的な運営報告書を ASER に提出する事を基本とするが、随時 ASER または ASER の委託を受けた Control Entity が現場を訪問し、稼動状況の確認を行うこともある。

b) モニタリングの時期

プロジェクトオペレーターは会計年度の終了したときにその年度のプロジェクト運営状況の報告書を提出する。

ASER はその報告書に基づいて ASER が所管する地方電化プロジェクト毎のデーターベースの更新を行う。

c) 報告書の記載事項

i) システム運営の状況

- 期初の稼動システム数、期中設置システム数、期中稼動停止システム数、期末稼動システム数。
  容量の異なるシステムが設置されている場合には容量ごとのシステム数を記載する
- システムメンテナンス実施状況
  現場技術者の数、および利用者訪問頻度、現場技術者の作業内容等を確認することにより、現場技術者が管理できるシステム数の範囲を把握する
- 期中取替え部品数 (部品の種類と部品稼動年数の報告)
  部品交換を行ったシステム部品の名前とその稼動年数を記録することにより、それぞれの部品の妥当な想定稼動年数の設定が可能となる
- 利用電気機器の種類と数、利用時間数
  プロジェクトの中のサンプル家庭における利用電気機器の種類と数および平均的な利用時間数を聞き取りにより報告にいれる。

  ASER ではこれらのデーターを集積することにより、システム容量ごとに利用可能な電気機器の種類、数、利用時間の推定が可能となる

- 現場技術者の訓練状況
  現場技術者のレベルアップのためにどのようなトレーニングが行われているかを把握し、ASER としてサポートが必要な事項を把握する

- 利用者に対する指導/教育の内容
  プロジェクトプロモーター／オペレーターが利用者に対して PV システムの利用方法向上のために行った指導／教育の内容を把握し他のプロジェクトへの参考とする

ii) 主なシステム故障の原因と修理内容

- 期中に発生した主な故障の原因とその修理の内容、および再発防止のための処置
  故障の原因を発生した部品別、原因別に分類し、その修理の方法と再発防止のための手段を類型化することにより、故障の頻度を低下させ、修理の時間を短縮することを目指す

iii) システム運営従事者の業務比率
プロジェクトの運営に従事した人たちのプロジェクト運営に直接関与した時間の比率：専業者を 100%とし、兼業者はその業務に従事した時間の比率で計上する。

PV システム電化に関与する要員数の推定と、運営管理費用の推定に利用

iv) システム運営財務状況

- 収入(予算と実績の対比)
  　期間中の利用料金および新設のシステムがある場合にはその初期投資金などの収集金額と、期初に予定していた予算額との比較。特に利用料金の回収率が重要である。未収分についてはその回収を強化する方法も報告に記載させる。

- 費目別支出(予算と実績の対比)
  支出については費目別に把握する。すなわち

  * 交換部品の費用：交換部品の価格、交換部品の在庫費用、交換のための経費、等

  * 運営管理の費用：利用者を指導し管理する費用、料金の収集のための費用、資金の調達と運用に関する費用、等

  * メンテナンスの費用：現場技術者の費用、外部技術者の費用、プロジェクトオペレーター技術者の費用、予備品の費用などが含まれる

これらの収入と費用を把握することにより、ASER はプロジェクトの運営が予定通り行われているか否かを判断できるとともに、PV システム運営に必要となる費用の確実な予測が可能となる。

プロジェクトの運営が予定通り行われていないときには、ASER は改善策について助言または指導を行う

v) 利用者からの要望またはコメント

利用者からのシステム利用に対する要望やコメントがあれば記入し、プロジェクトプロモーター／オペレーターで実施した対策や回答を報告する。

ASER はこれらの要望やコメントから利用者が PV 電化に対する期待や、不満を把握し、他のプロジェクト策定への参考とする。

これら報告のための参考フォーマットを添付資料-12 に添付する。

d) モニタリング不提出に対するペナルティ

ASER は補助金を支給するときの条件として必ず定期的なモニタリング報告を行うことを約束させ、理由が無く報告を実施しなかったときはそのプロジェクトプロモーター／オペレーターに対して妥当な罰則を適用する。

PV システム運用マニュアル

添付資料

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図のリスト

添付資料－1
Contract on the PV Electrification in Mar Island

CONTRACT ON THE PV ELECTRIFICATION IN MAR ISLAND

This contract is passed between MATFORCE "Compagnie d'Applications Mécaniques" which headquarters is located at 10 avenue Feidherbe-Dakar represented by his Managing Director Mr. Mamadou SOW acting on the behalf and for the above-mentioned company hereunder referred as the "operator" and subscriber
Mr.________________________living in____________________ (hereafter referred as "USER"). The two parties made the following agreement.

Preamble

This agreement is made in the idea of the execution of cooperation Pilot Project between MEH and JICA within the framework of Study for the PV Rural Electrification Plan. To cope with the new procedures of rural electrification subsequent to the reform on electricity sub-sector, the state has decided to entrust ASER through Project ownership delegation with the management of the Project.

The objective of this project is the implementation of PV system for the electrification of Mar Islands in the sub-prefecture in Fimela, Department of Fatick. This project consists in the installation of PV systems. The PV system for the contract consists of two parts.

1) The first part

The first part is as follows;
"One 55W Solarex PV panel (SX55)", "One Battery charge/discharge regulator Uhlman SLR1010", "One 100 Ah battery M14-SOL", "One battery box CPM-14" and "Cables and Fixtures" (hereafter referred as "MAIN PART")

2) The second part

There are three types of the second part. One type of the second part is selected by "USER".

The second part is as follows; (Please put a mark on the selected variety)

☐ Variety 1:
"Five – 8 [W] fluorescent lamp DC", "One DC/DC Voltage dropper", "One radio socket", "Five switches" and "Junction box and cables and fixtures"

☐ Variety 2:
"Three – 8 [W] fluorescent lamp DC", "One DC/DC Voltage dropper", "One radio socket", "One TV socket", "Three switches", and "Junction box and cables and fixtures"

☐ Variety 3:
"Two – 8 [W] fluorescent lamp DC", "Four –LED lamp", "One DC/DC Voltage dropper", "One radio socket", "One TV socket", "Six switches", and "Junction box and cables and fixtures"
(hereafter referred as "INTERNAL PART")

Chapter I: General Clauses

Article 1- Object of the Contract

The object of this contract is to define the necessary conditions for the implementation and management of the Rural Electrification Pilot Project in Mar Island and define the obligations and responsibilities of the concerned parties.

Article 2- Description of the concerned Partners

The owner of this project is MEH that entrusts its execution to ASER.

ASER, the executing agency of rural electrification is owner of the project and by the same way of the installed PV equipment and makes the Pilot Project Operator carry out management of the Project.

The Pilot Project Operator is entrusted by ASER, the mission to ensure proper management of the Project equipment.

The USER is the direct beneficiary of the electricity services offered.

Article 3- Validity

The present contract shall take effect for 5 years from the date of signature. The contract condition will be reconsidered between "USER" and "PILOT PROJECT OPERATOR" when the contract is terminated. "USER" also will be able to withdraw from the contract in this time.

Article 4- Settlement of Contentions

In case of contention between the two parties, the latter will try their best to reach amicable mutual understanding. If they fail to reach a compromise, the contention will be submitted to the judgment of ASER. If the contention still remains after submission to ASER, the two parties will submit to the competent Law court of Senegal.

Article 5- Penalty: Transfer of the PV System

If the "USER" does not pay the "Monthly Payment" within 30 days from the date of the invoice issued the "PILOT PROJECT OPERATOR" shall send a first notification to "USER" requesting payment of due amount within one week. If the latter still does not pay the "PILOT PROJECT OPERATOR" shall suspend the electric supply and give a last notification for payment within a fortnight. If at the end of that deadline "USER" still does not pay the "OPERATOR OF THE PILOT PROJECT" will remove the whole of the "PV System" from the "USER" at any time with its all accessories without any other notification and will keep at his disposition the removed system without prejudice to appeals given to him by legal clauses.

If the "USER" makes alternations or modifications that may cause damages to the PV system without approval of the "OPERATOR", the latter shall remove the PV system at any time from the "USER" as mentioned on article 13.

Chapter II: Obligations and Responsibilities of each party

(1) PILOT PROJECT OPERATOR OBLIGATION

Article 6– Maintenance & Repairs

The "PILOT PROJECT OPERATOR" under the contract with "ASER" shall be responsible for the maintenance and repair of the "MAIN PART" and the "INTERNAL PART". The "PILOT PROJECT OPERATOR" will carry out ordinary maintenance every month.

In case of minor repair, fixing or replacement is made within three (3) days from the date of notification. In case of major repair, fixing or replacement is made within seven (7) days from the date of notification. All of the necessary cost for maintenance and repair include replaced components is covered from the regular monthly payment.

Article 7– Replacement of PV system components

The "PILOT PROJECT OPERATOR" replaces components of the PV system based on the estimated lifetime of each component. Replacing components and estimated lifetime of components are as follows;

Replacing Components	Estimated Lifetime
Battery	4 years
Regulator	10 years
PV module	20 years
Ballast	10 years

All of the necessary cost for replacement is covered from the collected fees.

Article 8- Fee collection

The PILOT PROJECT OPERATOR is responsible for fee collection. The collected fees will be deposited in the bank account opened for that purpose.

The 25th of each month the User will receive an invoice which must be paid at the latest the 5th after consumption period. Fees must be paid to the operator employee who will give a receipt. Users will be informed of his visit 2 or 3 days before.

(2) OBLIGATIONS AND RESPONSIBILITIES TO BE TAKEN BY USER

Article 10– Initial Payment

So that to be provided electricity service using installed PV systems, User have to pay total Amount of FCFA 45,000 the Initial Payment for each PV system.
The initial Payment is not refundable.

Article 11– Monthly Payment

11-1 Amount of the Monthly Payment

The "USER" shall pay FCFA 3,700 as "Monthly Payment". The timing of the payment is depending on the payment schedule that the "USER" selected. (Please put a mark on the selected payment schedule). ASER and PILOT PROJECT OPERATOR have the possibility to revise the amount of the monthly payment every year. Meanwhile any modification must be submitted to a written notification and with ASER approval.

User chooses his own payment schedule and will put a cross in the corresponding box

- Monthly payment
  User will pay FCFA 3700 on December 30, 2000. The same amount will be paid all months from this date
- Quarterly payment
- User will paid FCFA 11,100 for December 30, 2000. The same amount will be paid all three months from this date.
- Semi-annually payment
  User will pay FCFA 22,200 on December 30, 2000, and will pay the same amount in every half year from this date.

11-2 Payment Method:

The "monthly payment " will be collected by the "Pilot Project Operator". "User" should pay his monthly payment as a schedule above

Article 12– Notification of the repairing demand

The "USER" must notify the "PILOT PROJECT OPERATOR" of malfunction and/or breakdown of the PV system. "PILOT PROJECT OPERATOR" fixes the PV system based on the notification. If the "PILOT PROJECT OPERATOR" does not fix the system beyond the schedule period, "USER" will inform ASER.

Article 13– Exclusion

Any repairing and replacement of the components of PV system in the case of following reasons, necessary cost is charged "USER".

- An important handling mistake
- A case of theft
- An accident, an omission or an abnormal use
- A displacement of the PV system without approval of the "PILOT PROJECT OPERATOR"
- Any modification, accessories assembling or dismantling of the PV system

If the "USER" makes alternations or modifications that may cause damages to the PV system without approval of the "PILOT PROJECT OPERATOR", the latter shall remove the PV system at any time from the "USER" who won't be able to ask for any compensation or indemnity.

Article 14– Cancellation of the contract

The User can cancel the contract when the operator does not respect his obligations as stipulated in the contract or when the latter does not provide the services as stated in above article 6 and 7.

In that case, that cancellation can be done through a letter (with acknowledgment of receipt) after having submitted a written notice without any success.

Article 15– Case of force majeure

The operator is not responsible for delays or damages springing from the execution of this contract in force majeure.

Force majeure means any event that the operator cannot control, any unexpected event that prevents the fulfillment of the obligations of the operator

Article16– Insurance

The operator will subscribe insurance for professional risks relating to the execution of this project.

Article 17– Accessibility

The operator can have access at any time and without restriction to the User's house to work on the PV system.

This contract was made into four copies and signed by both parties

Date, ...

The PILOT PROJECT OPERATOR   The USER

添付資料－2
Contract between the project operator and local operator

CONTRAT BETWEEN THE OPERATOR OF THE PV RURAL ELECTRIFICATION PILOT PROJECT IN MAR ISLAND AND THE EXTERNAL TECHNICIAN

The following agreement is made between MATFORCE « Compagnie d'Applications Mécaniques », operator of the PV rural electrification pilot project in Mar island and Mr. KAMA, solar energy technician:

Article 1 :

Mr. Joseph KAMA is the external technician of the PV rural electrification pilot project in the villages of Mar Lothie, Mar Soulou and Mar Fafako and is in that sense the part-time technical representative of the operator, MATFORCE « Compagnie d'Applications Mécaniques" in those villages.

Article 2 :

The external technician will have to visit Mar island every fortnight. Every visit, the external technician will have to undertake the following tasks:

- Constant inspection of users so that to avoid their modifying the initial installation or using appliances that are not authorised by the project;
- Provision of permanent and continuous training on proper system maintenance to the local technician;
- Maintenance and preventive and periodical maintenance of the 95 systems installed in Mar island, with the assistance of the local technician;
- Removal of system from users who don't pay monthly electricity fees;
- Submit to MATFORCE a report on the operation of the project, the main constraints and prospects, etc…

Article 3 :

The external technician will have to use his own equipment for the execution of these tasks.

Article 4 :

The external technician will have to take charge of necessary onsite transportation costs.

ARTICLE 5 :

MATFORCE will pay a total monthly amount of 80 000 CFAF (eighty thousand cfa francs) to the external technician for the assignments mention in the article 2.

Article 6 :

The term of this contract is 4 month, to be renewed.

However, in case the external technician does not respect the clauses stipulated in article 2 MATFORCE will have the right to terminate the contract at any moment.

DAKAR, January 05, 2001

The external technician
KAMA

MATFORCE
Mamadou SOW
General Manager

添付資料－3
Contract between the project operator and local technician

CONTRACT BETWEEN THE OPERATOR OF THE PV RURAL ELECTRIFICATION PILOT PROJECT AND THE LOCAL TECHNICIAN

The following agreement is made between MATFORCE « Compagnie d'Applications Mécaniques », operator of the PV rural electrification pilot project in Mar island and Mr. Pape Adama Faye solar energy technician:

Article 1 :

Mr. Pape Adama Faye is the local technician of the PV rural electrification pilot project in the villages of Mar Lothie, Mar Soulou and Mar Fafako and is in that sense the permanent technical representative of the operator, MATFORCE « Compagnie d'Applications Mécaniques" in those villages.

Article 2 :

Assignments of the local technician:

- Constant inspection of users so that to avoid their modifying the initial installation or using appliances that are not authorised by the project;
- Provision of constant and continuous training of users in the idea of a proper usage and maintenance of the system;
- Maintenance and preventive and periodical maintenance of the 95 systems installed in Mar island, with the assistance of the external technician;
- Prompt diagnosis and servicing in case of system trouble;
- Removal of system from users who don't pay monthly electricity fees;
- Management of the stock of spare parts at the local level;
- Remittance of monthly invoices to each individual user;
- Assist the account dispatched by MATFORCE in the collection of monthly fees;

- Permanent contact with local populations so that to promote the sales of the equipment sold by MATFORCE ;
- Submit to MATFORCE a report on the operation of the project, on specific constraints and prospects, etc…

Article 3 :

The tools provided to the local technician will remain the property of ASER and will be handed over to the operator in case of cancellation of the contract between the local technician and the operator. Those tools include :

- 1 ampere meter pliers,
- 1 digital multimeter,
- 1 analogical multimeter,
- 1 side cutters,
- 1 crimping pliers,
- 1 pliers,
- 1 compass,
- 1 hammer,
- 1 stripping pliers,
- 1 metal brush,
- 4 screw drivers
- 1 thermometer.
- Additional protection glasses and gloves against acid will be provided to the local technician by the operator.

Article 4 :

The operator will provide the local technician with an appropriate transportation means (horse cart, bicycle or motorbike) for him to be more preferment in his job.

Article 5 :

For the execution of the assignments stipulated in article 2 MATFORCE shall pay a monthly salary amounting at 40 000 CFAF (forty thousands cfa) to the local technician.

Article 6 :

The term of the contract is 2 years renewable.

However, in case the local technician does not respect the clauses stipulated in article 2 MATFORCE will have the right to terminate the contract at any moment.

MAR LOTHIE, January 05, 2001

The local technician
Pape Adama Faye

MATFORCE
Mamadou SOW
General Manager

添付資料－4
Technical Specifications of SHS

TECHNICAL SPECIFICATIONS FOR PV SYSTEM PROCUREMENT AND DATA LOGGER

1. Objective

The technical specification described in this document were prepared for the pilot project initiated in relation with the Photovoltaic Rural Electrification Plan in Senegal funded by JICA. The objective is the supply and installation and maintenance of lighting photovoltaic equipments.

2. Location of the Project

The project site is located in the region of Fatick, the Department of Fimela, villages of Mar Lothie, Mar Soulou and Mar Fafaco.

3. Technical Specifications of Components

3.1 LOT 1:Supply and Installation of PV System

(1) General Descriptions

The photovoltaic systems are designed to provide lighting of the three villages. Three types of equipment shall be installed.

1) Type 1:

a) One module of minimum 55Wp

b) One Battery of minimum 100Ah

c) One Charge Controller of 10A

d) Four Fluorescent lamps of 8W

e) One radio outlet

2) Type 2:

a) One module of minimum 55Wp

b) One Battery of about 100Ah

c) One Charge Controller of 10A

d) Three Fluorescent lamps of 8W

e) One TV outlet

f) One radio outlet

3) Type 3:

a) One module of minimum 55Wp

b) One Battery of minimum 100Ah

c) One Charge Controller of 10A

d) Two Fluorescent lamps of 8W

e) Four LED lamps of 0.7W

f) One TV outlet

g) One radio outlet

3.2 Photovoltaic Modules

1) The module should be made of mono-crystalline or poly-crystalline siliceous cells

2) The peak power shall be minimum 55Wp

3) Peak power must not be inferior to 90% of the nominal peak power.

4) The maximum output power at 60°C of cells junction temperature shall be higher than 85% of the nominal power

5) The voltage at the Maximum Power Point of the module at 60°C of cells junction temperature shall be higher than 16V

6) The module must be fitted with waterproof cases of IP54 standard at the connection points. The cases shall be fitted with oakum-press allowing the cables to pass through. The polarity of the terminals must be clearly indicated inside the cases.

7) Each module must be fitted with by-pass diode.

8) Each photovoltaic module must have a plate of notification at least the following prescriptions:

   a) name, trademark or symbol of maker
   b) number or reference of the model
   c) peak power, short-circuit current (A), open circuit voltage (V) for STC conditions
   d) Serial number
   e) manufacturing country

9) The proposed modules shall be tested by an authorized laboratory conforming to the EUR 101 and 502 (501) specifications published in the EUR 7078 and EUR 9414 reports or conforming to the corresponding IEC specifications. A ISPRA certification (or equivalent) showing that the tests are successfully achieved shall be attached to the document.

10) Incomprehensible things of these prescriptions, refer to the IEC1215, IEC1277, IEC1194, IEC904 standards

3.3 Support Structure

The material of the support for the module should last 10 years without any serious erosion. The following material is acceptable:

1) stainless steel
2) reinforced steel
3) anodized aluminum

A protection system against robbery must be taken into account either in the design of the type of fixation of the support (using bolts or anti-theft nuts) or in the design of the support itself.

3.4 Storage Batteries

The lead-acid monoblock batteries shall follow to characteristics shown below.

1) Nominal voltage: 12V

2) Nominal capacity: minimum 100Ah
3) A Lead-antimony flat or tubular plate and stationary liquid electrolytc batteries well adapted to PV systems
4) The thickness of each plate must be more than 2 mm
5) Self-discharge rate at 25°C must not exceed 6% of the nominal capacity in one month.
6) Tub of a battery must be thick and resistant enough to be transported and forwarded without any damage.
7) The level of the electrolyte of the battery must be easily verifiable by the user: marking of minimum and maximum on translucent tubs
8) The density of the electrolyte must not exceed 1.25 kg/l at 20°C
9) Gel electrolyte batteries are excluded.
10) The volume of electrolyte must be higher than 1.15 liters per 100Ah nominal capacity and per cell.
11) Each battery must have a notice plate of at least following information:
    a) name, monogram or symbol of maker
    b) number or reference of the model
    c) capacity (Ah) indicating the discharge system
    d) manufacturing date
12) The battery must have a permanent indication of polarity on each terminal.
13) Protection cover for the battery lead connections shall be delivered with the batteries.
14) The battery shall be dry-charged and delivered with necessary electrolyte. The volume of electrolyte must be more than 1.15 liters per 100Ah of the nominal capacity C20 and per cell.
15) The lead-calcium alloy as well as car batteries are excluded.
16) The batteries shall be put in a tub fitted with a lock and must have airing holes and endure erosion, acid spray and chocks. This tub shall be designed so as to allow easy access to the battery lead connections and control of electrolyte level and good cooling system.

17) Incomprehensible things of these prescriptions, refer to the IEC896, IEC1056 and NFC58510 standards.

3.5 Charge Controller

The function of the charge controller is to protect the batteries against surcharge and excessive discharge. The characteristics of the charge controllers shall be the following:

1) Voltage: 12V
2) Module current: 8A minimum, 10A maximum
3) Operation current: 8A minimum, 10A maximum
4) The charge controller must have Pulse Wave Modulation
5) The disconnection and reconnection voltages of the PV module and the loads of the charge controller must be fixed depending on the actual environment conditions and type of battery. The reference values for 20°C and 1.24 kg/L electrolyte density are the following:
    a) high voltage of disconnection =13.8v
    b) low voltage of disconnection =11.4v
    c) reconnection voltage = 12.6v
6) The charge controller must be fitted with a temperature compensation of high voltage of disconnection; the correcting factor to be applied is –4 or –5 mV/°C per battery cell (that is –24 or –30 mV/°C for a one piece 12V battery).
7) Self-consumption of the charge controller must not exceed 10mA whatever the operation condition.
8) The charge controller must be protected against the following accidents:
    a) inversion of the polarities when connecting battery or module to the charge controller
    b) short-circuits during operation: for this type of protection a fuse or equivalent must be used, which the user can easily replace without opening the case of the charge controller
    c) over voltage in the module input or in the load output (thunderbolt)

d) any use without battery, PV modules being connected to the charge controller.

9) The charge controller must be protected against current input 25% higher than the short-circuit current of the PV module and a load output current 25% higher than the maximal nominal current of the PV system (all appliances operating). for a period specified by the supplier. The charge controller must protect the module against nighttime discharge of the battery.

10) The charge controller must not create interferences with the radio waves whatever the operation conditions

11) The case of a charge controller must have the following characteristics:

a) minimum IP54 protection

b) fitted with a wall fixation system

12) The printed circuit of the charge controller shall be attached mechanically to the case immovably with clips or screws.

13) The charge controller must have a LED lamp showing the battery state of charge or an equivalent indication system providing users the following minimum information:

a) ready for use, charge level is sufficient

b) disconnected, very low battery charge

14) The charge controller shall be fitted with a warning system indicating that battery discharged completely, if possible

15) Each charge controller must have a plate indicating at least following information:

a) name, monogram or symbol of maker

b) number or reference of the model

c) nominal voltage (V)

d) nominal module input and usage output current (A)

16) The charge controller must be marked a permanent indication of polarity on each electric connection terminal.

17) The terminals must be out of the reach of users.

3.6 Lamps

Lamps are defined as the set including the bulb, the inverter and the case holding both components. Two types of lamp have been proposed:

1) Fluorescent lamps with electronic ballast and straight tube
2) LED lamp

(1) Fluorescent Lamp with Ballast Inverter

The fluorescent lamps must have the following characteristics:

1) nominal voltage: 12V
2) nominal power: 8W
3) frequency of the ballast: minimum 16kHz
4) The ballast must ensure normal operation of the lamp at voltage between -15% and +25% of the normal voltage.
5) The luminous efficiency of the ballast-lamp set must be minimum 40 lumens per watt.
6) The efficiency of the ballast must be minimum 80%.
7) The characteristics of the ballast current must satisfy the following conditions:
    a) The shape of the wave must be symmetrical.
    b) The peak factor must not exceed 1.7 times of the nominal operation current of the lamp at voltage between 11V to 12.5V.
8) The ballast must be properly isolated
9) The ballast must be protected against destruction in the case of;
    a) removal of the tube from its support while the lamp is under work or if the switch is turn on while there is no tube
    b) the ignition of the lamp doesn't work
    c) the polarities of the supplying voltage is inversed
    d) the terminals of the ballast are short-circuited

10) The ballast must not create interferences on radio waves whatever the conditions of usage

11) The lamp must be fitted with a wall fixation system

12) The electric connection point of the ballast;

    a) must allow a strong connection of the supply cable without causing any damage

    b) must have a size sufficient enough to allow connection of cable

    c) must have a permanent marking indicating of polarity of each input cable, which will be up to 2.5 mm^2

13) Since each system will provide one entrance lamp, the lamp should have a protection system against water infiltration.

14) If the lamp is fitted with a protection cover, this cover must be;

    a) insect proof

    b) easy to remove when the users need to change the bulb

15) The external lamps must follow IP 54 protection standard. An alternative solution to use the type of internal lamps with a protection system satisfying to the same tightness requirements is possible.

16) For each lamp, it must be possible to change separately the tube and the converter using spare parts without replacing the whole lamp set.

(2) LED Lamp

LED lamp shall have the following characteristics:

1)	Type	:	LED lamp
2)	Nominal voltage	:	12V
3)	Nominal power	:	0.7W
4)	Nominal current	:	60mA
5)	Luminous efficiency	:	22 lumen/W
6)	Working temperture	:	+10 degC to +50 degC
7)	Outlet	:	E27

For incomprehensible things of these prescriptions, refer to IEC458, IEC921, IEC924 and IEC925 standards relative to the characteristics and performances of transistorized ballasts.

3.7 TV Outlet

1) The TV outlets are designed for 12V appliances (radio, television, etc).
2) The television outlets shall be fitted with one indicator making the difference with standard 220V outlets. There must be a IP 32 protection standard at minimum and a permanent marking indicating + and – polarity.

3.8 Radio Outlet

1) The radio outlet shall be connected to a DC/DC converter to adapt 6 and 9v voltage.
2) The DC/DC converter must meet the following technical standards:
   a) Nominal input voltage : 12V
   b) Nominal output voltage : 6V or 9V
   c) Nominal current : 2A
3) The supplied voltage must correspond to the output voltage of the charge controller.
4) The converter must be a type of electronic conversion.
5) The case of the converter must have a IP 32 minimum protection standard
6) The case of the converter must be fitted with a wall fixation or hanging system
7) The switch of the converter must be clearly indicated to avoid confusion

3.9 Cables

(1) Wiring of the PV Module

1) The cable used between module to charge controller and between charge controller to battery connection must be adapted to external usage, following to the IEC60811 international standards.

2) H07 RNF type or equivalent standards

3) The section of the cable shall be 4 mm^2.

4) Maximum length: 10 m/system

(2) Connection Accessories

The fixations of the module connection cables shall be made following to "Legrand" *components as below (or equivalent characteristics):*

1) Legrand strings, Clipsotube type ref 319 03 or 06 or equivalent for the cables collected in the tubes,

2) For apparent cables the following fixation mode shall be used:

- with fasteners ref 31955 for masonry support and Colson polyamide UV resistant clamp fastener or equivalent.

(3) Internal Wiring of Buildings

1) Cables

The cables to be used for internal wiring should be available in the Senegalese market:

a) A03 VVF 2.5 types of wires or equivalent

b) 2.5 mm^2 section

c) Total inclusive lengths: 80 m/system

2) Switches

a) Switches shall be available in the Senegalese domestic market.

b) The following characteristics shall be respected:

- The level of protection shall be IP 43 for interior switches, and IP 55 for outside the buildings.
- Bipolar switches.
- ON/OFF position of the switch shall be identified clearly and shall correspond to the following directions:

+ ON: turning on, the switch moving from up to down
+ OFF: turning off, the switch moving from down to up.

3) Connection Boxes

The protection shall be IP 55.

Sufficient number of clips shall be prepared for wiring, that allows to carry out the installation following to the installation specifications of this book.

3.10 Technical Specifications of Installation

The complete installation of the systems shall be made carefully. The visual aesthetic of all installations must be respected:

1) Verticality of wires and of components fixed on the walls (outlets, switches, charge controller, clips, etc.).
2) Balance and arrangement of clips (every 25 cm)
3) Recovery of walls after making holes

(1) PV Module

1) Installation of PV Module

a) The supports of the PV modules shall be static.
b) The inclination of the modules in comparison with the horizontal position must be 15° with a margin of + or – 5°
c) The modules must be oriented towards the true South with a margin of + or – 10°
d) At each site, the place where the modules are installed must be chosen so that there shall not be any shade on them between 90 minutes after sunrise and 90 minutes before sunset.

2) Fixation of PV modules

a) In case of installation on a roof, a minimal distance of 0.1m must be left between the back of the modules and the roof. The module support must be fixed to the body of the frame or of the building, but not to the roof itself. A mounting system can be planned if necessary.

b) In case of wall mounting, the module support must be fixed at minimum 2 points. This system must pierce the wall (bolts and tightening plate).

c) In case of ground mounting, the module support must be installed in a space out of the passages. The modules and wires must be set out of the children's reach. The buried wires must set into a conduit(PVC or PE pipe).

d) The feet of the module support must be bolted or embedded in concrete on the ground. The minimal dimension of these reinforced concrete shall be 300mm x 300mm x 300mm.

e) A unique reinforced concrete stone slab with a section of 250mm x 250mm chained in the length is another acceptable option.

f) Whatever the case, the concrete shall be weighed at minimum 350kg. The lowest level of the module from the ground shall be at least 1m.

g) The components used for the module fixation to the support (nuts, washers, bolts) must be stainless materials.

h) The combination of the various materials (including bolts) on one same system is accepted provided that the technical arrangements preventing the forming of an electrochemical pile among these materials are clearly defined.

3) Wiring of the Module

a) All connection wires for the module shall be H07RNF flexible type.

b) The wires between the modules shall be systematically collected in the protection pipes set up under the modules, which are resistant to bad weather.

c) The wire between the module and the building shall be mechanically protected by pipe or a tube made for that purpose and buried (if the module is fixed on the ground).

d) The acceptable voltage drops shall be;

- module-charge controller connection : maximum 2%
- charge controller- battery connection : maximum 1%

- charge controller- lamp connection (the farthest lamp), under all lamps lit :5%.

(2) Charge Controller

The charge controller shall be set under shelter at 1.5 m from the ground, on a place as close as possible to the battery.

(3) Battery

1) The battery shall be set in a well- ventilated room where people do not spend the day (office, bedrooms, etc.) and shall be out of children's reach.
2) The wires for battery connections shall be;
    - either terminal covered with appropriate material
    - or covered in appropriate battery lead connections.
3) Soldering shall be strictly forbidden.
4) The battery lead connections shall be protected by stoppers filled with silicone, which shall protect them against conversion by users.
5) Preliminary charge shall be done following to the procedure as shown in attached sheet.

(4) Interior Wiring of Buildings

1) The wires shall be installed on surface of the walls or the structures of the frames of the roof.
2) The wires clips shall be put every 25 cm. Cables shall be set perfectly horizontally or vertically. At the points where the directions have to change, the curve shall exceed 6 times its exterior diameter.
3) The distance between components like switches, outlets, connection boxes, a charge controller and the closest clips leading cables to those components shall be equal to 5cm.
4) All connections shall be made with connection barrettes inside the appliances. Every terminal shall be hidden.

5) The connections or shunts by splices are forbidden. All connections shall be set in connection boxes or in electric appliances.

6) The end of cable in appliances shall be done through a pressing terminal whose size shall be adapted to the sections of the cables.

7) The cable goes to components located outside building like switches, outlets and lamps, shall be made in water proof. The entrance of the cable shall be made from lower horizontal level.

8) In order to make repairing easier, the cable color shall be standardized for all installations, with a standard color code for the positive and the negative poles.

(5) Switches

Switches shall be installed for each lamp. For double doors, the switch shall be set at the left of the entrance, at 20 cm from the door when the door is flapped against the wall.

(6) Lamps

Lamp bodies shall be set on the walls and their position must be at 1.80 m in comparison with the vertical from the ground except for case of contrary specifications,. Therefore, all fluorescent lamp bodies installed in the same building shall be set at the same height generally except for case of contrary specifications.

(7) Connection Boxes

Connection boxes shall be solidly fixed to the walls. They shall be high enough to be out-of- reach of users.

(8) Outlets

Outlets shall be installed at 25 cm from the ground and shall be fitted with a "disabuser" which allows making the difference from 220V standard outlets.

4. LOT2: DATALOGGER

(1) Objective

LOT2 aims at the supply of 3 sets of datalogger as well as accessories indispensable to the data collection of 3 PV systems planned in LOT1.

(2) Measurement Objects

The following measurements shall be done:

1) Irradiation: 0-2,000 W/m²
2) Ambient temperature: 0-50°c
3) PV module voltage: 0-25V
4) PV module electricity: 0- 10 A
5) Battery voltage: 0-25 V
6) Electricity consumption: 0- 10 A

(3) Technical Specification of Datalogger

The datalogger shall have the following characteristics

1) Number of analogical input: 6 to 8
2) Margin of input voltage: + or – 2,500m/V
3) Margin of common mode: + or – 5 V
4) Resolution: 0.33 μ V
5) Vivid memory protected by one internal lithium dry battery
6) Protection against transient
7) Rechargeable battery
8) Data shall be collected directly on the field by computer or telecommunication
9) Fitted with RS232 interface for a direct connection by notebook computer
10) Support software for the development of programs, data collection and analysis.
11) These data shall be collected as ASCII files and be transferred in Excel or Access software.
12) The datalogger shall be delivered with protection boxes.

(4) Accessories and Sensors

Each unit shall be delivered with compatible accessories and sensors. These accessories and sensors shall have the following characteristics:

1) 2 pieces of shunt for electricity measurement: 10 A/60mV

2) 2 pieces of voltage divider for voltage measurement

a) Input voltage: 25 V

b) Output voltage: 2,500mv

3) One temperature sensor for the measurement of ambient temperature.

4) the installation of a pyranometer for the measure of the irradiation

5. Pre-charging of the 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) I f 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.

添付資料－5
Plan Sommaire

EXAMPLE OF PV SYSTEM LAY OUT IN A HOUSEHOLD

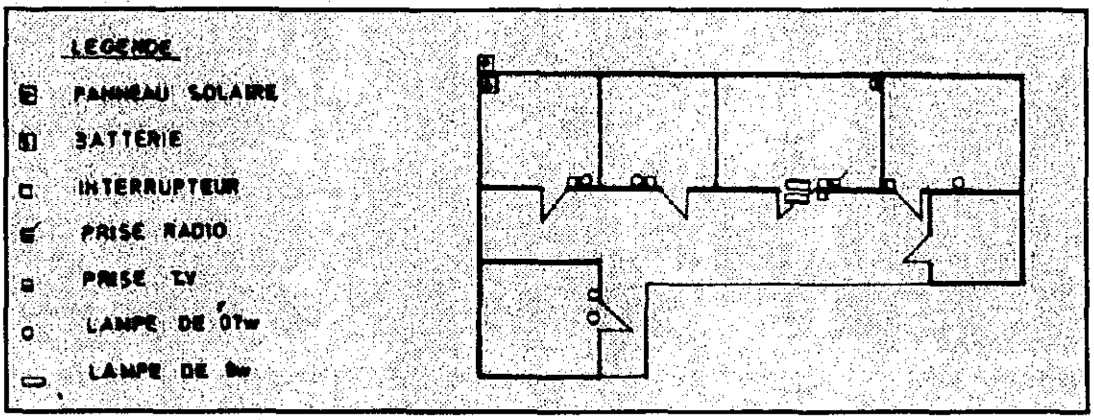

Figure 5-1　One PV system in a household

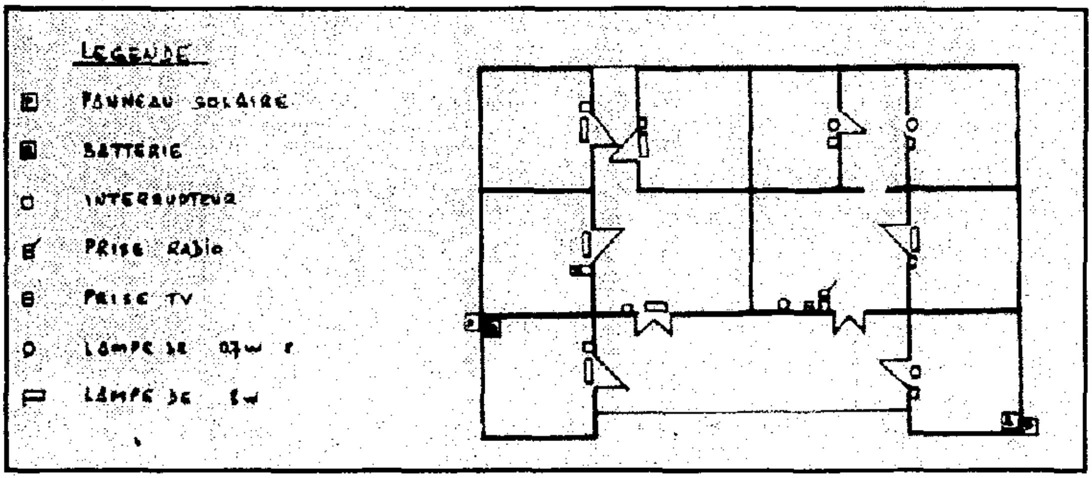

Figure 5-2　Two PV systems in a household

添付資料－6
Acceptance Check List for installation

Form A: Free Writing

ACCEPTNCE CHECK LIST

<table>
<tr><td>Date</td><td colspan="2"></td><td>TIME</td><td colspan="4">: :</td></tr>
<tr><td colspan="2">Mar Lothie</td><td></td><td colspan="2">Mar Soulou</td><td></td><td>Mar Fafaco</td><td></td></tr>
<tr><td colspan="2">OPTION 1</td><td></td><td colspan="2">OPTION 2</td><td></td><td>OPTION 3</td><td></td></tr>
<tr><td colspan="8">Customer</td></tr>
<tr><td colspan="2">ITEM</td><td colspan="6">observations</td></tr>
<tr><td>1</td><td>PV</td><td colspan="6"></td></tr>
<tr><td>2</td><td>Support structure</td><td colspan="6"></td></tr>
<tr><td>3</td><td>BAT</td><td colspan="6"></td></tr>
<tr><td>4</td><td>C/C</td><td colspan="6"></td></tr>
<tr><td>5</td><td>LAMPS</td><td colspan="6"></td></tr>
<tr><td>6</td><td>SOCKET</td><td colspan="6"></td></tr>
<tr><td>7</td><td>SWITCH</td><td colspan="6"></td></tr>
<tr><td rowspan="4">8</td><td rowspan="4">CABLE</td><td colspan="6"></td></tr>
<tr><td colspan="2" rowspan="3">LENGTH OF CABLE</td><td colspan="2">PV - C/C: max 5m</td><td colspan="2"></td></tr>
<tr><td colspan="2">C/C - BAT: max 2m</td><td colspan="2"></td></tr>
<tr><td colspan="2">C/C - Load: max 20m</td><td colspan="2"></td></tr>
<tr><td>9</td><td>REMARKS</td><td colspan="6"></td></tr>
</table>

Form B: Check Sheet Type

ACCEPTANCE CHECK LIST

Date		**TIME**	:	to	:
Mar Lothie		***Mar Souiou***		***Mar Fafaco***	
Customer					
Tester's signature			**Supplier's signature**		

	ITEM	POINT		SPECIFICATIONS	r.
1	PV	Inclination		15° ±5°	
		Azimuth		0° ±10°	
		Shadow		no shadow within azimuth ±60° to 120°	
				no shadow over 20° of elevation	
2	Support structure	Installation type		ROOF / WALL / GROUND	
		POINT		SPECIFICATIONS	r.
		Module height		Out of child's reach	
		Material of fitting device (bolts, nuts, washers)		Stainless or galvanic corrosion proof	
		? if roof mount	Distance between PV module and the roof	Minimum 0.1 m	
		? *if ground mount*	Ground anchor	300mm x 300mm x 300mm	
			Lowest point	Minimum 1 m above G.L.	
3	BAT	Location		Well - ventilated	
				Out of child's reach	
		Terminal connection		Cover with appropriate terminal cap	
		Electrolyte level		Between upper and lower indication	
		Electrolyte density: 1.24 kg/l ± 0.01			
		Cell 1 / Cell2 / Cell3 / Cell4 / Cell5 / Cell6			
4	C/C	Location		1.5m from ground as close as possible to the battery	
5	LAMPS	Height from the G.L.		At the same height in the same building	
6	SOCKET	Height from the G.L.		25 cm from the ground	
7	SWITCH	Location of switch		Left on the entrance	
8	CABLE	Cable protection when piercing the wall		pipe	
		Layout of cable		Outward on the walls	
		Pegging interval		25cm	
		Distance of first peg from objects		5cm	
		Connection method of wire - wire		Pressing clips	
		Branching method		Connection box	
		End of cable		Pressing clips	
		Polarity distinction		Colored	
		Verticality/ horizontality of wiring			
		Voltage drop		PV - C/C: max 2%	
				C/C - BAT: max 1%	
				C/C - Load: max 5%	
9	User's Guide	Location		Next to the regulator	
		Form		Picture	
		Guideline contents		Technical, security	

添付資料－7
Example of System Working Condition (Interim Data Collection)

INTERIM DATA COLLECTION

1. Installation of Isolation Amplifier

Because of fluctuation with the signal from shunt resistances for current measurement, accurate data couldn't be obtained at the time the datalogger was installed. It became obvious through the test in CERER that the data would be obtained well with isolating the signal from the shunt resistance (Through the kindness of the local expert, the study team was able to test how the datalogger work with putting an isolation amplifier into the system). An isolation amplifier was prepared in Japan and brought to the site. In order to cut the noise, the isolation amplifier was installed into the datalogger system. Although it is said that isolating all signals to the datalogger is preferable to be absolutely sure for accurate data acquisition, it was not necessary to isolate the signal of voltage this time.

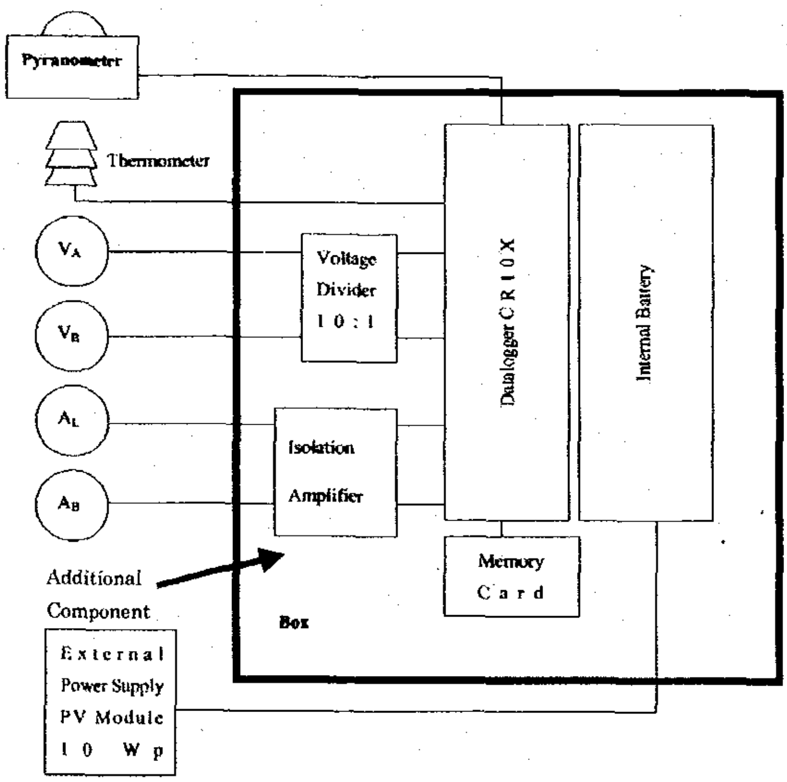

Figure 7.1 Block Diagram of Datalogger System

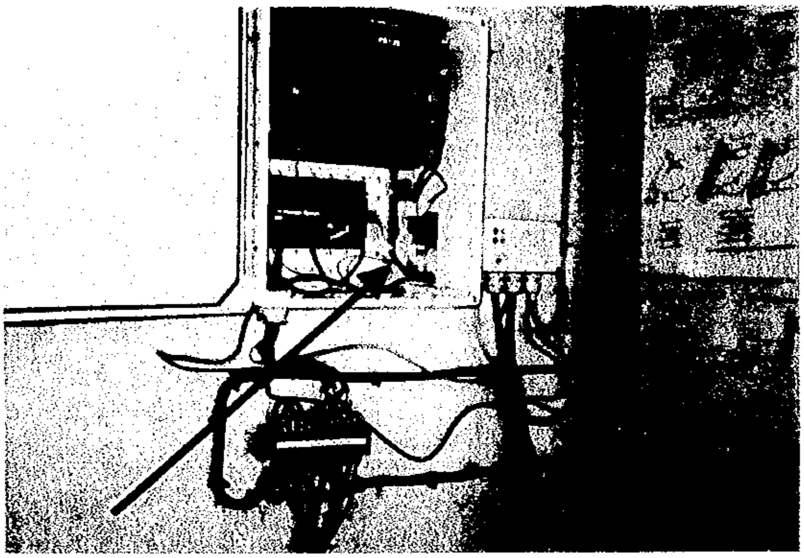

Figure 7.2 Isolation Amplifier Apearatus

2. Data Collection

Thorough the kindness to the local expert, a set of isolation amplifier had been borrowed and installed at one site in Mar Fafaco. Here is shown the data acquired at the site over 3 months since the installation.

(1) Computation of Generation and Consumption

Figure 7.1 shows the point of capturing basic data. The data shown in Table 7.1 was calculated with those basic data.

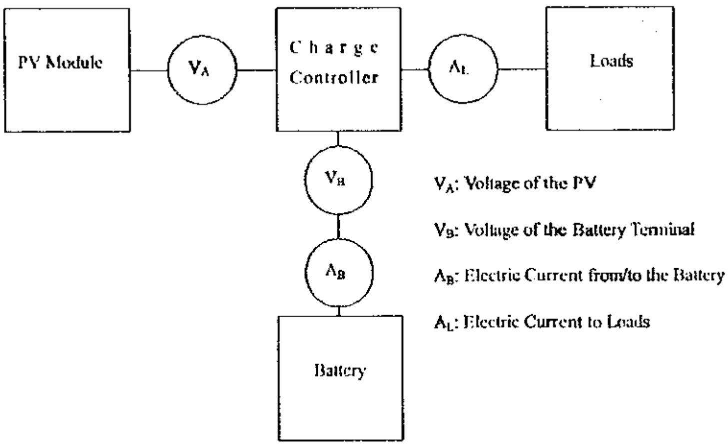

Figure 7.3 Data Capturing Point

Watt-hours are calculated by multiplying the current and voltage and cumulating the result. VB was applied on calculating watt-hours based on the assumption that there is no voltage drop between the capturing points. Current from PV is calculated with AL and AB (See figure 7.4). When sign of AB is positive, the current goes to the battery (charge). When it is negative, the current comes from battery (discharge).

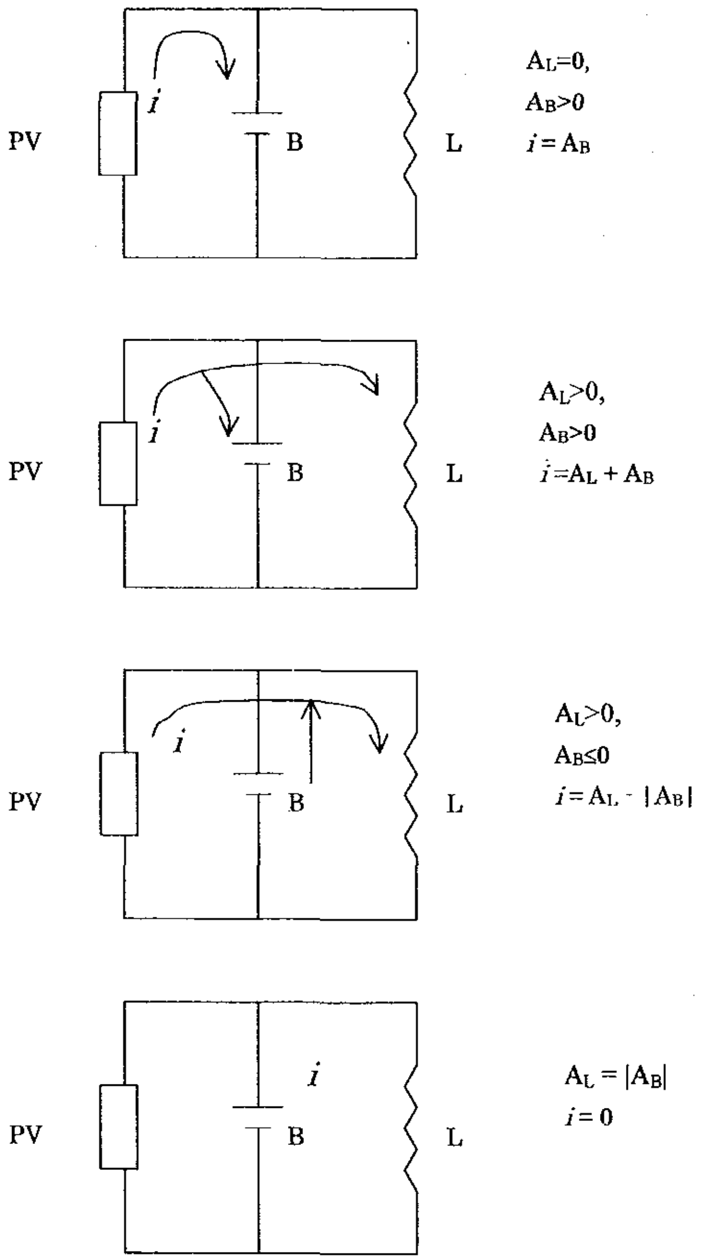

Figure 7.4 Determination of PV Current

Table 7.1 shows cumulative power generation and consumption by users. Since the system was put into service since November 28, 2000, here the value in November 2000 was omitted. The values in March are cumulative from 1st to 12th of the month.

Table 7.1-1 Generation and Consumption [kWh] in Term

	Irradiation [kWh/m²/term]	PV Generation [kWh/term]	Battery Charge [kWh/term]	Battery Discharge [kWh/term]	Consumption [kWh/term]
Dec-00	176.84	2.583	2.574	1.426	1.255
Jan-01	195.77	2.249	2.219	1.606	1.489
Feb-01	154.23	2.222	2.195	1.489	1.414
Mar-01 (1st–12th)	83.15	1.269	1.240	0.956	0.942
Total	609.99	8.32	8.23	5.48	5.10

Table7.1-2 Generation and Consumption [Ah] in Term

	Irradiation [kWh/m²/term]	PV Generation [Ah/term]	Battery Charge [Ah/term]	Battery Discharge [Ah/term]	Consumption [Ah/term]
Dec-00	176.84	185.88	185.70	114.43	100.79
Jan-01	195.77	162.37	160.66	129.03	119.57
Feb-01	154.23	161.73	160.20	119.45	113.38
Mar-01 (1st–12th)	83.15	92.37	90.64	76.82	75.58
Total	609.99	602.35	597.20	439.73	409.31

(2) Verification of Generation

The expected energy output of the system is given by the equation below.

$$E_O = P_M\left(\frac{R_A}{G_S}\right)K$$

Where,

E_O: Expected Energy Output [Wh/day]

P_M: Nominal Power of PV Module [Wp]

R_A: Irradiation [kWh/m²/day]

G_S: Irradiance at Standard Testing Condition [1000 W/m²]

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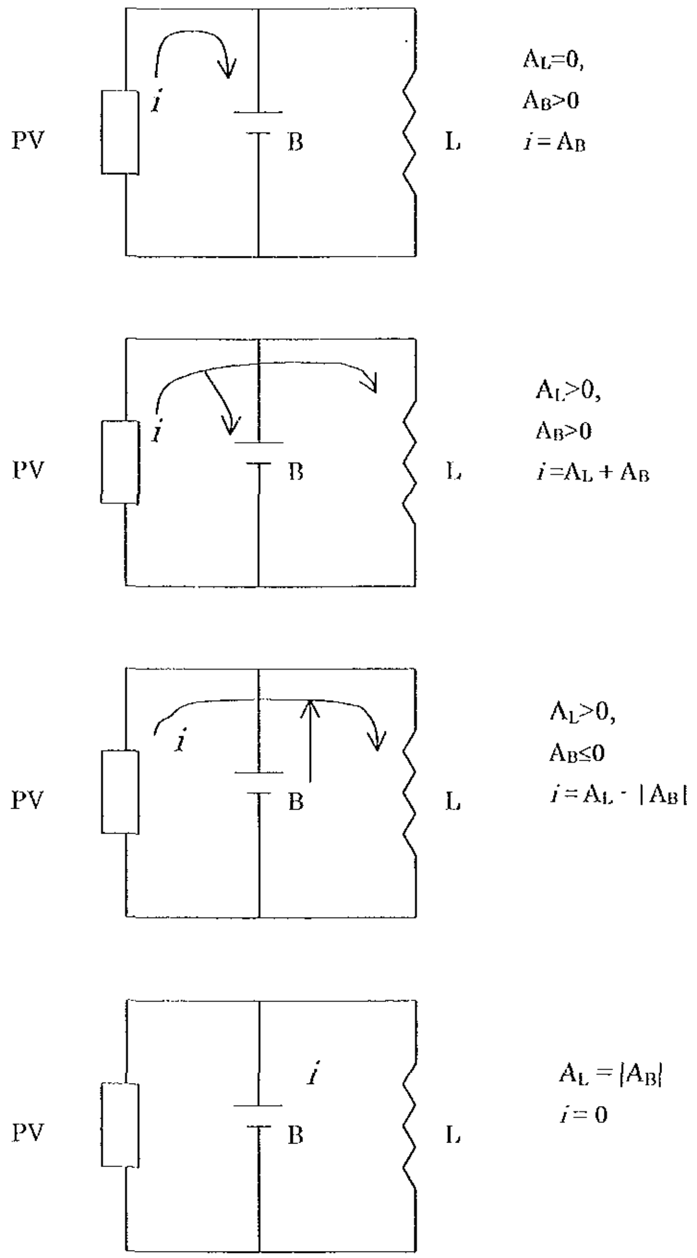

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K: System Loss Factor

The power output of the system was estimated about 180 Wh/day (what about 5.4 kWh/month) with the assumption below.

P_M: 55 [Wp], RA:5 [kWh/m²/day], K: 0.65

Table 7.2 Actual Consumption and Expected Energy Output

	Irradiation [kWh/m²/term]	(A) Actual Consumption [kWh/term]	(B) Expected Energy Output [kWh/term]	(A)/(B)
Dec-00	176.84	1.255	6.32	0.198
Jan-01	195.77	1.489	7.00	0.213
Feb-01	154.23	1.414	5.51	0.256
Mar-01 (1st–12th)	83.15	0.942	2.97	0.317

Expected energy output calculated with actual irradiation and estimated system loss factor is shown in Table 7.2. Actual consumption is 20 to 30 % of the expected energy output. Because of this small consumption of energy by users, the battery did not run so much as to be charged with the maximum performance of the PV module. The reason of this small consumption is considered that the user does not use loads other than lamps.

Table 7.3 Actual Daily Average Irradiation and Power Generation of the PV module

	Irradiation [kWh/m²/day]	PV Generation [Wh/day]
Dec-00	5.705	83.31
Jan-01	6.315	72.54
Feb-01	5.508	79.36
Mar-01 (1st–12th)	6.929	105.75

Table 7.3 shows actual irradiation and power generation of the PV module in average of each month. This table shows that the PV module didn't work in its full performance while the irradiation was higher than expected.

(3) Monitoring of Battery Charge and Discharge

Table 7.4 Battery Circuit Efficiency

	(A) PV Generation [kWh/term]	(B) Battery Charge [kWh/term]	(C) Battery Discharge [kWh/term]	(C)/(B) Battery Circuit Energy Storing Efficiency	(C)/(A) Battery Circuit Correction Factor
Dec-00	2.583	2.574	1.426	0.554	0.552
Jan-01	2.249	2.219	1.606	0.724	0.714
Feb-01	2.222	2.195	1.489	0.678	0.670
Mar-01 (1st–12th)	1.269	1.240	0.956	0.771	0.754

There are two factors for Monitoring of Battery Charge and Discharge. Each factor is defined as follows.

$$\eta \equiv \frac{E_{BO}}{E_{BI}}$$

$$K_B \equiv \frac{E_{BO}}{E_A}$$

Monitoring these factor allows to assess the efficiency of battery charge and discharge. When the factor decreases significantly, the battery may be going to die. However, it has to be totally determined with other parameters like battery terminal voltage, electrolyte density after equalization charge, rapid decrease of electrolyte level (high amount of water filled), if the battery has had used up.

(4) Consumption by Users

Figure 7.5 shows daily irradiation and daily cumulative energy generated by the PV module, charged to the battery, discharged from the battery and daily cumulative energy consumed by users since the first operation. For the day missing data observed because of maintenance of datalogger, the cumulative data was omitted. For the first few days, generated power by PV module and charged energy to the battery decreased day by day, despite of small energy discharge of the battery and energy consumption by the user. This is to compensate a shortage of initial charge of the battery.

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After the battery was charged sufficiently, PV energy generation moved along with the fluctuation of energy consumption.

In order to see the energy consumption tendency of the user, monthly average of consumption at each sampling time (every 20 minutes) is shown in Fig 7.6. The peak current of consumption increased every month up from November to March. Moreover, the time range of consuming energy got broader and broader as time passes.

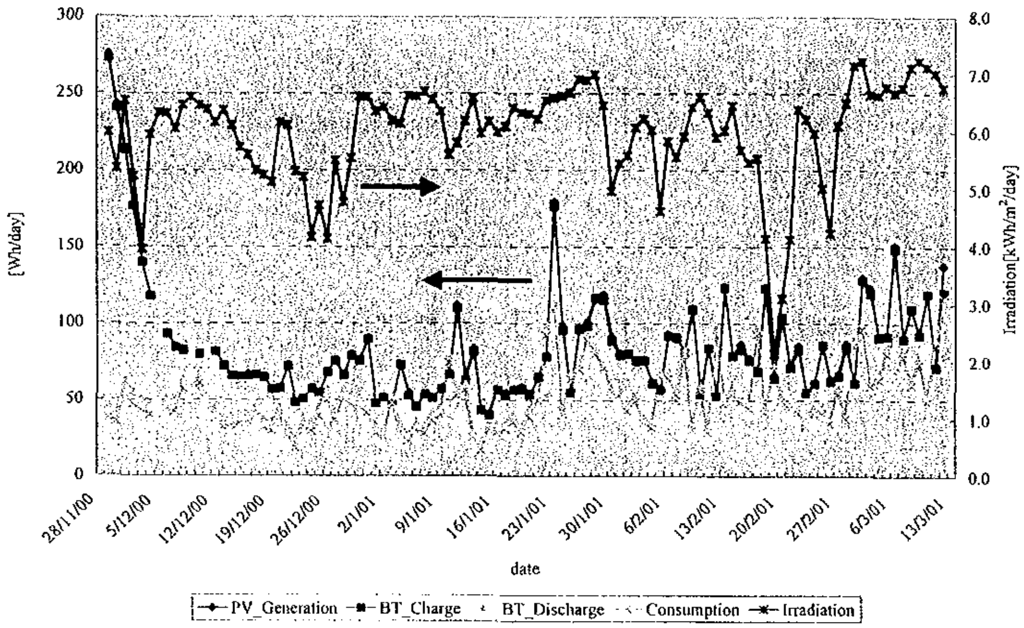

Figure 7.5 Daily Trend of Energy and Irradiation

The loads of the user are two 8W of fluorescent lamps and four 0.7W of LED lamps (Option-3). In addition, there are two outlets for TV and radio. One fluorescent lamp can be assumed to consume about 0.7 – 0.9 Amps, taking into consideration of the efficiency of its ballast inverter. As for a LED lamp, it would be 0.06 Amps. Considering over this current consumption of each lamp, the user seems to have used only one fluorescent lamp for 3 hours from around 7 to 10 pm in the evening on November and December in average. Since January, the user seems to have started using 2 fluorescent lamps in the same time slot of the day. The reason why the current in January and February is around 1.2 Amps, which does not correspond to the total value of 2 fluorescent lamps consumption, is considered that there were both days 2 lamps were used and days only one lamp was used. The user seems to have started using 2 fluorescent lamps in the peak time range.

All through the period the data gathered, the user seems to have used one LED lamp all through the night.

There can be seen another peak in the early morning on November and March. This phenomenon may be because of religious reason. About this reason, further socio-economic survey is expected.

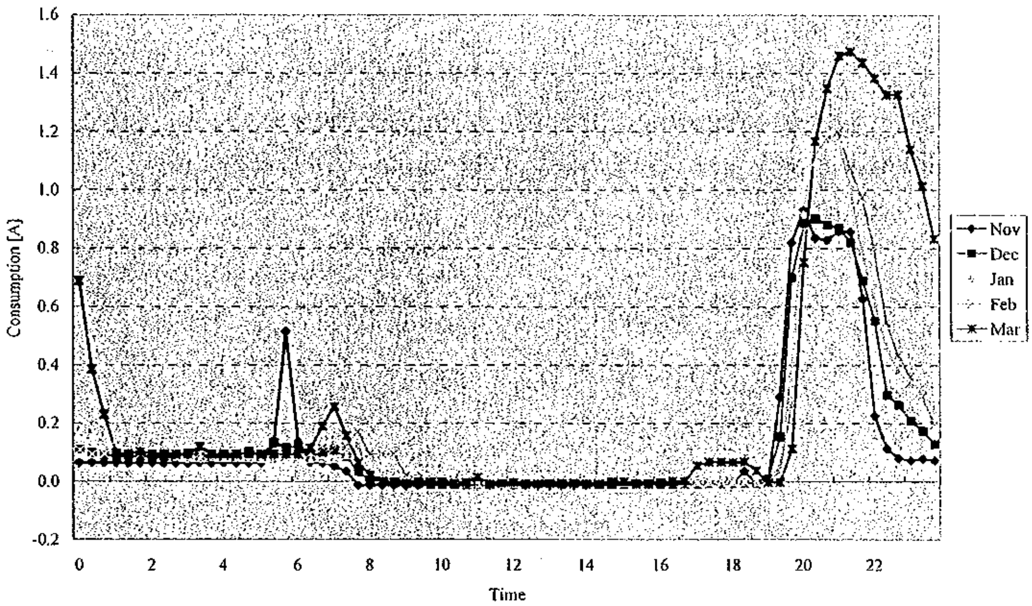

Figure 7.6 Monthly Average of Every 20 Minutes Trend of Consumption

(5) Battery Condition

The trend of current flow into/from the battery is shown in Fig. 7.7 and the battery voltage trend is in Fig 7.8. These trends are monthly average of each sampling time (every 20 minutes). The battery discharge current went higher and the discharging time spread out wider; consequently, the user got familiar with the system as mentioned above. However, the current charged to the battery stopped around noon even in March when the user started using more energy. This means the battery was charged fully by around noon.
The threshold voltage of the charge controller is shown in table 7.5.

Table 7.5 Threshold Voltage of the Controller

	SOC	Voltage (Reference)
Load Disconnection	<30 [%]	11.1 [V]
Load Reconnection	>50 [%]	12.6 [V]
Final Voltage of Charge Normal		13.7 [V]
Cycle		14.4 [V]
Equalization		14.7 [V]
Temperature Compensation		-4 mV/K/cell

Source: SLR1010 Installation and Operation Instruction Manual,Uhlmann Solarelectronic GmbH

All through this monitoring period, the battery voltage has never fallen down lower than the load disconnection voltage. The lowest battery voltage observed was 12.33 [V] in fact.

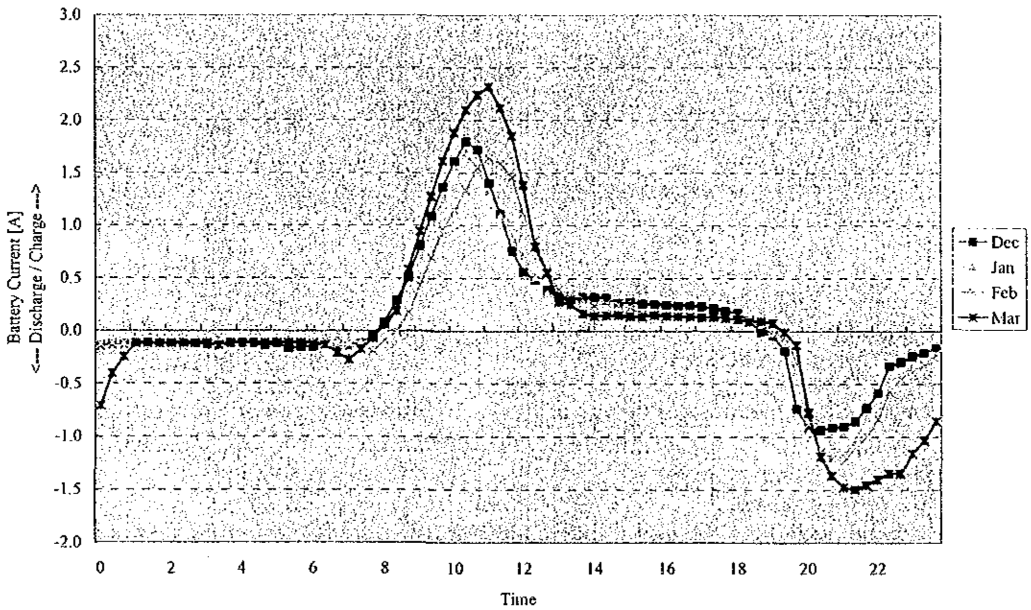

Figure 7.7 Monthly Average of Every 20 Minutes Trend of Charge/Discharge of the Battery

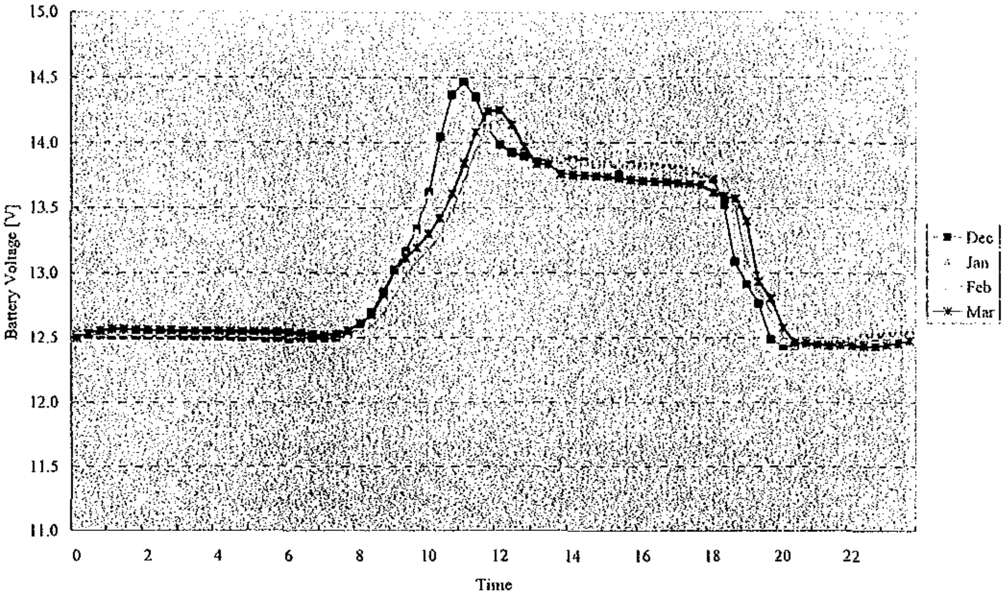

Figure 7.8 Monthly Average of Hourly Trend of the Battery Voltage

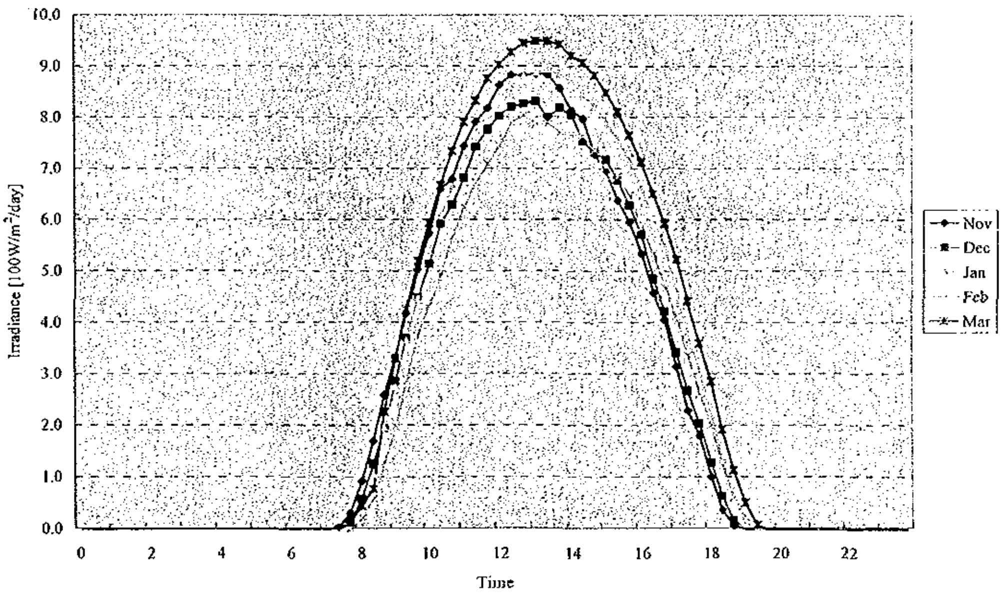

Figure 7.9 Monthly Average of Every 20 Minutes Trend of Irradiance

(6) Conclusion

Despite of sufficient irradiation, the power generation of the PV module was less than expected because the battery was not used full compared to its capacity. The user does not seem to have started using loads other than lamps so far. However, the user started using lamps longer hours as they got familiar with the system. The charge controller won't start regulating power until the user starts using another loads like TV and radio. It is expected the user will start learning how the system behaves after the charge controller begin regulating power when further consumption is added.