

THE INTEGRATED MASTER PLAN STUDY  
FOR DZONGKHAG-WISE ELECTRIFICATION  
IN BHUTAN

FINAL REPORT

**ANNEXES**

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***ANNEX-1***


***SCOPE OF WORK  
AGREED UPON BETWEEN  
JAPAN INTERNATIONAL  
COOPERATION AGENCY  
AND  
MINISTRY OF TRADE AND INDUSTRY***

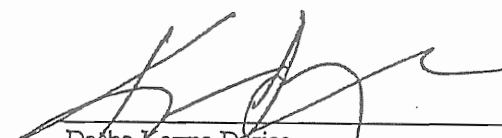
***JUNE 27, 2003***

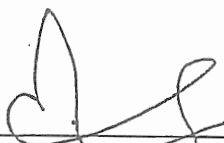
SCOPE OF WORK  
FOR  
THE INTEGRATED MASTER PLAN STUDY  
FOR DZONGKHAG-WISE ELECTRIFICATION  
IN  
THE KINGDOM OF BHUTAN

AGREED UPON BETWEEN  
JAPAN INTERNATIONAL COOPERATION AGENCY  
AND  
MINISTRY OF TRADE AND INDUSTRY


Thimphu, June 27, 2003

  
\_\_\_\_\_  
Dr. Akira Niwa  
Leader, The Preliminary study team  
Japan International Cooperation Agency (JICA)

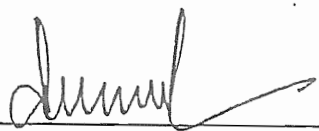
  
\_\_\_\_\_  
Dasho Karma Dorjee  
Secretary,  
Ministry of Trade and Industry

  
\_\_\_\_\_  
Mr. Sonam Tshering  
Director, Department of Energy,  
Ministry of Trade and Industry  
&  
Managing Director,  
Bhutan Power Corporation

In Witness:

  
\_\_\_\_\_  
Mr. Yasuyuki Mori  
Resident Representative  
JICA Bhutan Office

In Witness:

  
\_\_\_\_\_  
Mr. Pema Tshewang  
Officiating Director General  
Department of Aid and Debt Management  
Ministry of Finance

## 1. INTRODUCTION

In response to the request of the Royal Government of Bhutan (hereinafter referred to as "RGOB"), the Government of Japan decided to conduct the Integrated Master Plan study for Dzongkhag (District) wise electrification in Bhutan (hereinafter referred to as "the Study") in accordance with the relevant laws and regulations in force in Japan.

Accordingly, the Japan International Cooperation Agency (hereinafter referred to as "JICA"), the official agency responsible for the implementation of the technical cooperation programme of the Government of Japan, will undertake the Study in close cooperation with the Department of Energy (hereinafter referred to as DOE), Ministry of Trade and Industry, the counterpart agency and other concerned authorities of RGOB.

The present document sets forth the scope of work with regard to the Study.

## 2. OBJECTIVE OF THE STUDY

The RGOB aims to achieve "Electricity for All" by the year 2020. The target requires formulating a comprehensive rural electrification plan.

The main objective of the Study is, (1) to produce a sustainable techno-economic rural electrification plan and corresponding financial plan and (2) to strengthen planning and implementation capacity to accomplish the goal of electrification program up to the year 2020. The techno-economic plan shall be formulated as an optimal Dzongkhag (District)-wise rural electrification plan (hereinafter referred to as "RE Master Plan"), in which on-grid and off-grid electrification plans are combined. Also, capacity building programs shall be included to transfer necessary ideas and technologies in the course of the Study to the counterpart personnel of related organizations.

## 3. THE STUDY AREA

The Study shall cover all of the twenty Dzongkhags of Bhutan

## 4. SCOPE OF THE STUDY

The Study shall be carried out in the following three stages and appropriate capacity building programs shall be incorporated:

First Stage - Preliminary Survey

Second Stage - Analysis and Planning



### Third Stage - Master Plan and Strategy Formulation

Details of undertakings at each stage are itemized as follows:

#### 1) Preliminary Survey Stage

##### (1) Data collection and review of background data

Collection and review of the data and information relevant to:

- Long-term national plan for social development and social welfare
- Socio-economic data of remote villages (i.e. census data)
- Related national network development plan (i.e. road, telecommunication)

##### (2) Data collection and review on the power sector and rural electrification

Collection and review of the data and information relevant to:

- Policy and regulatory framework for rural electrification
- Power generation, transmission and distribution
- National budget plan for the power sector and financial plan of Bhutan Power Corporation
- Off-grid electrification projects in the past and their current status
- Cost data regarding on-grid and off-grid rural electrification
- Relevant study reports.

##### (3) Data collection and review on technical issues

Collection and review of the data and information relevant to:

- Existing electric power supply facilities and operation and maintenance of the facilities
- Design standards, construction and operating costs of transmission and distribution network
- Power supply technologies suitable for remote less populated areas
- GIS technologies suitable for power system planning and management

##### (4) Evaluation of medium voltage distribution network planning methodologies

Review and discussion on relevant computer programs and GIS maps for medium voltage distribution network planning shall be carried out to select the most appropriate medium voltage distribution network planning methodology to be applied in the Study. In the course of discussions, planning simulations shall be conducted on several model villages considering distance from existing power line, demand density and topography. Also, difficult-to-access

areas in Bhutan shall be studied to assess potential boundaries of on-grid and off-grid areas.

(5) Village data survey and database creation

In order to create a database of village-wise information necessary for formulating the RE Master Plan, a local subcontractor shall be selected and the following tasks shall be carried out:

- Data collection on unelectrified village from relevant organizations
- On-site unelectrified village survey with Global Positioning System and collection of village data (excluding those villages where key data can be obtained from other sources)
- Data compilation and data input to GIS map

(6) Study on off-grid energy sources

As an energy source for off-grid electrification, availability, cost, benefits and shortcomings of mini/micro-hydro, photovoltaic, wind power, and other technologies and resources shall be studied. Existing survey data of mini/micro-hydro sites shall be reviewed and preliminary site surveys shall be conducted.

(7) Preliminary site survey and power demand estimation

A series of preliminary site surveys at electrified and un-electrified villages shall be conducted in order to identify the needs for electricity and to estimate electricity demand.

Demand forecast analysis of un-electrified villages shall be conducted for the period up to year 2020, considering various consumer categories of residential, commercial, industry, government and other electric power use. Dzongkhag-wise Demand Map, showing the distribution of village load centers together with geographical conditions, is needed in the subsequent medium voltage distribution plan, and shall be constructed on GIS database.

Also, site surveys at the villages with off-grid systems shall be carried out to identify the benefits and shortcomings of off-grid electrification. After the site surveys, the unit electricity demand per household in remote areas to be used in medium voltage distribution network planning shall be set out. In setting the unit electricity demand per household, it is important to consider the following points:

- actual electricity consumption in the electrified villages
- village characteristics and electricity demand patterns
- objectives of rural electrification such as reduction of use of fuel wood, poverty alleviation, improvement of health and education and socio-economic development

## (8) Environmental data collection

Policy, legislation and programs on environmental conservation and environmental impact assessment with respect to rural electrification shall be studied. Also, environmental data and information on the environmental sensitive areas, including National parks, Wildlife Sanctuary, Biological Corridors, Forest Management Unit, habitat of endangered species and cultural and/or religious heritage site, shall be collected. On premises that collected data and information will be compiled as GIS topographical distribution on the important areas from environmental viewpoint will be clarified as much as possible at the data collection stage.

## 2) Analysis and Planning Stage

On-grid

## (1) Evaluation of efficiency and economic viability of rural electrification

Based on the results of the first-stage study, basic approaches for rural electrification, both on-grid and off-grid, shall be thoroughly reviewed with the involvement of concerned RGOB officials by paying attention to the key issues such as financial resources, efficient public spending, level of electricity tariff and subsidy requirements, and coordination with other sectors.

Electric power consumption in rural households shall be reviewed and assessed with regard to types of equipment in-use and the amount of consumption through the results of the first-stage study, and the evaluation shall be made of adequacy in introducing "Energy Best Mix", "New Renewable Energy", and "Demand Side Management" in improving efficiency in household electricity consumption.

## (2) Technical review of medium voltage distribution network system in remote mountainous areas

Technical review on medium voltage distribution network system shall be carried out to examine technology options (system configuration and equipment) in order to ease the difficulties of grid extension work in remote mountainous areas with a view to securing reliability and cost saving.

## (3) Development of methodologies for medium voltage distribution network planning

Using the computer program selected in the first-stage study, appropriate methodologies for GIS based medium voltage distribution network planning shall be developed. After incorporating relevant data, the developed methodologies shall be actually tested by Japanese study team. Computer operation training for Bhutanese engineers shall be conducted to make them master



the computer skills for medium voltage distribution network planning.

(4) Joint work to develop Dzongkhag-wise medium voltage distribution network plan

After setting technical and financial criteria for medium voltage grid extension in remote areas, a medium voltage distribution network plan for each Dzongkhag shall be developed as collaborative work between Japanese study team and RGOB counterparts paying attention to mitigating environmental impacts. Adequate mitigation measures shall also be investigated in consultation with National Environment Commission and other relevant organizations, if necessary.

The grid extension plan under RE Master Plan shall cover the 33kV and 11kV distribution lines that will supply electricity to un-electrified villages. Low voltage distribution network within the villages shall not be a part of the Study. Dzongkhag-wise distribution network plan shall be, after GIS formatting, superimposed on the existing network diagrams. Based on the training imparted, Bhutan Power Corporation (BPC) shall provide the existing network diagrams to cover those Dzongkhags electrified by the previous RE-1, RE-2, and RE-3. Distribution system analysis shall be conducted to estimate the least-cost electricity distribution.

(5) Review and adjustment to power system master plan

The Updated Power System Master Plan of Bhutan shall be reviewed and checked for the locations and specifications of interconnections with the medium voltage distribution network. In particular, the transmission substations shall be adjusted so as to enable efficient and reliable electricity supply to Dzongkhag-wise medium voltage distribution network. Recommendations for alternative plan shall be made, if any.

Off-grid

(6) Field survey

Considering the difficult-to-access areas studied in the first stage, socio-economic field surveys shall be conducted in selected villages to obtain in-depth socio-economic data for developing off-grid electrification model plans. Also, field surveys to identify mini/micro hydro resources shall be continued.

(7) Joint work to develop Dzongkhag-wise off-grid model plan

After selecting appropriate technologies, recommendable village-based off-grid electrification model plan by renewable energy sources for each Dzongkhag shall be developed as collaborative work between Japanese study team and RGOB counterparts paying attention to

mitigating environmental impacts. Villages in off-grid zones of each Dzongkhag shall be classified into sub groups that correspond to suitable off-grid model plan. In developing the off-grid model plans, it is important to consider the following points:

- Implementing agency of off-grid rural electrification
- Village organization to achieve autonomous operation and management
- Cost recovery and financial sustainability including public assistance
- Affordability and suitable financing scheme for the users
- Technical sustainability including backstopping scheme
- Income generation by using electricity

At the same time, efforts shall be made to study the possibility of connecting the existing off-grid plants to the grid system to secure reliable power supply.

#### Common issues

##### (8) Operation and maintenance scheme

Analysis on appropriate operation and maintenance scheme of on-grid and off-grid electricity supply systems shall be conducted.

##### (9) Environmental assessment

Strategic Environmental Assessment (SEA) study shall be conducted in cooperation with relevant organizations/personnel in order to build a consensus on rural electrification and environment. The study shall be conducted based on the process prescribed in the Regulation on Strategic Environmental Assessment of RGOB. Environmental guidelines of international donors, such as the World Bank, Japan Bank for International Cooperation (JBIC), Asian Development Bank (ADB), etc., shall also be considered.

##### (10) Evaluation of socio-economic impacts

Issues relating to rural electrification such as change of lifestyle, poverty alleviation, improvement of education and health, gender issues, greenhouse gas emissions, de-forestation shall be analyzed.

#### 3) Master Plan and Strategy Formulation Stage

##### (1) Joint review of Dzongkhag-wise rural electrification plan

A draft of integrated on-grid and off-grid electrification plan up to the year 2020 for each Dzongkhag shall be jointly reviewed between JICA study team and RGOB counterparts. The

Dzongkhag-wise rural electrification master plan (RE Master Plan) shall be developed after the review.

(2) Estimation of capital investment and recurrent costs

Necessary financial requirements covering the capital investment and recurrent costs shall be estimated up to the year 2020 based on the RE Master Plan. In-village low voltage line costs shall be included in the cost estimates, and shall be derived based on past rural electrification programs and as such will not cover detail survey and BOQ of low voltage connections within the villages.

(3) Strategic planning for the implementation of RE Master Plan

Measures necessary to implement the RE Master Plan and to achieve the goal of rural electrification shall be studied. Items to be studied will include:

- Financing strategies
- Cost allocation and electricity tariff scheme
- Institutional framework
- Human resource development
- Coordination with other social development activities
- Recommendation on environmental management and monitoring

(4) Conduct workshops on the RE Master Plan

Workshops to be attended by representatives from all Dzongkhags shall be held to take into account stakeholders' opinions.

(5) Finalize the RE Master Plan and preparation of summary report for distributing to possible donors/investors

#### 4. STUDY SCHEDULE

The Study is planned to be conducted for a period of 24 months in accordance with the tentative time schedule attached in Appendix I.

#### 5. REPORTS

JICA shall prepare and submit the following reports in English to RGOB at the due timing shown in the schedule.

1. Inception Report (Ic/R)

twenty (20) copies

2. Progress Report (P/R)	twenty (20) copies
3. Interim Report (I/R)	twenty (20) copies
4. Draft Final Report and Summary (Df/R)	thirty (30) copies
5. Final Report and Summary (F/R)	thirty (30) copies

The RGOB shall provide JICA with comments in writing on the Draft Final Report within one month after receiving the report.

## 6. DIVISION OF TECHNICAL UNDERTAKING

The division of technical undertakings by JICA and the Department of Energy, Ministry of Trade and Industry is detailed in Appendix II attached herewith.

## 7. UNDERTAKING OF THE ROYAL GOVERNMENT OF BHUTAN

1. To facilitate smooth conduct of the Study, the RGOB shall take necessary measures:

- (1) to permit the members of the Japanese study team to enter, leave and sojourn in Bhutan for the duration of their assignments therein, and exempt them from foreign registration requirements and consular fees;
- (2) to exempt the members of the Japanese study team from taxes, duties and other charges on equipment, machinery and other materials brought into Bhutan and out for the implementation of the Study;
- (3) to exempt the members of the Japanese study team from income tax and charges of any kind imposed on or in connection with any emoluments or allowances paid to the members of the Japanese study team for their services in connection with the implementation of the Study;
- (4) to provide necessary facilities to the Japanese study team for remittance as well as utilization of the funds introduced into Bhutan from Japan in connection with the implementation of the Study;
- (5) to facilitate prompt clearance through customs and inland transportation of equipment, materials and supplies required for the Study and of the personal effects of members of the Japanese study team.

2. The RGOB shall bear claims, if any arises, against the members of the Japanese study team resulting from, occurring in the course of, or otherwise connected with the discharge of their

duties in the implementation of the Study, except when such claims arise from gross negligence or willful misconduct on the part of the members of the Japanese study team.

3. The DOE shall act as a counterpart agency to the Japanese study team and also as coordinating body in relation to other governmental and non-governmental organizations concerned for the smooth implementation of the Study.

4. The DOE shall, on behalf of RGOB, at its expense, provide the Japanese study team with the following in cooperation with other concerned organizations:

- (1) security-related information on as well as measures to ensure the safety of the Japanese study team;
- (2) information on as well as support in obtaining medical services;
- (3) available data and information related to the Study;
- (4) counterpart personnel;
- (5) suitable office space with necessary equipment in Thimphu;
- (6) credentials or identification card

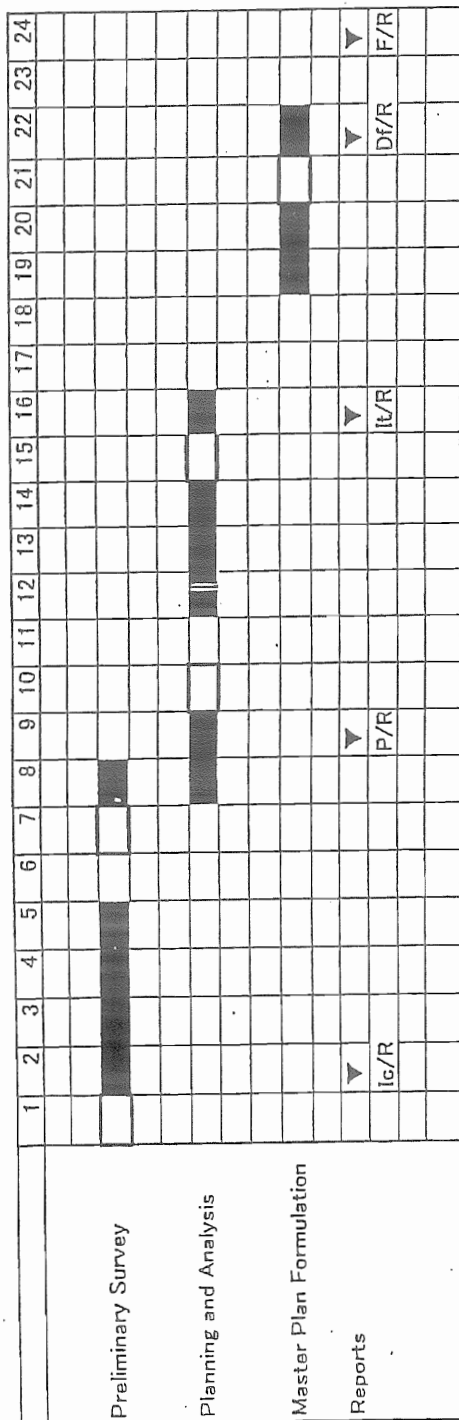
#### 8. OTHERS

JICA and DOE shall consult with each other in respect of any matter that may arise from or in connection with the Study.



Appendix I

Tentative time schedule



Work in Japan Work in Bhutan

Undertakings by JICA and DOE/BPC

Work Items	Undertakings by JICA	Undertakings by DOE/BPC
1) Basic data collection	1) Data collection and analysis	1) Provision of necessary data, reports and information 2) Arrangements for data collection from relevant organizations
2) Geographical Information System	1) Review of GIS maps, computer systems and software 2) Instruction and training on GIS technologies	1) Provision of GIS maps (1:50,000). 2) Provision of GIS-based outputs of RE-3 3) Participation in training 4) GIS mapping of existing power system
3) Preliminary socio-economic site survey	1) Interview survey on socio-economic conditions, electricity demand, environmental issues, etc. 2) Data analysis	1) Arrangements for site visits 2) Provision of assistance (counterpart) to site survey
3) Mini/Micro-hydro site survey	1) Survey on mini/micro hydro sites for near-by villages 2) Data analysis	1) Arrangements for site visits 2) Provision of assistance (counterpart) to site survey

Work Items	Undertakings by JICA	Undertakings by DOE/BPC
4) Medium voltage distribution network planning methodology	<ol style="list-style-type: none"> <li>1) Evaluation of candidate computer programs</li> <li>2) Selection of most appropriate program</li> <li>3) Training of counterpart officers</li> <li>4) Preparation of operation manuals</li> </ol>	<ol style="list-style-type: none"> <li>1) Participation in review and evaluation</li> <li>2) Provision of comments</li> <li>3) Participation in training</li> </ol>
5) Village data survey (by subcontract)	<ol style="list-style-type: none"> <li>1) Preparation of TOR</li> <li>2) Tendering and subcontracting</li> <li>3) Supervising the work (survey and database creation)</li> </ol>	<ol style="list-style-type: none"> <li>1) Provision of comments and advice on workflow</li> <li>2) Provision of assistance for tendering</li> <li>3) Arranging with Dzongkhag and BPC offices for smooth undertaking</li> </ol>
6) Analysis of issues on rural electrification	<ol style="list-style-type: none"> <li>1) Data collection and conducting interviews/discussions</li> <li>2) Conducting analyses</li> </ol>	<ol style="list-style-type: none"> <li>1) Provision of relevant information and data</li> <li>2) Provision of comments</li> </ol>
7) Technical review on remote power supply system	<ol style="list-style-type: none"> <li>1) Data collection</li> <li>2) Evaluation of available technologies</li> </ol>	<ol style="list-style-type: none"> <li>1) Provision of comments</li> </ol>
8) Dzongkhag-wise medium voltage network plan	<ol style="list-style-type: none"> <li>1) Demand estimation</li> <li>2) Setting criteria for medium voltage network</li> <li>3) Demonstration of planning process with sample Dzongkhags</li> <li>4) Provision of instructions and coaching for Bhutanese officials</li> <li>5) Review and evaluation of draft plans</li> </ol>	<ol style="list-style-type: none"> <li>1) Provision of comments and advice on workflow and criteria</li> <li>2) Participation in workshops/training to master skills for medium voltage network planning</li> <li>3) Load flow analysis and GIS mapping of draft network plans</li> </ol>



Work Items	Undertakings by JICA	Undertakings by DOE/BPC
9) Socio-economic field survey for off-grid planning	<ol style="list-style-type: none"> <li>1) Investigation on renewable energy potentials</li> <li>2) Interview survey on socio-economic conditions, electricity demand, environmental issues, etc.</li> <li>3) Data analysis</li> </ol>	<ol style="list-style-type: none"> <li>1) Arrangements for site visits</li> <li>2) Provision of assistance (counterpart) to site survey</li> </ol>
10) Off-grid model plan	<ol style="list-style-type: none"> <li>1) Analysis on technical, economic, and institutional issues relating to off-grid electrification</li> <li>2) Creation of model plans</li> </ol>	<ol style="list-style-type: none"> <li>1) Provision of relevant information and data</li> <li>2) Provision of comments</li> </ol>
11) RE Master Plan	<ol style="list-style-type: none"> <li>1) Study and evaluation of MV network plan and off-grid plan</li> <li>2) Integration into the RE Master Plan</li> <li>3) Investment and recurrent cost estimation</li> </ol>	<ol style="list-style-type: none"> <li>1) Provision of relevant information and data</li> <li>2) Provision of comments</li> <li>3) Organizing workshops</li> </ol>
12) Strategic planning	<ol style="list-style-type: none"> <li>1) Making policy recommendations and strategic action plans</li> </ol>	<ol style="list-style-type: none"> <li>1) Involvement of concerned organizations</li> <li>2) Holding meetings to discuss implementation</li> </ol>

***ANNEX-2***

***MINUTES OF MEETING***


***AGREED UPON BETWEEN  
JAPAN INTERNATIONAL COOPERATION AGENCY  
AND  
MINISTRY OF TRADE AND INDUSTRY***

***JUNE 27, 2003***

MINUTES OF MEETING  
FOR  
THE PRELIMINARY STUDY  
FOR  
THE INTEGRATED MASTER PLAN STUDY  
FOR DZONGKHAG-WISE ELECTRIFICATION  
IN  
THE KINGDOM OF BHUTAN

BETWEEN  
JAPAN INTERNATIONAL COOPERATION AGENCY  
AND  
DEPARTMENT OF ENERGY  
MINISTRY OF TRADE AND INDUSTRY

Thimphu, June 27, 2003



Dr. Akira Niwa  
Leader, The Preliminary study team  
Japan International Cooperation Agency (JICA)



Mr. Sonam Tshering  
Director, Department of Energy  
Ministry of Trade and Industry

The preliminary study team (hereinafter referred to as "the Team") sent by the Japan International Cooperation Agency (hereinafter referred to as "JICA"), headed by Mr. Akira Niwa, the Leader of the Team, visited the Kingdom of Bhutan from June 16 to June 27, 2003 for the purpose of discussing the Scope of Work regarding the Study on Integrated Master Plan for Dzongkhag-wise Electrification in the Kingdom of Bhutan (hereinafter referred to as "the Study"). JICA and the Department of Energy, Ministry of Trade and Industry (hereinafter referred to as "DOE"), discussed the following issues and finalized the Scope of Work. This minutes of meeting is prepared to record the issues that complement the Scope of Work.

The list of participants is attached as Annexure A.

### 1. Concept of RE Master Plan

The Team and DOE jointly developed the Study concept and workflow of RE Master Plan as shown in Appendix 1. Dzongkhag-wise Rural Electrification Master Plan and Recommendations for National Action Plan (policy and regulations, financial strategy, planning and implementation capacity, and technology in household energy) are expected to be the output of the Study.

### 2. Counterpart personnel

To ensure technology transfer, which is one of the important objectives of the Study, the DOE and the Bhutan Power Corporation (hereinafter referred to as "BPC") shall assign appropriate counterpart personnel with relevant technical background, experience and skills who will directly carry out the study work jointly with the Study team. Counterpart personnel from other related governmental agencies and organizations shall also be provided as and when required. The Study team will provide the DOE with a tentative plan of counterpart assignment, based on which the DOE will intimate the list of names of counterpart personnel.

### 3. Coordinating Committee

In order to facilitate the smooth implementation of the Study, a Coordinating Committee shall be established. The Coordinating Committee is responsible for the smooth implementation of the Study and also monitoring the progress of the Study. The Coordinating Committee meeting shall be held at least once in every quarter. The DOE shall coordinate the meetings. A tentative list of Coordinating Committee members shall comprise the DOE, BPC, Ministry of Finance, JICA/JOCV Bhutan office, and the Study team. Participation of other government agencies shall be coordinated by DOE in the event of need.

### 4. Workshop

The Team and DOE agreed to hold workshops in order to enunciate the draft Dzongkhag-wise RE Master Plan and to take into account opinions of stakeholders, including representatives of twenty (20) Dzongkhags (Districts). Necessary arrangements for the workshops, including sending invitation to stakeholder, scheduling, arrangements for the venue, etc. shall be conducted by DOE. The DOE requested including the expenses for the workshops



within the overall project scope. The Team understood the necessity of these expenses and will convey the request to JICA Headquarters.

#### 5.Provision of digital maps made by the Survey of Bhutan

The DOE agreed to provide the Study team with digital maps made by the Survey of Bhutan as DOE input.

#### 6.Provision of census data

The DOE agreed to pursue with the Department of Registration, Ministry of Home Affairs, for census data required for the purposes of the Study.

#### 7. List of unelectrified villages

The DOE will make all efforts to provide the list of unelectrified villages after RE-3 before the commencement of the Study.

#### 8.Office space and equipment

The Team requested that the DOE provide adequate office space to the Study team with enough furnishing, a telephone line, and necessary office equipment (e.g., desks, chairs, personal computer, multimedia projector, and printer) that are needed to carry out the Study. The Study team is expected to consist of around ten professionals. The DOE replied that adequately furnished office accommodation shall be provided including access to telecommunication connections. However, the DOE requested that office equipment such as desktop computers, copiers, fax machines etc. and running expenses of telecommunication system be included within the project cost.

#### 9.Counterpart training

The DOE requested that JICA provide opportunities of counterpart training in Japan for DOE staff. The Team replied that it would be possible to arrange the training for, at least, one person per year.

#### 10.Software and equipment to be used in the Study

The DOE requested, in the event software is required, to consider the use of MIPOWER software for power system analysis of the Study as they already have personnel trained in the use of this software. Further, the DOE mentioned the need for having several units of GPS equipment and GIS software. The Team will convey the request to JICA Headquarters.

#### 11.Timing of Study Commencement

The DOE requested the Team that JICA take necessary measures to commence the Study as soon as possible, preferably in November 2003.

## Annexure A

List of the MembersJICA Preliminary Study Team

Dr. NIWA Akira  
Team Leader, Senior Advisor for Power Development, JICA

Mr. TATEMATSU Shingo  
Study Planning, Program Officer, Energy and Mining Development Study Division,  
Mining and Industrial Development Study Department, JICA

Mr. OTAKI Kazuhiko  
Planning for Rural Electrification, Consultant, Proact International Co., Ltd.

Mr. OKAWARA Kunio  
Planning for Transmission and Distribution System, Consultant, A&S Engineering Co.,  
Ltd.

MR. IKE Tomohiko  
Environmental Issues, Consultant, E & E Solutions Inc.

Mr. YONEDA Gen  
Development Fund Planning, Deputy Director, Division 3, Development Assistance  
Department III, Japan Bank for International Cooperation (JBIC)

Department of Energy

Mr. Sonam Tshering  
Director, Department of Energy

Mr. Bharat Tamang  
Chief Engineer, Planning & Coordination Division, Department of Energy.

Mr. Karma P Dorji  
National Project Manager, Planning & Coordination Division, Department of Energy

Mr. Karma Tshewang  
Assistant Engineer, Planning & Coordination Division, Department of Energy



Bhutan Power Corporation

Mr. Tenzin Yonten  
General Manager, Customer Service Department, Bhutan Power Corporation

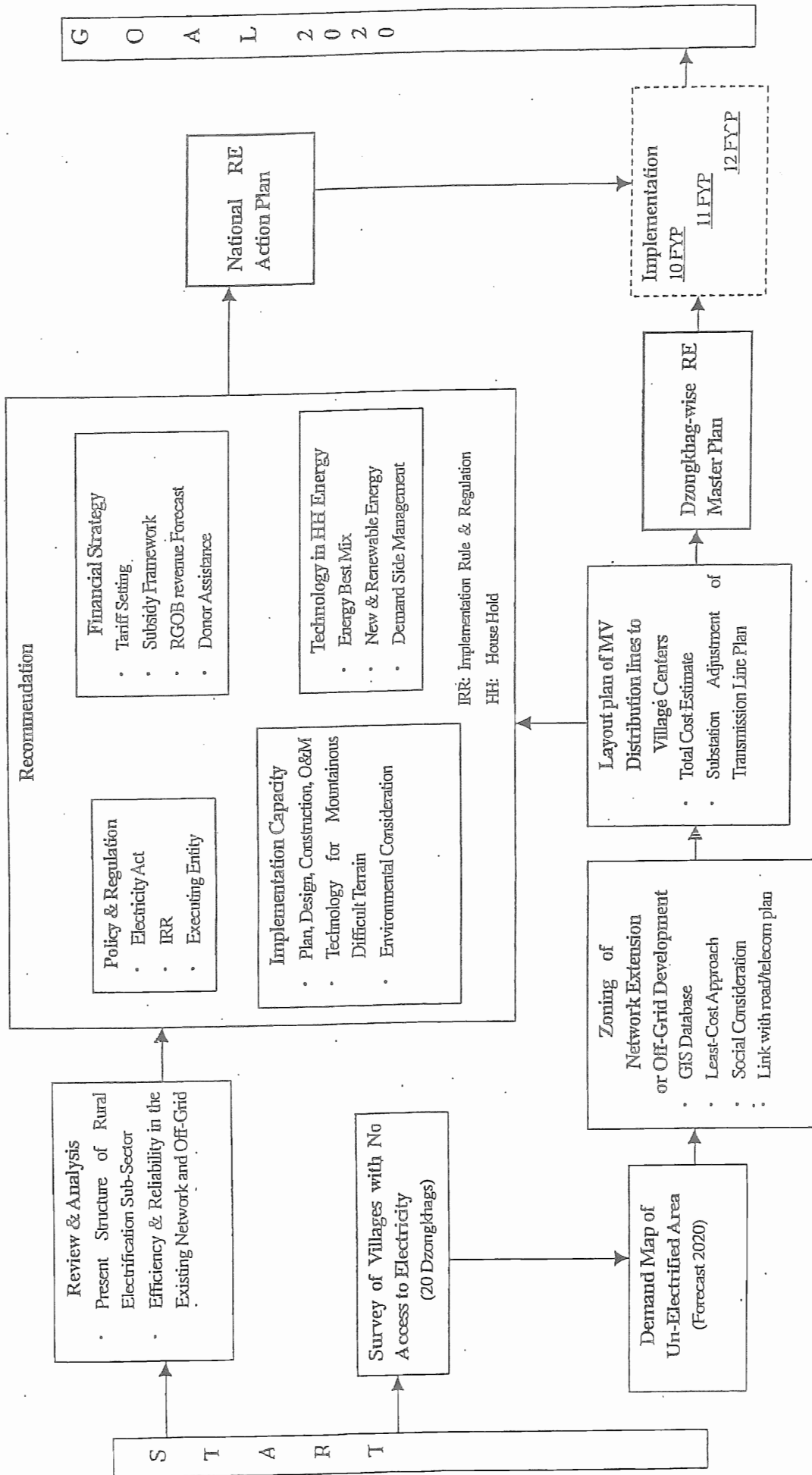
Mr. K. B. Wakhley  
General Manager, Development & Construction Department, Bhutan Power Corporation

Mr. Jigme Tobgyel  
Manager, Planning Division, Bhutan Power Corporation

Mr. Tenpa Gurme  
Sr. Manager, R & UED, Development & Construction Department, Bhutan Power Corporation

Mr. Sunil Rasaily  
Engineer, Customer Service Department, Bhutan Power Corporation





*[Signature]*

Work Scope of JICA Rural Electrification (RE) Master Plan



***ANNEX-3***

***MINUTES OF MEETING  
(FIRST SITE WORK: NO.1)  
BETWEEN***

***THE MASTER PLAN STUDY TEAM***

***AND***

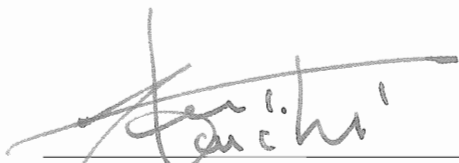
***DEPARTMENT OF ENERGY  
MINISTRY OF INDUSTRY***

***DECEMBER 24, 2003***

MINUTES OF MEETING  
FOR  
THE INTEGRATED MASTER PLAN STUDY  
FOR DZONGKHAG-WISE ELECTRIFICATION  
IN  
THE KINGDOM OF BHUTAN  
(FIRST SITE WORK: NO.1)

BETWEEN  
THE MASTER PLAN STUDY TEAM  
AND  
DEPARTMENT OF ENERGY  
MINISTRY OF TRADE AND INDUSTRY

THIMPHU  
DECEMBER 24, 2003



Mr. Tomoyasu Fukuchi  
Team Leader, JICA Study Team  
Nippon Koei Co., Ltd.



Mr. Sonam Tshering  
Director/Managing Director  
Depart. of Energy/Bhutan Power Corporation  
Ministry of Trade and Industry

The Master Plan Study Team (the Team) of the Japan International Cooperation Agency (JICA), which is headed by Mr. Tomoyasu FUKUCHI, arrived in Bhutan on December 2, 2003, and will leave on December 25, 2003. During their stay in Bhutan, the Team submitted the inception report, explained it to Bhutan side and had discussions with the officials concerned in Bhutan.

On December 23, 2003, the Team had a wrap-up meeting with Department of Energy (DOE), Ministry of Trade and Industry, Bhutan Power Corporation (BPC) and the parties confirmed the followings.

1. **Inception Report** : The Team submitted twenty copies of Inception Report to DOE on December 3, 2003 and discussed the contents with DOE and Bhutan Power Corporation (BPC). The Team received the official comments from DOE via their letter DOE/PCD/RE-MP/2003-04/354 dated December 19, 2003 (Attachement-1). The Team will revise the inception report according to the specific comments attached to the above letter and the letter itself will be a part of the inception report as attachment. The Team will resubmit twenty sets of revised inception report as final version.  
The Team well understands the general comments of the letter and those comments will be reflected in the master plan study. However, it is quite difficult to forecast the electricity demand up to 2035 or 2040 precisely; it's far future. Thus, the demand after 2020 may be simply forecasted with the appropriately estimated increase ratios.
2. **Counterpart Personnel**: DOE submitted the list of counterpart personnel by DOE/PCD/RE-MP/2003-2004/334 dated December 10, 2003 (Attachement-2). Project Manager from DOE and Focal Person from BPC will arrange and/or coordinate counterpart personnel as required by the Team. Besides, counterpart personnel for the financial and economic analysis will be coordinated with Ministry of Finance through DOE.
3. **Coordinating Committee** : The first coordinating committee will be held on January 15, 2004 at 10:00 a.m. at DOE's conference hall as informed by DOE's letter (Attachment-3).
4. **Workshop** : The first workshop will take place at RICB/BCCI Conference Hall, on January 30, 2004 from 10:00 a.m. according to the program shown in the Attachment-4. DOE will send the invitation to the members of coordinating committee, the official concerned, the representative of each Dzongkhag and the related donors and NGO/NPO by December 30, 2003.  
The Team has provision to provide budgetary support for the workshop such as conference hall charges and other associated logistic cost.

5. **GIS Map** : The Team received the digital file of GIS map prepared by BPC. Department of Survey and Land Records (DoSLR) confirmed that they are still in process of digitizing the maps and will not be in position to provide the information as requested by Department of Energy (Attachment-5). However, DOE procured topo sheets from DoSLR for the Team. The Team offers to share the GIS data from the study with DoSLR through DoE if required.
6. **Census Data** : According to the Ministry of Home Affairs, they are in the process of cross checking and updating the census data and scheduled to be completed by early next year. The Team will be able to receive the preliminary census data as confirmed by Deputy Secretary, Administration and Finance Division, Ministry of Home Affairs on request through DoE.
7. **List of Non-Electrified Villages** : The Team received the data of non-electrified villages in the form of list. The status of received data is shown in the Attachment-6. DOE will provide the remaining data in the middle of January 2004.
8. **Office Equipment**: DOE will provide the following office equipment by January 10, 2004.
 

a) Working desk:	5 sets
b) Small table:	2 sets
9. **Power System Data** : As base line data, the Team needs all the existing power system data. However, at present, the existing transmission and distribution line infrastructure are not recorded completely and accurately on the map/GIS. The Team received the GPS coordinates of the existing distribution transformers installed as of year 2000 in the form of Excel file.

In connection with the above, DOE/BPC will provide the following data by the end of January, 2004.

- a) Single line diagram of the existing transmission lines
- b) GPS coordinates of the existing substations
- c) Location data as coordinates and capacity of the distribution transformers installed from 2001 to the present<sup>1</sup>
- d) GIS data of RE3 network which is to be completed by the end of 2007

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<sup>1</sup> The Time frame does not seem realistic as the process involves identifying adequate and relevant personnel from 19 Electricity Service Divisions, conducting GPS training and data collection.

- e) Route length and conductor size of all the distribution lines

The existing distribution line routes will be mapped on GIS map based on the above available data.

10. **Lending GPS** : The Team lends 10 sets of GPS to DOE from December 24, 2003 to January 23, 2004 only for the purpose to locate the existing distribution transformers and the other power facilities.
11. **Next Site Work** : The Team explained the next site work Schedule (January to February 2004) as shown in the Attachment-7 and was accepted by DOE.
12. **Participants to Site Survey** : DOE will select the personnel to take part in the site survey mentioned in the schedule of January and February 2004.
13. **GIS Training** : GIS training will be held on January 19/Mon through 21/Wed and 23/Fri, 2004 (4 days) at DOE/BPC office to the counterpart personnel. The Team will prepare ArcGIS trial version and will also arrange two proper licenses for the training.
14. **Installation and Training of Power System Program** : Mipower will be installed and initial training will be held at DOE office by the program supplier on January 26/Mon through 28/Wed, 2004 (3 days). Complying with the conditions of contract between the Team and the supplier, number of participant to the training is limited to two. Mr. Oohara from the Team and one personnel from BPC/DOE will take part in the training.

End

#### Attachment

1. DOE's letter: DOE/PCD/RE-MP/2003-04/354 dated December 19, 2003
2. DOE's letter: DOE/PCD/RE-MP/2003-2004/334 dated December 10, 2003
3. DOE's letter: DOE/PCD/RE-MP/2003-2004/348 dated December 16, 2003
4. Program of First Workshop
5. DoSLR's letter PA-ADM(21)/900 dated December 15, 2003
6. Status of Received Data of Non-Electrified Villages
7. Site Work Schedule in January and February 2004



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DEPARTMENT OF ENERGY  
MINISTRY OF TRADE & INDUSTRY  
THIMPHU : BHUTAN

DOE/PCD/RE-MP/2003-04/ 354

19 December, 2003

✓ Mr. Fukuchi Tomoyasu  
Team Leader  
Nippon Koei Co. Ltd.  
Thimphu

**Subject: *Integrated Master Plan Study for Dzongkhag-wise Electrification in Bhutan.***

Sir,

Thanks for giving us the inception report. While it has been very well prepared, we would like you to take into account certain views from our side so that the document is in line with our expectation.

The following points are to be noted and regarded with priority for inclusion with clarity in the study although most of these have been touched upon in various parts of the inception report. This is being stressed in order to achieve realistic and practical program document for rural electrification in future.

1. The study should conduct a Dzongkhag wise electricity demand forecasting upto 2035 or 2040 (as deemed foreseeable).
2. The study must identify and provision for electrifying the entire country by 2020 as envisioned by the RGOB (with adequate provisions for increase in the number of houses).
3. The study must analyze and identify the optimum infrastructure capacities so that unnecessary investments in large extra capacities are minimized.
4. The field surveys need to incorporate some technical survey data besides socio-economic data collections for e.g. the provision of route lines and source or tapping position of proposed lines.
5. The study should review the existing system design, standards and equipment with the objectives of deducing the least cost system options in Bhutan's context. Especially, thorough and convincing cost benefit analysis/least cost benefit analysis must be done on the following:
  - a) the most cost effective steel poles w.r.t. optimizing the pole strength, height and weight vis-à-vis the conductors used, span length etc.,
  - b) the most cost effective conductors used for over head lines from available conductors such as ASCR, AAC, AAAC and insulated ABC,
  - c) the most cost effective insulators from those such as porcelain insulators, silicone rubber insulators, etc.,
  - d) the most cost effective grounding equipments such as spike earthing, chemical rod earthing, pipe earthing, plate earthing, etc.,
  - e) isolators such as auto reclosers, load break switches and Gang operated switches,

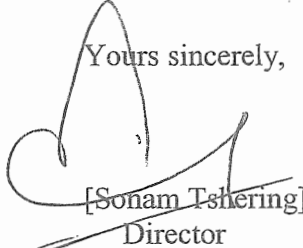
- f) SWER vis-à-vis cost reduction in RE,
- g) Small (1kVA to 30 kVA) single phase transformers versus three phase transformers. This also requires to address the reduction of weight, suitability/easiness for construction and maintenance given the terrain and remoteness of villages in Bhutan's context,
- h) Oil filled transformers versus dry type transformers in terms of cost, weight and adoptability in Bhutan,
- i) digital versus analog energy meters. Also some consideration on current limiting devices/prepaid cards especially from perspectives of cost of billing and collection at village level not viable venture,
- j) since the RE is commercially not viable, there is need to look into RESCO concepts ( Rural Energy Service Cooperatives) where the energy service is operated and maintained by community based management. Hence the issue of sustainability also needs to be addressed in detail.
- k) Technological developments should also be catered for in order to come out with the most suitable and cost effective solutions.

We are also attaching the specific comments herewith. I hope you will find the comments in order and look forward to your incorporating them in the report.

Words/sentences to be deleted/edited are shown in italics and underlined. Additions are shown in bold letters.

Thanking you,

Yours sincerely,



[Sonam Tshering]  
Director

## CHAPTER 1 INTRODUCTION

### 1.1 Background

- Page 1-1, Para 1, first line: Replace 30% with 40%
- Page 1-1, Para 2, 4<sup>th</sup> line: Delete "with some points of view of correction of differentials between Urban and Rural"

## CHAPTER 2 BASIC APPROACH OF THE STUDY

### 2.1 Basic Understanding to the study

- Page 2-1, Para 3, 3<sup>rd</sup> line: Delete "a" in "at around 100 W per household"
- Page 2-1, Para 3, 4<sup>th</sup> line: Replace "Renewable energies including micro hydros are regarded as supplemental electrification schemes where the extension of distribution lines are difficult" with "Renewable energies including micro hydros were an interim measure pending availability of grid supply"
- Page 2-1, Para 3, 2<sup>nd</sup> last sentence: Replace "The clear goal to achieve "100%" electrification level by 2020" is not a mere slogan but has a meaning of an order from the king that must be achieved" with "The clear goal to achieve "100%" electrification level by 2020" is not a mere slogan but a goal whereby all citizens have access to the natural resource of Bhutan which is hydro used for generating power"
- Page 2-1, Para 4, Line 1&2: Replace "demand, 400 MW, 100 MW" with "capacity, 428 MW, 128MW"
- Page 2-1, Para 5, 2<sup>nd</sup> sentence: Replace "30%" with "40 %"
- Page 2-2, In the summary with bullets: Add "**The Master Plan study will fulfill the role a program document of RE**" as first bullet point.

- Page 2-4, (3) Preparation of the plans with the view of the implementation: Comment on 3<sup>rd</sup> sentence "The finance plan is basically from the village's own money" - *As RE is not commercially viable, subsidy aspects will need to be addressed.*
- Also add to the next Para towards the end with "**and also look at overcoming transport bottlenecks**".

### Page 3-2, 3.2 First Site Work

- (1) Explanation of and Discussion on Inception Report,  
Para 2, Line 1: Insert "to" to read the sentence as " In the meeting, the Team will confirm to the DOE....."
- (2) Collection and Analysis of Baseline Data



- a) Reports and contract documents for the rural electrification having been executed and planned by the ADB, “Replace NORAD with Sustainable Development Secretariat (SDS)” and other International supporting groups.

Page 3-5, 2) Study on methodology and software for the planning, Para 2, 3<sup>rd</sup> line: Replace word “village” with “voltage”.

Page 3-13, 2) Power Demand Forecast, 2<sup>nd</sup> Sentence replace word “Particularity” with “Peculiarity”



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DEPARTMENT OF ENERGY  
MINISTRY OF TRADE & INDUSTRY  
THIMPHU : BHUTAN

DOE/PCD/RE MP/2003-2004/ 334

December 10, 2003

Ms. Kondo Michiko  
JICA Representative  
Camp: Thimphu

Subject: Forwarding of list of counterpart personnel and the coordination committee.

Madam,

Please find enclosed herewith note No. DOE/PCD/RE-MP/332 dated 10<sup>th</sup> December 2003 containing the list of counterpart personnel and the coordination committee.

This is in accordance with the "Minutes of Meeting" for project " The Preliminary Study for the integrated master plan study for Dzongkhag-wise Electrification in the kingdom of Bhutan" between Japan International Cooperation Agency and Department of Energy, Ministry of Trade and Industry held on 27<sup>th</sup> June 2003, wherein the Executing Agency "Department of Energy" have agreed to provide list of Coordination Committee and Counterpart Personnel for the study before the commencement of the project.

Thanking you,

Yours sincerely,

  
[Karma P Dorji]  
Project Manager

Cc: ✓ The JICA study Team Leader, Nippon Koei Co. Ltd. for kind information and perusal please.

DOE/PCD/RE-MP/ 332

December 10, 2003

NOTE

In accordance with the "Minutes of Meeting" for project "The Preliminary Study for the integrated master plan study for Dzongkhag-wise Electrification in the kingdom of Bhutan" between Japan International Cooperation Agency and Department of Energy, Ministry of Trade and Industry held on 27<sup>th</sup> June 2003, the Executing Agency "Department of Energy" have agreed to provide list of Coordination Committee and Counterpart Personnel for the study before the commencement of the project.

Upon request by the JICA study team, an internal coordination meeting was held between Department of Energy, Bhutan Power Corporation and the JICA study team on 9<sup>th</sup> December 2003 at BPC conference hall. The meeting discussed mainly on following key areas:

1. Inception report submitted by the study team on 3<sup>rd</sup> December 2003
2. Counterpart Personnel
3. Formation of coordination committee

The comments on the inception report by BPC and DOE were discussed with the study team and will be giving in writing to the study team soon. On the counterpart personnel, the following list of counterparts for the study team from DOE and BPC is proposed. The list of counterparts from BPC was discussed and agreed upon by General Manager, CSD, Manager, Planning Division and Sr. Manager, DCD subject to approval by the Managing Director, BPC.

*Department of Energy:*

Name	Position	Organization
Karma P Dorji	Project Manager	PCD, DOE
Karma Tshewang	Off-grid Development (Hydro)	PCD, DOE
Mewang Gyeltshen	Off-grid Development (Solar)	RED, DOE
Dechen Wangmo	GIS study	PCD, DOE

*Bhutan Power Corporation:*

Name	Position	Organization
Jigme Tobgyel	Focal Person from BPC	Planning Div, BPC
Pushpa Lal	Power Distribution Design	CSD, BPC
Sonam Tobgay	Financial study	Finance Dept., BPC
Sonam Palden	Environment Impact Evaluation	DCD, BPC
Sunil Kr. Rasailly	GIS study	CSD, BPC
Ujjwal D Dahal	GIS study	Planning Div., BPC
Dechen Dema	Load flow Analysis	CSD, BPC
Suresh Nepal	Design Engineer	DC, BPC

The counterpart personnel are being felt important to ensure technology transfer, which is one of the main objectives of the study. The counterparts will directly carry out the study jointly with the study team and the study team will provide the DOE with a tentative plan

of counterpart assignment, based on which the DOE will intimate the counterpart personnel.

In order to facilitate the smooth implementation of the study, we also require forming a Coordination Committee consisting of members from DOE, BPC, JICA/JOCV (Thimphu), MOF (DADM) and Study Team. The following members are proposed for the coordination committee.

Designation	Organization	Position
Director	Department of Energy	Chairman
Head	Planning & Coordination Division, Dept. of Energy	Member
Resident Representative	JICA/JOCV, Thimphu	Member
General Manager	Customer Service Department, Bhutan Power Corporation	Member
Representative	DADM, MOF	Member
Team Leader	Nippon Koei Co. Ltd. JICA Study Team	Member
Project Manager	PCD, DoE	Member Secretary

The coordination committee is responsible for smooth implementation of the study and also monitoring the progress of the study. The committee meeting shall be held at least once in every quarter and DoE shall coordinate the meeting. DoE will also coordinate participation of other Government agencies in the event of need.

Therefore, it is submitted to Directorate for according approval, as we require submitting the list of coordination committee and counterpart personnel to JICA office in Japan as a part of our commitment for the study at the earliest.

Submitted for approval please.

*Recommended for kind approval*

*[Signature]*  
 Head, Planning and Coordination Division, DoE

*[Signature]*  
 (Karma P Dorji)  
 Project Manager

*[Signature]*  
 DIRECTOR, DEPARTMENT OF ENERGY

*Approved*

*[Signature]*  
 9/12



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བསྐྱོན་རྒྱུ་ལྷན་ཁག་།

DEPARTMENT OF ENERGY  
MINISTRY OF TRADE & INDUSTRY  
THIMPHU : BHUTAN

DOE/PCD/RE-MP/2003-04/ 348

16 December, 2003

**Subject: Project “Rural Electrification Master Plan Study” Coordination Committee Meeting.**

Sir,

Department of Energy has received technical assistance from Japan International Cooperation Agency, Japan for the project “ The Preliminary Study for the integrated master plan study for Dzongkhag-wise Electrification in the kingdom of Bhutan”. In accordance with the “Minutes of Meeting” between Japan International Cooperation Agency and Department of Energy, Ministry of Trade and Industry held on 27<sup>th</sup> June 2003, the Executing Agency “Department of Energy” have agreed to provide list of Coordination Committee for the study before the commencement of the project.

In this context, Department of Energy hereby proposes to convene the first meeting of coordination committee on *15<sup>th</sup> January 2004 at 10.00am at DOE Conference Hall* to confirm the nomination as well as discuss and review the project inception.

The following members are proposed for the coordination committee.

Designation	Organization	Position
Director	Department of Energy	Chairman
Head	Planning & Coordination Division, Dept. of Energy	Member
Resident Representative	JICA/JOCV Bhutan	Member
General Manager	Customer Service Department, Bhutan Power Corporation	Member
Representative	DADM, MOF	Member
Team Leader	Nippon Koei Co. Ltd. JICA Study Team	Member
Project Manager	PCD, DoE	Member Secretary

The Coordination Committee is required in order to facilitate the smooth implementation and also monitoring the progress of the study. The committee meeting shall be held atleast once in every quarter and DoE shall coordinate the meeting. DoE will also coordinate participation of other Government agencies in the event of need.

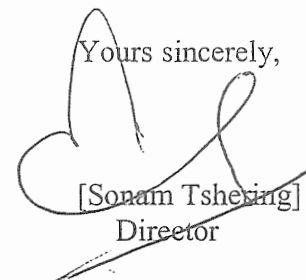
We would be grateful if a representative could be present for the meeting.

Phone # 328279 Fax # 328278

Your cooperation in this regard will be appreciated.

Thanking you,

Yours sincerely,



[Sonam Tshering]  
Director

Cc: The Managing Director, Bhutan Power Corporation with a request to depute GM, CSD, BPC for the meeting.

To

1. The Director  
Department of Aid and Debt Management  
Ministry of Finance  
Thimphu.

2. Mr. Yasuyuki Mori  
The Resident Representative  
JICA Bhutan Office  
Thimphu.

3. Mr. Fukuchi Tomoyasu  
Team Leader  
Nippon Koei Co. Ltd.  
Thimphu.

4. The General Manager  
Customer Service Department  
Bhutan Power Corporation  
Thimphu.

5. The Chief Engineer/Head  
Planning and Coordination Division  
Department of Energy  
Thimphu.

## DRAFT

Attachment-4

Japan International Cooperation Agency (JICA)  
Department of Energy (DOE), Ministry of Trade and Industry

**The Integrated Master Plan Study for  
Dzongkhag-wise Electrification in the Kingdom of Bhutan**

**First Workshop  
30 January 2003, in Thimpu**

**Agenda**

9:30 - 9:40	Welcome and Introduction	Director DoE
9:40 - 9:45	Greetings by JICA Bhutan Office	Representative of JICA Bhutan Office
9:45 - 10:00	Introduction of Study Team Members and Explanation of General Flow of the Study	Team Leader, JICA Study Team
10:00 - 10:30	Explanation of Current Status and Problem of Rural Electrification	DoE
10:30 - 10:50	Coffee Break	
10:50 - 12:30	Presentation of Methodology of Master Plan Study	Study Team Members
12:30 - 13:00	Questions and Answers	
13:00 - 14:00	Lunch	
14:00 - 15:00	Presentation of Actual Status of Rural Area and Request to Master Plan Study	Dzongkhag representatives
15:00 - 15:30	Discussions	
15:30 - 15:45	Coffee Break	
15:45 - 16:00	Presentation of New Technology	Study Team Members
16:00	Closing Remarks	Director DoE

8018  
18/12/03

Post Box No. 142

ROYAL GOVERNMENT OF BHUTAN  
DEPARTMENT OF SURVEY & LAND RECORDS  
MINISTRY OF HOME AFFAIRS  
THIMPHU

Attachment - 5

Tel: 321743  
321745  
Fax: 321746  
EPABX  
324741/321217/  
324259/322798

PA-ADM(21)/900

Date: 15<sup>th</sup> December 2003

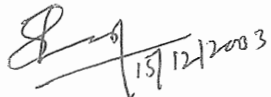
✓ To,  
The Director  
Planning & Coordination Division  
Department of Energy  
Thimphu.

Sir,


I am directed to convey that, with regard to your letter No.DOE/PCD/RE/2003-04/304 dated 21-11-2003, we regret our inability to provide the required data as we are still in the process of digitizing the maps.

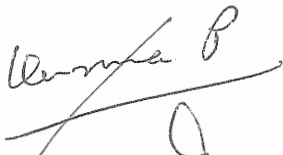

The inconvenience caused is highly regretted please.

Yours faithfully,

  
(Shankar Sharma)  
Dy.S.Engineer  
Map production Division

(JICA) Team leader  
For your information pls.

  
28/12/03

  
  
18/12

Land Registration  
323024  
322965  
325274  
325607 Fax

Cadastral Info  
325219  
322939  
323565 Fax

Map Production  
325145  
321171 Fax

Topographical Survey  
322588  
324654 Fax



## Attachment - 6

## Status of Preparation of Listing Non-Electrified Villages after RE-III by DOE

- as of December 24, 2003 -

Dzongkhag	Status		Number		Remarks
	Received	Not Received	Non-Electrified Villages	Non-Electrified Households	
Bumthang	✓		36	491	
Chhukha	✓		122	2,603	
Dagana	✓		-	2,168	Only total number of non-electrified households by Gewog is listed, but there is no breakdown of non-electrified households by village.
Gasa		✓	-	-	
Haa	✓		10	212	
Lhuntse		✓	-	-	
Mongar		✓	-	-	
Paro	✓		34	430	
Pemagatshel		✓	-	-	
Punakha	✓		73	357	
Samtse		✓	-	-	
Sarpang	✓		99	2,104	
Samdrup Jongkhar	✓		138	3,449	
Thimphu	✓		40	243	
Trashigang	✓		91	1,745	
Trashiyangtse		✓	-	-	
Trongsa	✓		39	1,029	
Tsirang	✓		-	2,504	Only total number of non-electrified households by Gewog is listed, but there is no breakdown of non-electrified households by village.
Wangdue Phodrang	✓		188	1,531	
Zhemgang	✓		53	1,639	
<b>Total</b>			<b>923</b>	<b>20,505</b>	

Prepared by JICA Study Team (December 24, 2003)

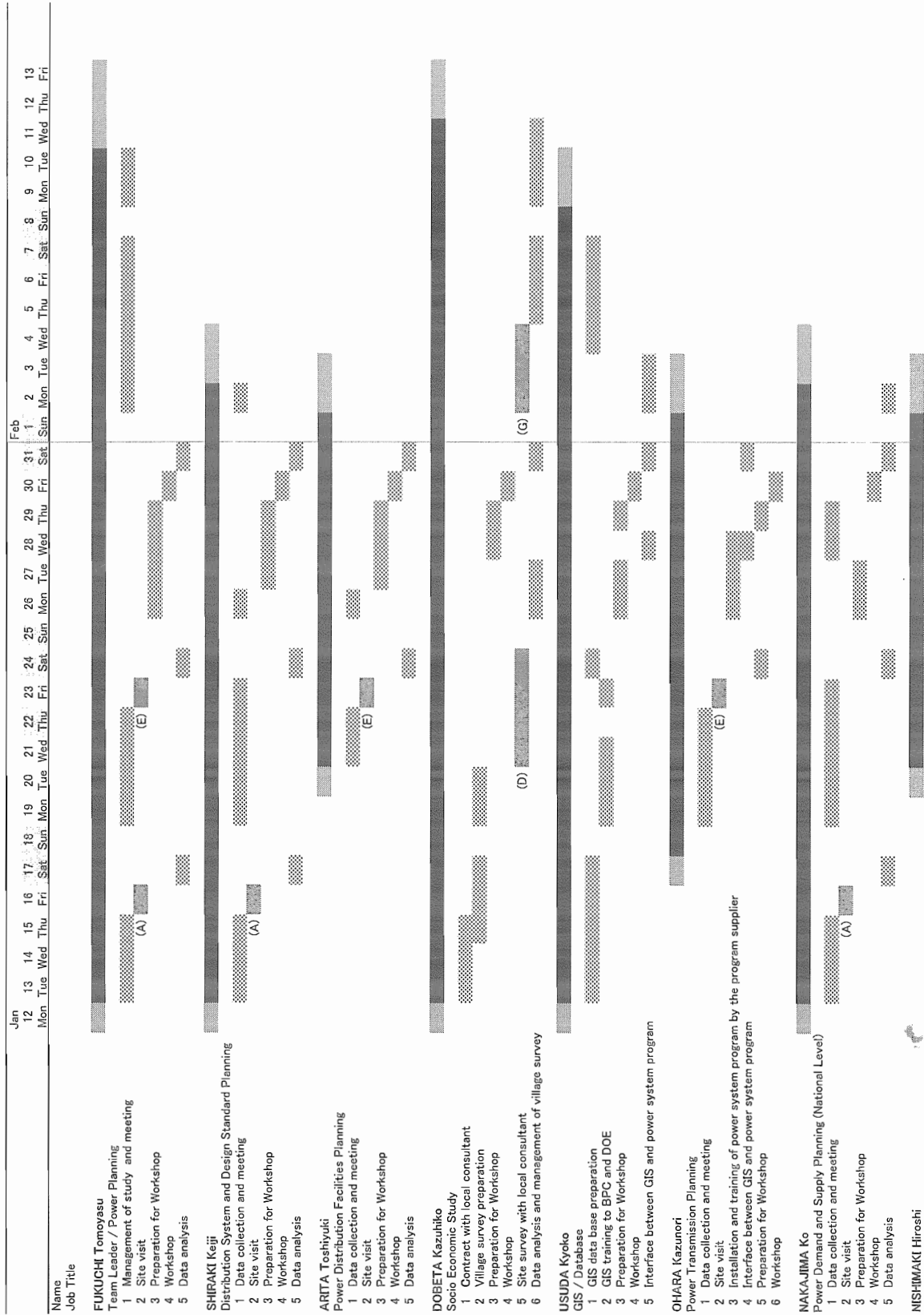
## Attachment - 7

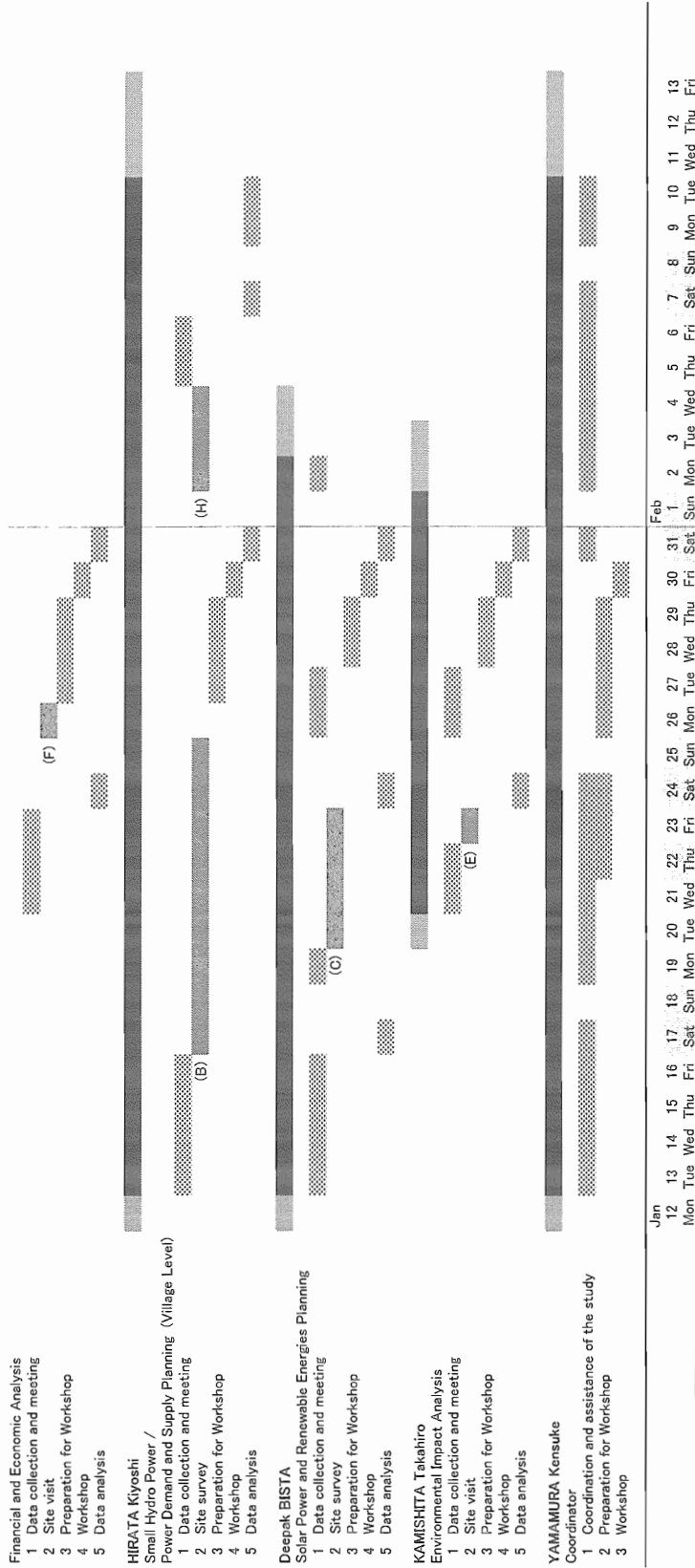
## Schedule of the 1st Site Work; 12 Jan to 13 Feb 2004

Date	Day	Activities	Accommodation	Remarks
1/12	Mon	(A) Narita/1045->Bangkok/1545 by TG641 (B) Nagoya/1030->Bangkok/1515 by TG645	Bangkok	(A) Fukuchi, Hirata, Dobeta, Usuda, Nakajima, Bista, Yamamura (B) Shiraki
1/13	Tue	(A) Bangkok/0650->Kolkata->Paro/1010 by KB125 (1) Meeting with JICA/Bhutan (1600)	Thimpu	(A) Fukuchi, Hirata, Dobeta, Usuda, Nakajima, Bista, Yamamura, Shiraki
1/14	Wed	(1) Meeting with DOE (1000) (2) Study in Thimpu	Thimpu	
1/15	Thu	(1) Coordinating Committee Meeting (1000) (2) Study in Thimpu	Thimpu	
1/16	Fri	(1) Study in Thimpu (2) Site visit	Thimpu	
1/17	Sat	(A) Nagoya/1520->Bangkok/1935 by JL737 (1) Site survey (2) Study in Thimpu	Thimpu, Bangkok, Other	(A) Ohara
1/18	Sun	(A) Bangkok/0650->Kolkata->Paro/1010 by KB125 (2) Site survey	Thimpu, Other	(A) Ohara
1/19	Mon	(1) GIS training to BPC and DOE (2) Site survey (3) Study in Thimpu	Thimpu, Other	
1/20	Tue	(A) Narita/1045->Bangkok/1545 by TG647 (2) GIS training to BPC and DOE (3) Site survey (4) Study in Thimpu	Thimpu, Bangkok, Other	(A) Nishimaki, Arita, Kamishita
1/21	Wed	(A) Bangkok/0650->Yangon->Dhaka->Paro/1110 by KB127 (1) GIS training to BPC and DOE (2) Site survey (3) Study in Thimpu	Thimpu, Other	(A) Nishimaki, Arita, Kamishita
1/22	Thu	Site survey	Thimpu, Other	National holiday
1/23	Fri	(1) GIS training to BPC and DOE (2) Site survey (3) Study in Thimpu	Thimpu, Other	
1/24	Sat	(1) Site survey (2) Study in Thimpu	Thimpu, Other	
1/25	Sun	Site survey	Thimpu	
1/26	Mon	(1) Installation and training of power system program (2) Study in Thimpu	Thimpu	
1/27	Tue	(1) Installation and training of power system program (2) Study in Thimpu	Thimpu	
1/28	Wed	(1) Installation and training of power system program (2) Study in Thimpu	Thimpu	
1/29	Thu	Study in Thimpu	Thimpu	
1/30	Fri	Workshop-1	Thimpu	
1/31	Sat	Study in Thimpu	Thimpu	
2/1	Sun	Leaving Thimpu to Paro	Thimpu, Paro	Nishimaki, Arita, Ohara, Kamishita

2/2	Mon	(A) Leaving Thimpu to Paro (B) Paro/930->Bangkok/1530 by KB126 (1) Site survey (2) Study in Thimpu	Thimpu, Paro, Bangkok, Other	(A) Shiraki, Nakajima, Bista (B) Nishimaki, Arita, Ohara, Kamishita
2/3	Tue	(A) Paro/0930->Bangkok/1450 by KB124 (B) Bangkok/1120->Narita/1900 by TG640 (C) Bangkok/08:30->Narita/16:10 by JL708, Narita/18:15->Nagoya/19:30, by JL053 (1) Site survey (2) Study in Thimpu	Thimpu, Bangkok, Other	(A) Shiraki, Nakajima, Bista (B) Nishimaki, Arita, Kamishita (C) Ohara
2/4	Wed	(A) Bangkok/1120->Narita/1900 by TG640 (B) Bangkok/0830->Narita/1610 by JL708, Narita/18:15->Nagoya/19:30 by JL053 (1) Site survey (2) Study in Thimpu	Thimpu	(A) Nakajima, Bista (B) Shiraki
2/5	Thu		Thimpu	
2/6	Fri	Wrap-up meeting (1000)	Thimpu	
2/7	Sat	Study in Thimpu	Thimpu	
2/8	Sun	Leaving Thimpu to Paro	Thimpu, Paro	Usuda
2/9	Mon	(A) Paro/930->Bangkok/1530 by KB126 (1) Signing of Minutes of Meeting (1000) (2) Study in Thimpu	Thimpu, Bangkok	(A) Usuda
2/10	Tue	(A) JICA/Bhutan (1000) and Leaving Thimpu to Paro (B) Bangkok/1120->Narita/1900 by TG640 (1) Study in Thimpu	Thimpu, Paro	(A) Fukuchi, Hirata, Yamamura (B) Usuda
2/11	Wed	(A) Leaving Thimpu to Paro (B) Paro/0930->Delhi/1230 by KB204, JICA/India (1600)	Paro, Delhi	(A) Dobeta (B) Fukuchi, Hirata, Yamamura
2/12	Thu	(A) Paro/0930->BKK/1450 by KB124 (B) Embassy of Japan (0900), JBIC/India (1100)	Bangkok, in Air	(A) Dobeta (B) Fukuchi, Hirata, Yamamura
2/13	Fri	(A) Bangkok/1120->Narita/1900 by TG640 (B) Deli/0:05->BKK/05:35, BKK/08:20->Narita/16:00, by TG772		(A) Dobeta (B) Fukuchi, Hirata, Yamamura

**Schedule of the 1st Site Work (Detail); 12 Jan to 13 Feb 2004**





Site Visit and Site Survey

Team	Date/Day	Study Members	Sites	Objectives
(A)	Jan 16 / Fri	FUKUCHI, SHIRAKI, NAKAJIMA	Chhukha	Transmission and distribution lines
(B)	Jan 17 / Sat to Jan 25 / Sun	HIRATA	Tashigang, Mongar, Yangtse Lhuntsahi (via Wangdi Phodrang, Tongsa and Bumthang)	Small hydropower power and demand forecast
(C)	Jan 20 / Tue to Jan 23 / Fri	BISTA	Paro	Solar and renewable energies
(D)	Jan 21 / Wed to Jan 24 / Sat	DOBETA	Chhukha, Ha (via Paro)	Village survey with local consultant
(E)	Jan 23 / Thu	FUKUCHI, ARITA, OOHARA, KAMISHITA	Wangdi Phodrang	Distribution lines and environmental impact assessment
(F)	Jan 28 / Mon	NISHIMAKI	Chhukha	Electrified village survey
(G)	Feb 02 / Mon to Feb 04 / Wed	DOBETA	Punakha	Village survey with local consultant
(H)	Feb 02 / Mon to Feb 04 / Wed	HIRATA	Ha (via Paro)	Small hydropower power and demand forecast