

No.

ブータン国
地方電化マスタープラン調査
予備調査報告書

平成15年7月

国際協力事業団
鉦工業開発調査部

鉦調査

JR

03-121



「S / W及びM / M署名式」



「貿易産業省エネルギー局カウンターパート」

ブータン国地方電化マスタープラン

予備調査報告書 目次

第1章 予備調査の概要	1
1.1 予備調査の背景・経緯	1
1.2 団員構成	3
1.3 日程	4
1.4 対処方針	5
関係資料1：正式要請書	11
関係資料2：口上書	25
関係資料3：質問書	31
第2章 調査結果と協議概要	45
2.1 主協議者とS/W署名者	45
2.2 本格調査の実施内容（目的、実施方法、成果品等）	45
2.3 本格調査実施に必要な情報の収集	49
2.4 署名したM/Mの概要	51
2.5 団長所感	53
関係資料1：署名したS/W	57
関係資料2：署名したM/M	73
関係資料3：面談記録	81
第3章 予備調査での確認事項と追加情報	109
3.1 地方電化の現状と課題	109
(1) 地方電化マスタープランの位置付け	109
(2) 県、村落の社会経済データの整備状況と入手可能性	109
(3) 村落における電化ニーズとインパクト	110
(4) オフグリッド電化の現状	110
(5) 地方電化のための資金	112
(6) 地方電化担当組織	112
(7) DOEとBPCの本格調査における要望	113
3.2 送配電の現状と将来見通し	114
(1) 電力系統の現状	114

(2) 送電システムの将来計画	121
(3) ADB の配電網整備計画 (Rural Electrification Phase 1 ~ 3)	131
(4) ADB の配電網整備計画に用いられたコンピューターソフトウェア	139
(5) 県レベルの配電網計画立案のための GIS データベース構築の必要性	140
3 . 3 環境配慮	142
(1) ブータン国における環境管理状況 (環境行政組織、環境関連法規、環境影響評価、環境保護区の設定状況)	142
(2) 事業化にあたっての環境配慮 (既存送配電設備建設計画における環境配慮状況、地方電化計画における 環境影響評価、環境モニタリング、ミティゲーション等)	149
(3) CDM 等 CO2 排出削減クレジットの地方電化事業における活用可能性	150
3 . 4 開発資金計画	151
(1) ブータンにおける予算プロセスと対外借り入れの考え方	151
(2) 地方電化の事業化における留意点	151
(3) JBIC 海外経済協力業務実施方針との関連性	152
関係資料 1 : 収集資料リスト	155
第 4 章 本格調査の実施方針と留意事項	159
4 . 1 地方電化計画	159
(1) 地方電化マスタープランの骨格づくり	159
(2) 村落データベースの作成	159
(3) 需要原単位と電化インパクトの調査	160
(4) オフグリッド電源	161
(5) 資金と組織	161
4 . 2 送配電計画	162
(1) 配電側から見た適切な高圧変電所地点の選定	162
(2) 系統解析ソフトウェアの取り扱い	162
(3) 計画・設計基準の統一化	162
(4) RE- 3 の計画・設計の確認と確実な情報連絡	163
4 . 3 環境配慮	164
(1) 計画における環境配慮	164
(2) 戦略的環境影響評価の実施	164

第 1 章 予備調査の概要

1.1 予備調査の背景・経緯

ブータン王国は、GNP354 百万ドル、一人当たりの GNP が 470 ドル（いずれも 1998 年、世銀アトラス 2000 による）の後発開発途上国である。同国は、インド政府からの援助で建設された水力発電所を中心とする電源開発を進めており、国内の発電設備容量 444MW のうち、約 430MW（うち、500kW 以下のマイクロ水力の設備容量計は約 1.3MW）を水力に依存している（2002 年 11 月）。発電電力量の約 75%をインドに輸出しており、第 8 次 5 ヵ年計画期間中（1997 年～2002 年）で見れば、インド向け売電収入は国庫収入の約 45%に達する。

全国世帯電化率は 30%を下回っており、産業部門（約 71% 南西部工場地帯にあるフェロシリコン、カーバイド等の産業需要）及び商業部門（約 4%）の消費電力量が全体の約 75%を占め、一般世帯の消費電力量は約 15%に過ぎない（2001 年現在）。ブータン政府は、2020 年までの全世帯電化達成を第 9 次 5 ヵ年計画以降における優先課題として掲げ、地方電化事業を推進している。人口の 85%が都市部から離れた地方部に居住していること、国土全体が急峻な山岳地帯に覆われていること等から、送電線延伸による地方電化の推進は容易ではない（同国における「地方部」は全国 20 県の各首都を除く国土全域を指し、地方部人口は全体の 85%を占める）。

かかる状況の下、2000 年 8 月、同国政府より、地方電化の促進、及び、これによる農村地域住民の生活改善と民生向上を目的とする開発調査実施に係る要請が提出された。要請機関はブータン貿易産業省電力局（DOP）であった。以下は協力要請の概要（要請書記載内容の骨子）である。

- 未電化地域における需要マップの作成
- 独立分散型による電化が推奨される地域の風況・太陽光ポテンシャルマップ作成
- 未電化地域に対する電力供給計画立案
- 地方部における維持管理システム立案
- 未電化村落を対象とする電化計画に係る基本設計

これを受け、JICA は、2002 年 11 月にプロジェクト形成基礎調査（以下、プロ形調査）団を派遣し、要請背景の確認、協力内容に係る協議を実施し、M/M の署名交換を行った。プロ形調査の結果概要は以下のとおりである。

(1) 要請背景等

プロ形調査の結果、以下の諸点を背景として、ブータン政府が S/W 締結に向けた協議の実施を強く要望していること、要請案件の実施は同国の国家政策において重要かつ緊急の開発課題解決に大きく資するものであること等が確認された。

2020年までの100%電化達成という目標が明確にされ、目標達成のためには、第10次5カ年計画(2007年~2012年)以降、各県の地方部で新たに約65,000世帯を電化する必要があるとされているが、その実現に向けた具体的な長期計画の策定がなされていないこと

従来までの地方電化事業は、主にADBの支援により、5カ年計画に基づき5年毎のプロジェクトを積み上げていくという手法により実施されてきたが、これは、既存の送電システムを与条件として次の5カ年間で実施すべき配電網延伸計画のF/Sを実施し、配電システムの延伸を局地的に実施するものであったこと等から、既存の電力設備は必ずしも最適なシステム設計に基づくものとなっておらず、最適システム設計の観点からも長期マスタープランが必要とされていること

これらを背景として、第9次5カ年計画(2002年から2007年)中に、グリッド電化計画及びオフグリッド電化計画から構成される「全国レベルの長期地方電化基本計画」の策定を早急に行い、策定された長期計画に基づいて、第10次5カ年計画以降の地方電化事業計画具体化に向けたADB・インド等ドナーとの協議、自主財源確保等の方策を講ずることが政府部内での重要課題とされていること

(2) 要請案件に係る先方政府の意向

プロ形調査の結果、上述した「全国レベルの長期地方電化基本計画」の作成、及びこれに必要とされる技術移転・カウンターパート機関の能力強化が我が国の協力に期待されているアウトプットであることが確認された。先方と共同して作成したTOR修正案(M/Mに記載)の骨子は以下のとおり。

- 電力需給構造と電力供給に係るコスト効率性の評価
- 地方村落における電化ニーズと電化のインパクトの確認
- 地理情報処理(GIS)技術を活用した未電化地域の需要マップの作成
- 2020年を目標年限とするグリッド及びオフグリッドの組み合わせによるコスト積算を含む地方電力供給計画の策定
- 地方部での電力供給についてのオペレーション、メンテナンスのための組織・ガイドラインに係る提言
- 遠隔地における電力供給システムを自立的に維持するための社会開発プログラムの提言

(3) 実施機関

要請提出当時の貿易産業省電力局(DOP)は、電力セクター改革により、2002年7月に、政策立案、計画策定、電力事業実施に係る財源確保、及びブータン電力公社に対する補助金給付等を担当するエネルギー局(DOE)、送変配電設備の整備・維持管理、電力料金徴収、及び設備容量20MW未満の水力発電所建設・維持管理等を担当するブータン電力公社(BPC)(100%国有)、電力料金に係る許認可等の規制を担当するブータン電力規制庁(BEA)に分割されたことが確認された。

1.2 団員構成

(1) 総括	丹羽 顕	JICA国際協力専門員
(2) 調査企画	立松 信吾	JICA工業開発調査部資源開発調査課
(3) 地方電化計画	大瀧 克彦	プロアクトインターナショナル(株)
(4) 送配電計画	大河原 邦夫	(株)エーエスエンジニアリング
(5) 環境	池 知彦	イーアンドイーソリューションズ(株)
(6) 開発資金計画	米田 元	JBIC開発第3部第3班調査役

1.3 日程

日順	月日		調査内容	宿泊先
1	6/16 (Mon)		移動 成田 バンコク 1100-1530 TG641 (全団員)	バンコク
2	6/17 (Tue)		移動 バンコク パロ 0650-1010 KB121 (全団員) 移動 パロ ティンブー 陸路移動 (全団員) ・ JICA 事務所訪問、団内協議	ティンブー (米田団員 については 6/22 パロ)
3	6/18 (Wed)	AM	・ エネルギー省 (DOE) 打ち合わせ ・ 計画委員会 (PC) との意見交換	
		PM	・ 貿易産業省エネルギー局 (DOE) 打ち合わせ ・ ADB コンサルタントからの情報収集	
4	6/19 (Thu)	AM	・ 電力公社 (BPC) 打ち合わせ データ収集 ・ 内務省測量局での GIS Map 作業状況調査 ・ 内務省戸籍登記局で住宅、人口データ収集状況の調査	
		PM 1 班	・ NORAD 調査プロジェクトマネージャーからの情報収集 ・ DOE 水力課との意見交換 ・ DOE 太陽光課との意見交換	
		PM 2 班	・ 環境委員会からの情報収集 ・ 森林省からの情報収集	
5	6/20 (Fri)		・ 合同協議 (DOE・BPC) ・ JICA 事務所中間報告 ・ 追加データ収集 (BPC、BEA、UNDP、通信省道路局など)	
6	6/21 (Sat)		・ 団内協議、S/W 案・M/M 案修正等	
7	6/22 (Sun)	1 班	・ 資料整理、報告書作成 移動 パロ ティンブー 陸路移動 (米田団員)	
		2 班	移動 ティンブー プナカ県	
8	6/23 (Mon)	1 班	・ BPC、ADB、NORAD からの資料収集 移動 パロ ダッカ 0700-0800 KB126 (米田団員)	
		2 班	・ プナカ県調査 (県庁、BPC 事務所) 移動 プナカ県 ティンブー	
9	6/24 (Tue)		・ DOE との打ち合わせ ・ BPC との打ち合わせ ・ 追加データ収集 (民間コンサルなど)	
10	6/25 (Wed)		・ S/W 協議、M/M 協議、S/W 案・M/M 案修正等	
11	6/26 (Thu)		・ S/W 協議、M/M 協議 (合意に至った場合は署名) ・ 現地報告書作成	
12	6/27 (Fri)		・ JICA 事務所報告 ・ 団内協議 (公示案・業務指示書案作成準備)	
13	6/28 (Sat)		・ 資料整理、報告書作成 ・ 公示案・業務指示書案作成準備	
14	6/29 (Sun)		ティンブー パロ 陸路移動 (官団員) ・ 現地再委託業務 TOR 予備検討、再委託候補先検討 ・ 公示案・業務指示書案作成 ・ 資料整理、報告書作成 (コンサルタント)	パロ (官) ティンブー
15	6/30 (Mon)		パロ デリー 0730-1030 KB202 (官団員) ・ JICA インド事務所報告 (官団員) ・ 在インド日本大使館報告 (官団員) ・ 資料収集・整理、報告書作成 (コンサルタント) デリー 0005- TG316 (官団員) ティンブー パロ 陸路移動 (コンサルタント)	デリー (官) パロ
16	7/1 (Tue)		バンコク-0540 (官団員) バンコク 成田 0735-1545 TG772 (官団員) パロ バンコク 0700-1230 KB120 (コンサルタント) バンコク 2310- TG642 (コンサルタント)	機中
17	7/2 (Wed)		成田 -0730 (コンサルタント)	

1.4 対処方針

以下に示す各項目につき協議を実施の上、S/W、M/Mの署名を行う。

(1) ブータン側の主協議者及びS/W署名者について

本案件は、DOE局長とBPC社長とを兼務するMr. Sonam Tschering、及びDOE企画・調整部長Mr. Bharat Tamagがキーマンとなる。S/Wの協議はMr. Sonam Tscheringとの間で実施することとし、必要に応じてDOE内外の関係者との意見交換を行うこととする。S/Wの署名者はDOEのMr. Sonam Tscheringとする。

要請主体であり、一義的なカウンターパートとなるのはDOEであるが、電力事業に関連する技術的知見を有する人材を多く擁しているのはBPCであることに鑑み、BPCを共同カウンターパートとすることも念頭に協議を行い、合意できた場合には、BPCを共同カウンターパートとして位置づけ、S/WにはBPCの代表者からの署名も徴することとする。

(2) 本格調査の実施内容（目的、実施方法、成果品等）について

1) 本格調査の目的について

本格調査の目的は、環境配慮を前提として、世帯単位ではなく村落単位での最適な電力設備拡張・増強計画、事業実施計画、データベース、維持管理、制度・組織に関する政策提言等から構成される2020年までの地方電化マスタープランを策定すること、現地調査の過程で調査・分析作業をカウンターパートとともに行うことにより、マスタープランの完成後もカウンターパートが自立的かつ継続的にローリングプランとして改訂していくことや、地方部に存在する設備の適切な維持管理を実施していくことが可能となるように技術移転・カウンターパート機関の協力強化を行うことである。かかる考え方を説明し、本格調査の目的につき合意形成を図る。

2) パワーシステムマスタープラン策定スケジュールと本格調査スケジュールの関係について

本格調査は11月頃開始することとなるが、現在DOEがノルウェー開発協力庁（NORAD：Norwegian Agency for International Development）と作業を行っているPower System Master Plan(PSMP)の作業スケジュール等も確認の上、本格調査実施時期との調整を行う（2003年11月から2005年12月までを本格調査期間と想定）。

3) マスタープラン内容の確認（成果品）

本格調査の成果品として想定されるマスタープランの内容について以下の点を明確にする。

目標年度

先方が我が国協力を期待するアウトプットは、2020年までの100%電化達成のための全国世帯電化基本計画の策定であることが確認されているが、本予備調査においても、マスタープランにおける目

標年度の設定（5ヵ年毎/各年毎等）について先方の意向を再確認する。

対象地域

要請においては全国を網羅することとしているが、他プロジェクトとの整合性にも十分留意し、本案件で検討対象とすべき範囲を設定する。特にインド・アッサム州との国境付近への立ち入りができないことが本格調査実施上の制約要因となることを説明し、先方の理解を得る。

計画立案（マスタープラン）の対象範囲

2020年を目標年限とした大規模電源開発計画（150MW以上）及び220kv、132kv、66kvの高圧送電系統整備計画については、本年中にノルウェー（NORAD）の協力により計画策定がなされる予定であり、本格調査においては、地方電化計画の上流計画とされるべき大規模電源開発計画及び高圧送電計画を与条件として取り扱い、本格調査でのマスタープラン計画立案の対象領域は33kv及び11kvの中圧配電網とする可能性は高いと考えられる。大規模電源開発計画、既存の送電系統整備計画をどのように取り扱うべきか、という点について先方の意向を再確認する。

オフグリッド電化計画の取り扱い

極力グリッドによる電化を進めたいというブータン政府の意向は無視できないため、本格調査の重点はグリッド計画の立案となると考えられる。

その一方、人口密度、地形等の条件から、オフグリッドによる電化とせざるを得ない地域も相当程度存在すると考えられ、グリッド電化の投資効率を議論した上で、オフグリッド電化計画の検討を行う必要がある。但し、オフグリッド電化計画については、全県の未電化村落を全て実地調査の対象として詳細な電化計画を立案することは予算、期間等の制約から現実的ではないことから、代表的な複数地点についての村落現地調査結果（小水力ポテンシャル、需要原単位、支払可能額、社会・経済指標等の情報収集・分析）に基づいて、複数の電化手法のモデルプラン（複数のパターン）を作成の上、かかるモデルプランに基づき全国レベルでの検討を行うという我が方の考え方を説明し、理解を得る。

他セクターの開発計画とのリンケージの考慮

電化のインパクトを最大化するという観点から、道路、通信、教育、医療、農業等の他セクターの開発計画とのシナジー効果を念頭に、これらセクターの開発計画を十分踏まえた計画策定を行うべきであるという我が方の考え方を説明し、先方の理解を得る。併せて、関連開発計画に係る情報・資料の提供を要請する。

4) 技術移転及びキャパシティビルディングの方法について

本格調査時の現地作業においてカウンターパートと共同で作業を行うことで電化計画立案に必要とされる技術移転・カウンターパート機関のキャパシティビルディングを図ること、必要に応じて複数名を日本におけるカウンターパート研修に招聘することが可能であること、インセプション・プロGRESS・

インテリムレポート協議時及びドラフトファイナルレポート協議時にセミナーを行うことを提案し、先方のニーズを確認する。また、本格調査の成果品にマスタープラン改訂マニュアルを含めること等についても先方のニーズを確認する。

5) ブータン側実施体制の確認（関連機関の）担当部署、責任窓口、連携体制の確認

要請提出当時の貿易産業省電力局（DOP）は、電力セクター改革により、2002年7月には、政策立案、計画策定、電力事業実施に係る財源確保、及びブータン電力公社に対する補助金給付等を担当するエネルギー局（DOE）、送変配電設備の整備・維持管理、電力料金徴収、及び設備容量20MW未満の水力発電所建設・維持管理等を担当するブータン電力公社（BPC）（100%国有）、電力料金に係る許認可等の規制を担当するブータン電力規制庁（BEA）に分割された。

要請案件のカウンターパート機関はDOEとなるが、開発調査実施のためには、既存の送変配電設備及び計画中の送変配電設備に係る正確な理解が必要であること、DOEが策定した計画に基づき事業を実施する主体となるBPCの積極的な関与が不可欠であることを説明し、先方の理解を得る。

また、DOE及びBPC内における担当部署及び責任者が記載されたメンバーリストの提出を要請するとともに、本格調査実施時に関連機関からの情報入手、意見交換が可能となるよう要請する。

6) 電化計画策定のためのソフトウェアについて

グリッド電化計画策定において使用するソフトウェアについての意見交換を行う。調査終了後のF/S作業（ADBによるTAが想定される）とのデータの互換性、維持管理・操作の容易さを考慮し、活用するソフトウェアを検討する。また、本格調査終了後におけるソフトウェアのアップデートについてはブータン側が実施すべきものであるとの我が方の考え方を示し、先方の理解を得る。

7) ローカルコンサルタント（村落データ収集）の活用について

本格調査においては、ブータン国内事情に精通しているローカルコンサルタントを活用する必要があるものと思料される。ブータンの地方部村落の大部分は未電化（未電化村落数は約2000）であり、そのデータ収集は本格調査に必要不可欠である一方、アクセスの問題等から膨大な時間を要する。現地再委託による情報収集を想定し、本予備調査において、TOR草案に係る検討、ローカルコンサルタントの調査実施能力、コスト等に係る情報収集を行う。

8) 地図等データの持ち出しについて

本格調査は、現地における作業が中心となることを想定しているため、地図等のデータの国外持ち出しが本格調査実施上の必須条件とはならないと考えられるが、国内作業での利用を想定し、全土をカバーする地図データ（5万分の1）を始めとする諸データの国外持ち出しの可否を確認する。

9) ブータン側の便宜供与事項について

本格調査の円滑かつ効率的な実施のために、 什器備品（机、椅子、キャビネット等）を伴うDOE内の

執務スペース、 移動用車輛、 通信回線（電話、ファックス、及びインターネット接続）が必要であることから、遅くとも本格調査団の現地到着時点には、これらの便宜供与がなされ、必要な執務環境が整備されている必要があることを説明し、先方の理解を得る。これまで同国で実施した開発調査案件での経緯に鑑みれば、S/Wに記載のブータン側Undertakingにおけるローカルコスト負担につき、その負担が事実上困難となる可能性は否定できない。この点につき確認し、仮に先方より何らかの要望があげられた場合は、その旨をM/Mに記載の上、持ち帰り検討するものとする。

10) 調査用資機材について

本格調査の実施にあたっては、パソコン、プリンタ、コピー機、電話機、携帯電話、ファクシミリ機、GISソフトウェア、配電系統解析用ソフトウェア等の機材調達が必要となる可能性もある。これら機材の現地調達の可能性につき事務所からの情報収集等も通じて確認する。

(3) 本格調査実施に必要な情報の収集

以下の点を中心に情報収集を行う。別添5に示すDiscussion Notesを事前送付し、我が方の関心事項、問題意識を示すことにより、先方の協議準備を促すこととする。

1) 関連プロジェクトの動向

本開発調査に関連するプロジェクトとして以下が挙げられる。

- 配電線延伸による地方電化プロジェクト（第3期）（RE- ）（ADB）
- Power System Master plan (PSMP) (NORAD)

ADBが実施しているRE- についてはF/Sレポートがまもなく完成する予定である。今回の予備調査においてその動向を把握し、要請案件との整合性が確保されるよう配慮するものとする。なお、本対処方針、S/W案は、承認後、ADBマニラにも事前送付の上、コメントを求めるものとする。また、PSMPの成果品については、期限を設定の上、その提供を要請する。

2) 事業化の考え方、財務状況の把握

ブータン政府は、地方電化事業の実施について、ADB の TA 及び借款を念頭においた構想を抱いている可能性が高い。本格調査における事業化の可能性を検討するに際しては、先方政府の考え方が重要な要素となるため、事業化のための資金調達に係る先方の意向を確認するとともに、JBIC からの団員が中心となり、ブータン政府との意見交換を行うものとする。

また、ADB からのローンだけでは 2020 年までの 100%電化達成は困難であるとの見方もできることから、事業化のための自主財源確保の重要性を説明するとともに、4 年後に完成予定のタラ発電所（1050MW）等からの売電収入からの財源確保見通し等について聴取するとともに意見交換を行う。

3) 環境配慮事項

ブータンは世界でも10指に数えられるほど生物種密度が高い国であり、貴重な生態系が豊富に存在している。また、小規模の開発行為に至るまで、EIA（Environmental Impact Assessment）やIEE（Initial Environmental Examination）等の環境評価が適用されており、政府による環境保護政策への注力が伺われる。このような国を対象とするマスタープランは、電力設備開発上の環境配慮事項を十分に踏まえたものとする必要がある。また、適切な環境配慮は国際金融機関における借款においても重視され、計画の事業化の上でも重要である。このような視点より、予備調査においては、世銀、JBIC、ADB等の国際金融機関におけるガイドライン等を踏まえた上で、ブータン国におけるマスタープラン策定上考慮すべき自然・社会的環境要素と環境関連法規について情報収集を行う。

4) GISマップの準備状況

プロ形調査において、成果品となる長期計画は、データの維持管理、改訂の容易さ等の観点から、GISマップを含むデジタル媒体で提供されることが要望されたが、かかる要望に応じるためには、少なくとも本格調査の開始時点で、配電計画などの作業をGISで行うための前提となるデジタル地形図が調査団に提供されなければならない。この作業の進捗具合、完成時期を確認するとともに、デジタル地形図は本格調査団に無償で提供されるべきものであることを説明し、合意を得る。

5) 治安への配慮

治安上配慮すべき事項につき、事務所等を通じ情報収集を行う。

インド・アッサム州で分離独立を求める過激派組織であるアッサム統一解放戦線やポドランド民族民主戦線などが、インド軍に追われ、ブータン領内に侵入してきており、ブータン南部を移動するブータン人が過激派に襲撃される事件が発生している他、インド軍・治安部隊と過激派との間での武力衝突や、政府要人に対するテロ事件、他州からの移民に対するテロ事件が発生している。これを背景としてブータン南東部（インド・アッサム州との国境付近）には「渡航の是非を検討して下さい」が発出されている。アッサム州との国境に位置する地域での調査は実質上困難であるところ、机上検討を中心とすること等を念頭に治安の観点からも調査のあり方を検討する。

6) 村落データ

本格調査で必要となる未電化地域の村落の位置・人口等のデータは基本的にブータン政府から提供されるものであることを説明するとともに、そのデータ整備状況を本予備調査で確認する。その整備状況如何によっては、本格調査で補足調査を行う必要性も想定され、その実施方法について協議する。

7) 国内向け電力供給に係る方針

ブータンにおいては、売電による外貨（インドルピー）獲得は依然として重要な政策課題であり、今後開発が計画されている大規模電源についてはインドへの売電がメインとなる。国内需要の規模からすれば、インド向けの売電が国内向け電力供給の制約要因となる可能性は低いと考えられるものの、国内への電力供給に係る先方の政策について情報を収集する。

關係資料 1 正式要請書

APPLICATION FOR THE TECHNICAL COOPERATION BY THE GOVERNMENT OF JAPAN

1. BACKGROUND INFORMATION

1.1 Project Title

Integrated Master Plan Study for Dzongkhag (District) Wise Electrification by Renewable Energy in Bhutan
- Challenge from Villages -

1.2 Location of the Object

The Whole of Bhutan - 20 Districts (Dzongkhag) -

1.3 Executing Agency

Department of Power
Ministry of Trade & Industry
Royal Government of Bhutan

1.4 Project Justification

(1) Background

Bhutan has 46,500 km² in land area and about 667 thousands in population. Land of the country rises from about 100 m in altitude in the Indian border area up to 7,500 m toward Tibetan Plateau. Most of the population is concentrated in the river villages. Mainly these are four river basins, namely Amo chu, Wang chu, Puna chu and Manas chu (Refer to Attachment-1).

Necessity of Rural Power Supply

Some 85 % of the population are living in rural area and almost all the people there have no access to electricity. At present the people receiving electricity supply is less than 30 % of the country population despite the large installed generating capacity of 357 MW. In the year 1999, 76 % of the total generation was exported to India and the remaining only 24 % was consumed in the country. Of course, the power exporting is important income source of the foreign currency. That income has much contributed to improving

level of people's living standards especially for health and education according to the national developing policy and will be so continuously in the future.

On the same line of the development policy, enhancing electricity supply in the rural area becomes essential to proceed to the next stage of the development. For instance, the health clinics need the electricity to keep vaccine in a refrigerator, the schools needs the electricity to give the education of computer literacy to avoid digital divide and the households needs the electricity for light, TV and radio and for other socio-economic activities (cottage industry, weaving, craft work, etc.). And non-electrified households still use fuel woods and imported kerosene for cooking and for light, from which the smoke exhausted harmfully affects the health with respiratory disease of the people living in the households, especially for the women and children the situation is serious. Electricity supply will change this situation toward the healthy and hygienic life condition, and improve the economic conditions. Further, giving electricity and other economic opportunities for development will reduce the rural-urban migration taking place which is concern to the Royal Government of Bhutan.

Besides the above, the Royal Government of Bhutan (RGOB) give a high priority on strengthening telecommunication and Information Technology (IT) of the country. Expanding rural electrification is a key factor for telecommunication and IT facilities to function well.

Necessity of the Master Plan Study

First, the Master Plan Study is necessary to accomplish Bhutan's long term target of 100 % rural electrification by year 2020 (Vision 2020 document).

RGOB has the long-term target to achieve 100 % electrification across the country by the year 2020. As it is generally well known, Bhutan has a huge amount of hydro potential, which is estimated to 30,000 MW. By the reason of huge hydro potential and also to feed the stable power to the consumers, RGOB has been giving top priority in developing hydro resources and extending the grid for rural electrification.

However it seems to be difficult to realize the long-term target of 100 % electrification only by the hydro development and grid extension. Because Bhutan is sparsely populated and then the demand densities of almost rural areas are much low. Grid extension has small advantage of economics for the areas of exceedingly low demand density, and the isolated grid with small/micro hydro also needs some level of demand density. To the extremely small demand, like two or three households, isolated far away from grid, solar or small wind system usually take advantage of economics.

Up to now RGOB has not yet established such master plan focusing on the final target of 100 % electrification considering all the potential power sources and power supply system for the socioeconomic development of the country, specially the rural areas.

The above is first reason why RGOB needs this Master Plan Study.

Secondly, the Master Plan Study is necessary to establish integrated operation and maintenance system involving local people for sustainable rural power supply.

Participation of the local people and involving local people are essential for sustainable operation of rural power supply. Now the people receiving power in rural area cannot repair the simple fault, like just changing one fuse of the power supply facilities. Department of Power (DOP) staffs have to make a long trip to the local villages from Thimphu for 5 or 6 days just to change the broken fuse on call (e.g. for solar panels in remote areas). This is a big loss of DOP's resources. The remaining non-electrified areas are mostly very far from roadway. Under the present management system to the rural areas, achievement of sustainable rural power supply to the remaining non-electrified areas is desperate.

Lack of information and fundamental training to the local people and lack of self-reliance mind of local people leads to the above situation. For the sustainable power supply to the rural areas, it is important to set up the integrated operation and maintenance system including local people. The system should periodically provide fundamental training and information on operation and maintenance and Demand Side Management (DSM) to the local people, and more important, that should stimulate self-reliance mind of the local people.

The self-reliance mind is the most basic factor not only for sustainable power supply but also for widely social development in rural areas. In order to incubate and encourage the self-reliance mind of local people on the rural power supply, the following are recommendable: (i) involving local people from the planing stage, (ii) sharing responsibility on power supply between the local people and DOP, such as making fund by the village themselves for operation and maintenance, and (iii) introducing competitive system among villages.

The idea about the competitive system among villages is to prepare some evaluation system of the villages from the viewpoint of sustainability before introducing power supply facilities. Priority ranking of power supply to the villages is to be decided considering this evaluation result in addition to the economical point of view. By the system, the villages made much effort ready for operation and maintenance can mostly receive power earlier than the villages of less effort. The system will inevitably stimulate self-reliance mind of local people.

In order to establish the above mentioned integrated operation and maintenance system, technical assistance is required as the Master Plan Study.

Thirdly, the Master Plan Study is necessary to introduce the up-to-date, state-of-the-art technology.

The revolutionary changes are proceeding in the field of power at present. The price of solar and wind generating system have been drastically going down. Almost major auto-makers in the world announced that they would release fuel cell vehicles on commercial basis in the year 2004 or 2005. And there is a possibility to use the

produced hydrogen for cooking and heating substituting fuelwood or kerosene. It is said that almost all the batteries will be replaced by super condenser in the near future, which is complete maintenance free and long life of more than 20 years.

This kind of changes relatively increase the attraction of more intermittent renewable energy like solar and wind compared with hydro power. Introducing these new technologies for the rural power supply is realistic enough. We hear that the super condensers were decided to be applied to the traffic signals with solar panels and Light Emitting Diode (LED) lamps in some intersections in Kathmandu under the Japanese Grant Aid Program; the major reasons to apply such new technology were maintenance free and environmentally friendly.

To make the master plan considering the up-to-date technologies is effective to achieve the final goal of 2020 from the viewpoints of economics, environment and sustainability.

(2) Objectives of the Study

Objectives of the Study are as follows:

- a) Preparation of demand map of non-electrified area;
- b) Observation of wind and solar energy in the areas where grid extension seems to be not feasible and preparation of these potential map;
- c) Formulation of appropriate development plan of rural power supply for the non-electrified areas considering all the option of renewable energy with priority ranking list, and cost estimates;
- d) Presentation of integrated operation and maintenance system for sustainable power supply in rural areas;
- e) Execution of basic level of study to the villages highly prioritized;
- f) Accepting voluntary activities for pilot plants, demonstration plants and /or actual plants installation and/or operation from private enterprises and any other government or multilateral organizations under the coordination of the Study to effectively use the information and formulate integrated master plan, if any.

(3) Prospective Beneficiaries

The prospective direct beneficiaries will be the rural people no access to electricity, about 470 thousands people today. However, indirectly all the people of the country will receive the benefit from the result of the study, Bhutanese policy makers and planners will have long term prospective district wise plan (a blue print) to mobilize timely resources to achieve 100 % rural electrification as per their 2020 Vision.

(4) **Project Priority in National Development Plan**

The Master Plan Study is urgently needed to establish the appropriate strategy to achieve RGOB's long term target "electricity for all" by the year 2020. The Study is to be given high priority for realizing sustainable development of rural power supply by renewable energy resources for environmental conservation and for social and economic development.

1.5 Proposed Implementation Schedule

The period to establish the master plan is estimated at twenty-four (24) months (Refer to Attachment - 2).

1.6 Expected Funding Source

Technical assistance program by the Government of Japan.

1.7 Other Related Project

- (1) ADB:
Power Distribution Master Plan Study for Rural Electrification by Grid Extension
- (2) UNDP/GEF:
Bhutan Mini/Micro Hydropower Development Project
- (3) JICA (under request)
 - Feasibility Study for Small Hydropower Generation for Rural Development
 - Review of Existing Micro Hydro Stations (13 Nos.) Implemented under 1st Phase and 2nd Phase Japanese Grant and Possible Up-gradation to meet New Electricity Demand
 - Sustainable Rural Electrification through Extension of Grid to Villages

2. SCOPE OF THE STUDY

2.1 General

In accordance with the Objectives of the Study, the Study is broadly divided into three stages:

- Stage 1: Initial formulation stage
- Stage 2: Master Plan formulation stage
- Stage 3: Basic design level study stage and cost estimate

Transfer of technology is to be carried out mainly in the form of on-the-job training from time to time during the course of the above studies, at the seminars to be held and JICA's counterpart training. In the counterpart training, training on planning and design of the system including methodologies for a system upgrade and efficiency improvement for the system will be carried out to DOP counterparts.

The detailed scope of the Study is itemized as follows:

Stage 1: Initial Formulation Stage

In this stage, establishing study formation involving the local people is major objective. And the detailed targeted areas of this study should be decided through the collection of existing data including future plan of grid extension and discussion with DOP.

The major components of the study are outlined below:

- (1) Collection and analysis of the existing data and information;
- (2) Identification of non-electrified villages and decision of detailed target areas of the Study (GPS Survey);
- (3) Preliminary site survey (sample detailed identification of households/villages);
- (4) Setting up study formation including local people;
- (5) Selection of meteorological observation points (around 20 points).

Stage 2: Master Plan Formulation Stage

In this stage, major objectives of the Master Plan Study are accomplished. The work is much local-oriented, so the Study Team seems to need to assign local consultants (and/or Royal Bhutan Polytechnic students).

The study in this stage is itemized as follows:

- (1) Installation of meteorological observation units and start of data collection;

- (2) Seminar at each targeted Dzongkhag;
 - Distribution of questionnaires to local people to collect basic data for formulating operation and maintenance system, power supply system design, etc.
 - Technology transfer
- (3) Collection of questionnaires and their analysis;
- (4) Preparation of demand map;
- (5) Preparation of integrated operation and maintenance system;
- (6) Preparation of ranking list of villages on operation and maintenance with evaluation method;
- (7) Sample site reconnaissance to verify the study results;
- (8) Grouping of demand and preparation of standard type power supply system;
- (9) Preparation of potential map of solar and wind;
- (10) GIS mapping of the system;
- (11) Cost estimation and economic analysis on standard type power supply system and total plan;
- (12) Formulation of appropriate development plan of rural power supply with priority ranking list and network diagram;
- (13) Accepting voluntary activities for pilot plants, demonstration plants and /or actual plant installation and/or operation from private enterprises and any other government or multilateral organizations under the coordination of the Study to effectively use the information and formulate integrated master plan, if any.

Stage 3: Basic Design Level Study Stage

According to the result of the study, basic design level of the study will be carried out to all the villages that have to be electrified by year 2020.

2.2 Work Schedule

The proposed work is to be completed within the period of twenty-four (24) months.

2.3 Expected Inputs of Expertise

Following experts are expected to be assigned to the proposed study:

- (1) Team Leader (Power System Planner)
- (2) Social Planner
- (3) Transmission & Distribution Line Expert
- (4) Photovoltaic Power Expert
- (5) Wind Power Expert
- (6) Mini/micro Hydro Power Expert
- (7) Hydrologist
- (8) Meteorologist
- (9) Civil Engineering Design Expert
- (10) Total Energy Planner
- (11) Economist
- (12) Surveyor
- (13) GIS Mapping Expert
- (14) Coordinator

2.4 Expected Major Outputs

It is envisaged that the Study Team will submit the following reports in English during the Work:

- | | |
|-------------------------|-----------|
| (1) Inception Report: | 10 copies |
| (2) Progress Report: | |
| - Progress Report-1: | 10 copies |
| - Progress Report-2 : | 10 copies |
| (3) Interim Report: | 25 copies |
| (4) Draft Final Report: | 25 copies |
| (5) Final Report: | 30 copies |

2.5 Request to Other Donor Agencies

No specific request has been made to other donor agencies with respect to the master plan study on rural power supply targeting 100 % electrification by 2020.

2.6 Other Relevant Information and Request

- (1) Not only the need of electricity supply but also the need of water supply is extremely high in rural areas. Then, only in the case that the local request is much strong and also renewable energy can be effectively utilized for water supply, the water supply system could be included in the Study.
- (2) Energy demand-supply basic forecast for each district for 2020 (firewood, LPG, kerosene, petrol/diesel) will be included in the study.
- (3) One package of the development project in the priority list will be mostly small. Therefore, in addition to the Government own budget, the option of finance sources will increase; for example, Japanese grass root grant, NGO/NPO's assistance and any other small voluntary assistance will become acceptable to execute the one package of the project.

3. GLOBAL ISSUES

3.1 Environmental Components

The Study envisages formulating a rural power supply development plan by renewable energy resources for the sustainable growth of the country. Environmental aspects are to be carefully managed to increase its positive effects.

The greenhouse effect of the Earth is not encouraged through the development of renewable energy, which is one of the Global Issues suffered by CO₂ and Nox gas emission.

3.2 Environmental Impacts Forecast

The project implementation will lower the gap of living standard level between urban and rural, then contribute the mitigation of people's concentration to urban areas. No deforestation is required for the execution of the project. Since the power supply to households reduces the consumption of fuel woods, the Project will contribute forest conservation.

3.3 Women as Main Beneficiaries

The electrification of households will reduce daily hard burden of women like fuel wood collection and long time domestic work in dark and unhygienic kitchen. The Project will create job opportunities for both male and female, and further increase production in

various economic sectors. The electricity supply will reduce labor intensive burden of daily life usually assigned to women.

3.4 Poverty Reduction Components

Electricity supply by renewable energy resources will contribute to expediting industrialization and modernization of the society and consequently raise standard of living, income level of people. This will activate various commercial / industrial activities and enhance job opportunities which will contribute to the reduction of poverty in the country; cottage and service industries can grow in the rural area.

3.5 Any Constraints against Low Income People

No specific issue is considerable for low-income people by the rural power supply by renewable energy resources.

4. UNDERTAKING OF THE GOVERNMENT OF BHUTAN

4.1 Creation of Good Conditions for Work

(1) Assignment of Counterpart Personnel

DOP will assign additional counterpart personnel as discussed with the Study Team. DOP will also mobilize experts from other authorities concerned, if necessary. It is requested that DOP has the information about the number of required expertise counterparts, required knowledge level and experience about one month prior to the commencement of the Study.

(2) Topographic and Geological Surveys

DOP will support topographic and geological surveys for the selected priority subprojects required for the Study, if the work is needed.

(3) Available Data, Information, Documents, etc.

All the available data, information, documents, etc. in English are to be submitted to the Study Team at their request according to the formality being agreed between DOP and the Study Team.

4.2 Undertakings of the Government

In order to facilitate a smooth and efficient conduct of the Study, the RGOB shall take necessary measures:

- (1) to secure the safety of the Study Team.
- (2) to permit the members of the Study Team to enter, leave and sojourn in the country in connection with their assignment therein, and exempt them from alien registration requirement and consular fees.
- (3) to exempt the Study Team from taxes, duties and any other charges on equipment, machinery and other materials brought into and out of the country for the conduct of the Study.
- (4) to exempt the Study Team from income taxes and charges of any kind imposed on or in connection with any emoluments or allowances paid to the members of the Study Team for their services in connection with the implementation of the Study.
- (5) to provide appropriate office and office equipment including copy and facsimile machines required for the Study Team procured for the project.
- (6) to provide necessary facilities to the Study Team for remittance as well as utilization of the funds introduced in the country from Japan in connection with the implementation of the Study.
- (7) to secure permission or entry into private properties for the conduct of the Study.
- (8) to secure permission for the Study to take all data, documents and necessary materials related to the Study to Japan.
- (9) to provide medical services as needed. Its expenses will be chargeable to the members of the Study Team.
- (10) to provide Dzongkha - English interpreters.

Attachment - 1: Location Map
Attachment - 2: Proposed Work Schedule of the Master Plan Study
Attachment - 3: Organization Chart of Royal Government of Bhutan
Attachment - 4: Organization Chart of Department of Power

關係資料 2 口 上 書



EMBASSY OF JAPAN
BHUTAN

No.B/39/03

NOTE VERBALE

The Embassy of Japan presents its compliments to the Royal Bhutanese Embassy, and has the honour to refer to the recent discussions held between the representatives of the Government of Japan and the Royal Government of Bhutan concerning the project for Integrated Master Plan for Dzongkhag-wise Electrification by Renewable Energy and to propose the following arrangements:

1. The Government of Japan will enter into survey, in accordance with the relevant laws and regulations of Japan for the project for Integrated Master Plan for Dzongkhag-wise Electrification by Renewable Energy.
2. The Royal Government of Bhutan will accord privileges, immunities and other benefits to the Japanese survey team necessary for the conduct of the survey, and will take necessary measures to secure the safety of the survey team members.
3. The details and procedures for cooperation in the present arrangements, including specific privileges, immunities and other benefits to be accorded to the Japanese survey team as mentioned in paragraph 2 above, shall be provided for in the implementing arrangements to be agreed upon between the Japan International Cooperation Agency and the Ministry of Trade and Industry, Royal Government of Bhutan.

The Embassy of Japan has further the honour to propose that the present Note and the Royal Bhutan Embassy's Note in reply accepting on

behalf of the Royal Government of Bhutan the foregoing proposal shall be regarded as constituting an agreement between the two Governments.

The Embassy of Japan avails itself of this opportunity to renew to the Royal Bhutanese Embassy the assurances of its highest Consideration.



Royal Bhutanese Embassy
Chanakyapuri
New Delhi

ROYAL BHUTANESE EMBASSY
CHANDRA GUPTA MARG
CHANAKYAPURI
NEW DELHI-110021



NGA/I-84 (A)/288

The Royal Bhutanese Embassy presents its compliments to the Embassy of Japan, and has the honour to acknowledge the receipt of the latter's Note No. B/39/03 dated March 18, 2003, concerning the project for Integrated Master Plan for Dzongkhag-wise Electrification by Renewable Energy.

The Royal Bhutanese Embassy has further the honour to accept on behalf of the Royal Government of Bhutan the proposal set forth in the above-mentioned Note and to agree that the Embassy of Japan's Note and this Note shall be regarded as constituting an agreement between the two Governments.

The Royal Bhutanese Embassy avails itself of this opportunity to renew to the Embassy of Japan the assurances of its highest consideration.



Embassy of Japan
New Delhi

關係資料 3 質 問 書

June , 2003

Discussion Notes to DoE
on
Integrated Master Plan Study for Dzongkhag Wise Electrification
by Renewable Energy in the Kingdom of Bhutan (The Study)

JICA Mission

Outstanding matters carried over from the previous discussion are enumerated in the followings. These are 1) data/information required for electrification planning, 2) associated programs for sustainability in rural electrification work, 3) and other necessary system of the Study.

The upcoming discussion meeting on the Scope of Work will be centered on these matters, and prior arrangements by DoE for the response will be highly appreciated.

Questionnaires are presented in separate sheets. Data and information specified in the questionnaires are primarily for use in the Study, and therefore the reply is necessary for the confirmation of the availability.

Refers to the Minutes of Meeting on the Study agreed upon between JICA and DoE on November 5, 2002

1. Data & information Required

Clarification of the current position of the activities listed below is at most important to JICA mission in defining the Scope of Work.

(1) GIS Mapping Work

GIS mapping work of the whole Bhutan based on digitization of topographical maps of scale 1:50,000 will form a basis for electrification planning. Subsequently, data/information from socio-economic survey on the target villages will be compiled in to the GIS mapping. Therefore, the GIS work has to be finished within the Preliminary Survey Stage of the Study.

DoE is requested to obtain the relevant information from Department of Survey and Land Records, and analyze the current position against the original schedule and scope, and identify the measures, if necessary, to fulfill the requirements for time completion and quality/quantity.

(2) RE-3 Feasibility Study Report

Up to now, rural electrification plan had been developed by repetitions of three phases of REs (RE-1, 2, and 3), and experienced presumably of alternations in standards/regulations of the system design, and also of changes in size and configuration of HH electricity demand over the previous periods.

Higher cost performance in rural electrification can be attained from a view point of a

long term planning, and the Study shall review and assess supply-demand structure and cost effectiveness of the present power supply. JICA mission will identify a necessity in reforms and/or improvements in design concept and methodology of distribution system planning.

DoE is requested to arrange for a presentation session on the draft final report of the Feasibility study for 9th FYP Rural Electrification Program. Of particular emphasis is to be placed on presentation of drawings of 20 Dzongkhag (districts) showing electrification plan of 15,000 HHs, and also of optimization concept and methodology employed in the design of the least-cost power supply expansion. Furthermore, utilization of computer software programs, especially of PSS/ADEPT, shall be elaborated in each step of distribution network design. JICA mission will assess the applicability to the Study and/or necessity of upgrading/revision of the programs.

(3) NORAD Study Outcome

It should be noted that the target of the Study is to design distribution network of 33/11kV lines and associated facilities for rural electrification. Power transmission of 220/132/66kV lines and associated substations is the backbone system, from which the distribution network will be expanded. Accordingly, master plan study of the power transmission system up to year 2020 is considered to be a prerequisite for the Study, and it is supposed to be made available by NORAD Study.

Regarding the outcome of Water Resources Management Plan and Update of the Power System Master Plan, DoE is requested to arrange for a presentation session attended by the Project Manager.

JICA mission will assess the adequacy of adopting the NORAD study results as the prequalification of the Study, and therefore DoE's elaboration on the outcome of the NORAD study is most desirable.

2. Programs for Sustainability

In order to secure sustainability in rural electrification, the Study shall include facilitation of various programs supporting the smooth implementation of the rural electrification plan. Other items not listed below will be raised during the discussion.

(1) Operation and Maintenance Guidelines for Rural Electrification

In expanding power network into country-wide area, it will be more and more physically difficult for centrally situated Begana technical staffs to cope with every occasion of technical problems in the remote area. It will become demanded to gradually shift parts of the central obligations for O&M works towards district levels.

The self-reliance of district wise O&M system has to be facilitated by community level undertakings by introduction of rural organizations/industries in various aspects of electricity supply services.

DoE is requested to arrange for a field trip to Punakha district for JICA mission to have a discussion with local government officials and the electricity sector's personnel. JICA mission will review the current conditions in O&M of the local network system based on the records of the past performances, and will identify the prospective of the local community participation in the electricity supply services.

Moreover, Human resources development targeting the local villagers is one of the highest in national priority, and currently Basic Skills Development Project is on-going under the leadership of National Technical Training Authority (NTTA) with ADB support.

DoE is requested to arrange for a meeting with NTTA and JICA mission to identify possible coordination mechanism between the NTTA activities and the Study in the area for skill development and creation of new employment opportunities in electricity supply services.

(2) Social Development Programs

The past electrification already covered district centers and sub-centers, and accordingly the target of electrification in the Study will be mostly a remote area with difficult access conditions. In the remote area where people's living have no other choices but to rely on public facilities in health and education opportunities, there will be an increasing need for rural electrification in good harmony with the social welfare development, such as medical and educational services.

Functional output of basic health unit (BHU) and other social facilities has to be maximized by provisions of electric power supply, not only for satisfying the electricity requirements of the medical and educational equipments but also for accommodating electrified living quarters to attract new recruits of employment staffs.

In the Study for formulating master plan for rural electrification, higher priority shall be given to the electrification of the social facilities.

DoE is requested to setup a meeting between JICA mission and the relevant social sectors to share understanding the common needs in pursuit of identifying suitable cooperative programs to be considered in the Study.

(3) Financial Strategy

With Tala and other big hydro development schemes coming into operation, a considerable increase in the national revenue is expected to take place, and the financial status of GoB will experience a gradual reduction in its dependency on foreign funding. In particular interest is of GoB's capacity in financing rural electrification work will be strengthened.

Also with rapid expansion in the domestic electrification network, the recurrent cost for the operation and maintenance will certainly become a burden, and at the same time electrification cost per HH will sharply rise up due mainly to have to face with

mostly sparsely distributed electricity demand.

Such advantages as well as disadvantages in the outcome of the financial environment of the rural electrification will be a controlling factor for sustainable development of rural electrification, and there will be a necessity of more in-depth analysis of the economical and financial implications of the rural electrification work on the overall financial viability of GoB. It is important in the Study to analyze the adequacy of future foreign investment and propose necessary adjustments to maintain GoB's financial viability.

DoE is requested to set up discussion meeting with DoF in defining the Scope of Work in this regard.

3. Undertakings of DoE and JICA

Preparatory Survey Stage of Master Plan will be suitable to be conducted partly by the undertakings of DoE.

DoE is also responsible for overall coordinating the works among other related organizations/institutions in RGOB.

Tentative Plan

Part of the Preparatory Works	Undertakings by
GPS Survey	JICA
Socio-economic Survey	JICA
GIS Mapping Work	DoE

4. Coordination Committee

Having recognized the facts that;1) data/information required for the Study must come from other organizations/institutions, and timely coordination meeting by DoE becomes often necessary; 2) the resultant output such as GIS database will be made open later for use by other organization/institutions, and it become desirable to adopt an uniform format commonly accessible by many organizations/institutions; and 3) coordination with other organizations/institutions for various programs such as in social development;

Establishing a formal group to function, as a coordination body for the various activities involved in the Study, is well justified.

DoE is requested to initiate a formation of Coordination Committee to be participated by other related institutions/organizations, DoE as the chairman.

5. Counterpart Personnel

For effective technology transfer for capacity building in the Study, counterpart team shall be participated by DoE/BPC and other related officials. DoE is requested to submit a list of candidate member who will join to the Study as the counterpart personnel.

The proposed member positions are shown in the table below for use in further discussion with DoE.

Tentative Plan

Position	Organization	# of Staff
Project Manager	DoE	1
Power Transmission Design	BPC	1
Power Distribution Design	BPC	1
Off-grid development (Hydro)	DoE	1
Off-grid development (Solar)	DoE	1
Socio-economic Survey	DoE	1
Environmental impact evaluation	NEC	1
Economic and Financial Study	MoF	1

Questionnaire for Integrated Master Plan Study for Dzongkhag wise Electrification in The Kingdom of Bhutan

Please provide the following information.

Item	Description	Remarks
General		
1	<p>General Information</p> <p>(1) Latest Power Data</p> <p>(2) Latest Statistical Year Book</p>	<p>Power Data 2000-2001 (April 2002) is already obtained.</p> <p>Statistical year book of 1997 is already obtained.</p>
Power System Planning		
1	<p>General Information of Power System</p> <p>(1) Geographical map of power system and System configuration with capacity of power station and substation, transmission line length, conductor type and size</p> <p>(2) Power flow map of transmission system(in case of heavy and light load condition)</p>	
2	<p>Economical Data for System Plan</p> <p>(1) Life time of each kind of facility such as Hydro power plant, Transmission line, Substation, Distribution line</p> <p>(2) Annual expenditure rate to construction cost of each kind of facility</p> <p>(3) Long term marginal cost per kW and kWh, of each kind of facility</p>	
3	<p>Update of Power System Master Plan (PSMP)</p> <p>(1) Please show us/or explain following items</p> <p>1) Progress situation of the study with outcome</p> <p>2) Design criteria presented to DoE 28.Nov 2002,</p> <p>3) Applied planning standard, such as voltage regulation limit, allowable current, fault clearing time.</p> <p>4) Unit cost estimation and economic/financial consideration,</p> <p>5) Relationship between demand forecast of district and forecast of substation load</p> <p>6) Employed computer and software: name and its function</p>	
4	<p>System Analysis Data used for PSMP</p> <p>(1) Please provide listed data after completion of the study</p> <p>Generator constant, Transformer impedance, Transmission line and Distribution line impedance, admittance, etc.</p> <p>(2) Connection diagram of system map for system analysis.</p>	<p>Detail data of Up-date PSMP</p>
5	<p>Information of Computer Software Installed in DoE and/or BPC</p> <p>(1) Please explain function and using condition of listed software for System Plan</p> <p>PSS/E, PSS/ADEPT, PSS/U, MiPower for Techno-economic analysis</p> <p>Comfo III for GIS</p> <p>Arc Info2.1, Arc View3.1, Arc GIS8.1</p>	<p>Please refer to an attachment for detail.</p>
6	<p>Software used for Pre-F/S for 9th FYP Rural</p> <p>(1) Kind of software and its function</p> <p>(2) Linkage method to GIS Data</p>	

Questionnaire for Integrated Master Plan Study for Dzongkhag wise Electrification in The Kingdom of Bhutan

Please provide the following information.

Item	Description	Remarks
Medium and Low Voltage Distribution System 1 Law, Regulation, Standard and Manual	(1) Laws related to planning, design and construction of distribution system	
	(2) Regulation related to planning, design and construction of distribution system	
	(3) Standard related to planning, design and construction of distribution system	
	(4) Manual related to planning, design and construction of distribution system	
2 Standard Unit Cost for Grid Extension	(1) 33kV and 11kV feeder bay (per bay include a circuit breaker)	
	(2) 33kV and 11kV feeder (per km by conductor size)	
	(3) 33kV/400,230V and 11kV/400,230V transformer (per Tr. by capacity/installation. type)	
	(4) 400/230V feeder (per km by conductor size)	
	(5) SVR and Capacitor	
	(6) Service drop wire	

Question on your computer software

1. We have discussed the development of computer model for grid extension designing, testing and on the job training on it as mentioned on the minutes of meeting dated Nov.5 2002. .

In connection with this matter, let us know the situation of your PSS computer program series PSS/E, PSS/ADEPT, PSS/U, and MiPower.

Please explain the following questions for these software one by one.

- 1) What kind of work or analysis do you use of them?
 - 2) How often do you usually use each of them?
 - 3) How many persons practically use each of them?
 - 4) When do you install them? (Produced year)
 - 5) How do you maintain them? (Contract with PTI?)
 - 6) Do they well work?
 - 7) Do you think more user training is necessary?
2. Comfor III
- 1) What kind of function does this software has?
 - 2) And please explain for same question mentioned above item1.
 - 3) Is this software used for “Pre-feasibility study for 9th five year plan rural electrification program”?
 - 4) Are there any linkage to GIS related software, Arc Info, Arc View and Arc GIS?

Questionnaire for Rural Electrification Master Plan Study by Grid Extension in The Kingdom of Bhutan

Please provide the following information.

Item	Description	Remarks
Environmental legislation	<p>(1) Environmental Legislation</p> <ul style="list-style-type: none"> - Number, title, publication date and outline of environmental legislation, including the environment basic law, laws and regulations for air/water quality conservation, prevention of noise and vibration, etc. - Pollutants/parameters and numerical limits for ambient air/water/noise quality, air emission, aqueous effluent, noise and vibration generation, etc. <p>(2) Legislations for nature conservation (Especially, outline and requirements of the following legislations are important.)</p> <ul style="list-style-type: none"> - Forest and Nature Conservation Act (1995) - Forest and Nature Conservation Rules (2000) - Regulation for Environmental Clearance of Projects (2002) <p>(3) Environmental Assessment</p> <ul style="list-style-type: none"> - Outline of the Environmental Assessment Act (2000) - Outline of the Sectoral Guideline for "Highway and Road" - Will the Strategic Environmental Assessment is required for the preparation of the master plan? If yes, please provide the information concerning name and outline of underlying laws, outline of regulatory requirements, guidelines for implementation of Strategic Environmental Assessment, etc. 	<p>The following documents are already obtained;</p> <ul style="list-style-type: none"> - Sectoral Guideline for Power Transmission Lines, - Environmental Assessment Process Manual

Questionnaire for Rural Electrification Master Plan Study by Grid Extension in The Kingdom of Bhutan

Please provide the following information.

Item	Description	Remarks
<p>1 Environmentally Sensitive areas</p>	<p>1 Protected Areas - Maps which indicate the location of the protected areas and sensitive habitats including reserved forests, national parks, wetlands, important habitats for wildlife, etc. - Name of institutes/organizations in charge of management of database on environmentally sensitive areas - Present status of preparation of GIS database on environmentally sensitive areas - Present status of implementation of BIODIVERSITY ACTION PLAN</p> <p>2 Rare/Endangered Species - Name list of major rare/endangered species, protected species and ecologically important species - Maps which shows habitats of major rare/endangered species, protected species and ecologically important species - Present status of preparation of GIS database on major rare/endangered species, protected species and ecologically important species (including both flora and fauna)</p> <p>3 Social/Cultural Sensitive Areas Are there any maps which indicate the location of social/cultural sensitive areas shown below? If yes, please provide the source of information and how to obtain the information. - Cultural/religious heritage sites/area - Areas/sites of unique, historic, archeological, or scientific interests - Areas which are traditionally occupied by cultural communities or tribes - Reservoir - Habitation area of indigenous people/ethnic minority</p>	<p>The following document is already obtained; - BIODIVERSITY ACTION PLAN FOR BHUTAN 2002</p>
<p>2 Environment Management Plan</p>	<p>- Present status of preparation of GIS database related to the forest management plan - Name of institute/organization in charge of preparation of GIS database related to the forest management plan</p>	<p>The following document is already obtained; Forest Management Plan (Draft)</p>

Questionnaire for Rural Electrification Master Plan Study by Grid Extension in The Kingdom of Bhutan

Please provide the following information.

Item	Description	Remarks
Organizational Structure for Environmental Management		
1	Name and objective of environmental management organizations including below; - NEC - Ministry of Agriculture - Other organizations related to environmental management	
2	Organizational chart, and role and responsibility of the above environmental management organizations	
Clean Development Mechanism		
1	Framework and system for CDM project implementation in Bhutan (Is NEC DNA of Bhutan?)	
2	National strategy, status of CDM infrastructure development and potential CDM projects in Bhutan	