No

Japan International Cooperation Agency

Department of Energy Affairs,
Ministry of Mines, Natural Resources and Environment, Republic of Malawi

The Follow-up Study for the Master Plan on Rural Electrification in Malawi

Final Report (Summary)

September 2004

Nomura Research Institute, Ltd.

ED
JR
04 － 016

The Follow-Up Study for the Master Plan on Rural Electrification in Malawi

Final Report (Summary)

Table of Contents

List of Figures and Tables

＜List of Figures＞

＜List of Tables＞

Chapter 1 Background and Objectives of the Study

1.1 Background of the Study

The Republic of Malawi is a landlocked country in southern Africa, surrounded by Tanzania, Zambia and Mozambique. Its average household electrification ratio is only 4%, one of the lowest in Africa, where the average household electrification ratio is about 20%. The electrification ratio in rural areas in Malawi is still less than the national average, and reportedly does not reach even 1%. This low electrification ratio is considered one of causes of the low average life span, the low literacy rate and poverty.

The Government of Malawi transferred the obligation for rural electrification (RE), most of which is not profitable, from the Electricity Supply Company of Malawi (ESCOM) to Department of Energy Affairs (DOE) in order to promote poverty mitigation in 1995. At present, the DOE is implementing the Phase 4 project in the RE program using the Japanese grant aid.

Japan International Cooperation Agency (JICA) has been assisting the RE project in Malawi and conducting the development study, "The Master Plan Study on Rural Electrification in Malawi", from September 2001 to March 2003. The study suggested the rural electrification Master Plan, transferred the technique of the electrification planning and made recommendations related to organization and institution.

It is not very long since the DOE started RE projects, and it cannot be said that its organizational and individual abilities are fully sufficient to promote its business by itself. Under this situation, for quick and smooth implementation of the RE project, the Government of Malawi requested of the Government of Japan to conduct a follow-up study for the assistance of Phase 5 in the RE project and for recommendations for subsidy systems and business models in the future independent RE projects. Based on the request, the Government of Japan decided to commence the Follow-up Study for the Master Plan on Rural Electrification in Malawi (Study).

1.2 Objectives of the Study

The objectives of the Study are to:

(1) Assist the feasibility study (FS) for the Phase 5 in the RE project

(2) Make concrete recommendations for the Detailed Regulations for the RE policies and institutions

(3) Make recommendations for RE business models for newcomers;

(4) Transfer technique for improvement of organizational and individual abilities of counterparts.

1.3 Overall Study Flow

The Study was carried out over about 10 months from December 2003 to September 2004,and the JICA Study Team conducted work three times locally in Malawi. The overall study flow is shown in Table 1-1.

Table 1-1 Overall Study Flow

JFY	2003				2004					
Month	12	1	2	3	4	5	6	7	8	9
Work in Japan	Preliminary Work in Japan				1st Task in Japan		2nd Task in Japan		3rd Task in Japan	
Work in Malawi		1st Task in Malawi				2nd Task in Malawi		3rd Task in Malawi		
Report	△ Inception Report							△ Draft Final Report		△ Final Report
Workshop		△ 1st Workshop						△ 2nd Workshop		

Work Items in Japan

Preliminary Work in Japan

- Data Collection and confirmation of contents in the Master Plan
- Preparation of the draft FS implementation manual
- Preparation of the draft Inception Report
- Procurement of the survey equipment
- Determination of present conditions of organizations, institutions and plans related to the RE project in Malawi
- Advance evaluations of post FS results
- Preparation for the 1st Workshop
- Presentation to JICA

1st Task in Japan

- Presentation to JICA
- Acquisition of FS results from the DOE and assistance of FS management
- Analysis, evaluation and direction of FS results from the DOE
- Preparation of the revised FS implementation manual
- Provision of information and recommendation for the project management
- Revision of recommendation for the Detailed Regulations related to the Rural Electrification Bill
- Revision of draft business models
- Improvement of Electricity Demand Forecast Method

2nd Task in Japan

- Presentation for the 2nd Workshop
- Preparation of the Draft Final Report
  - (1) Confirmation of results of the Phase 5 project
  - (2) Recommendations for the Phase 6 project
  - (3) Revision of the FS implementation manual
  - (4) Preparation of a recommendation report related to the Detailed Regulations for the Rural Electrification Bill
  - (5) Revision of draft business models

3rd Task in Japan

- Preparation of the Final Report
- Presentation to JICA

Work Items in Malawi

1st Task in Malawi

- Presentation and discussion of the Inception Report
- 1st Workshop
- Discussion with ESCOM over FS
- Confirmation of FS methods
- Assistance of FS
- Study of modification for FS procedures
- Evaluation of FS conducted by the DOE
- Discussion with the DOE over the Detailed Regulations related to the Rural Electrification Bill
- Discussion with ESCOM over the organizational and institutional aspects
- Draft Recommendations for organizations and institutions

2nd Task in Malawi

- Evaluation and direction for results of all sites in the Phase 5 project
- Technology Transfer related to project management
- Discussion of recommendations related to the Detailed Regulations for the Rural Electrification Bill
- Discussion of the revised business models
- Improvement of Electricity Demand Forecast Method and revision of criteria for TC prioritization targeted to Phase 6 and later

3rd Task in Malawi

- Discussion of the Detailed Regulations and the business models
- 2nd Workshop

Chapter 2 Technical Transfer related to FS Procedure for Distribution Line

2.1 Outline of the FS

2.1.1 Overall Schedule

The Phase 5 FS was implemented from October 2003 to June 2004. From the standpoint of technical transfer, it was decided to present a detailed account of this aspect, which was grounded in the support furnished by the JICA Study Team in the follow-up study, by dividing the work into three phases: before the FS support; during the FS support; and after the FS support. Table 2-1 shows the number of trading centers (TCs) studied and the time of field surveys at each stage.

Table 2-1 Number of TCs studied and time of field surveys at each FS stage

Stage	Before FS support	During FS Support	After FS Support	Total
Number of TCs studied	23	13	18	54
Time of Field Surveys	from 10/2003 to 12/2003	from 1/2004 to 2/2004	from 2/2004 to 6/2004	-

2.1.2 Setup for the DOE FS Implementation

(1) Organization and Staffing

- The DOE and ESCOM have implemented the Phase 5 FS for RE project together. The DOE assigned 9 counterparts including a manager, engineers and economists to implement the FS. In addition, it has appointed one chief engineer and one chief economist to take general charge of the work.
- ESCOM has assigned one employee each to the FS in the northern, central, and southern offices.

(2) Team

- The FS work is implemented by teams. Each team consists of one or two DOE engineers, one economist, and one ESCOM engineer. Because teams are formed with consideration of the scheduling for other activities, the membership of the team may change each time.

- Engineers and economist implement the preparation and the map study. The major duty of the engineers, in terms of deskwork after field survey, is calculation of voltage drop and construction cost, while those of the economist are forecasting of electricity demand and assessment of economic merit.

2.1.3 FS Flow

(1) The FS flow consists of the 7 stages of preparation, map study, field survey, electricity demand forecasting, calculation of voltage drop, calculation of construction cost and assessment of economic merit.

(2) The FS results are presented in a FS report, drawings of site situation, and calculation sheets prepared in accordance with the FS implementation manual.

2.2 Technical Transfer related to FS Procedure for Distribution Line

2.2.1 Problems with FS Results before Provision of Support and Instructions for them

The JICA Study Team identified the following problems with the results and the procedure of FSs before the provision of support, and provided instructions on how to improve them, as follows:

(1) Problems

(a) The TC drawings of site situation did not contain uniform symbols, and this made it difficult for non-drawers to ascertain their meaning, which may cause misunderstanding of subsequent work.
(b) According to information from the JICA expert, there was not enough cooperation among the team members, and the field surveys of TCs consequently took a lot of time.
(c) A definite method had not been established for determination of the number and capacity of transformers, which may cause inaccurate cost calculation results.

(2) Methods of instruction

(a) Preparation of standard symbols.

The JICA Study Team prepared the standard symbols and instructed the counterparts regarding their meanings and reflected these symbols in FS implementation manual.

(b) Preparation of a standard timetable sheet

To achieve adequate cooperation among members, it is important for all FS team members to have a solid grasp of their respective roles, discharge these roles, and be prepared to assist other members when their own part is completed. The JICA Study Team prepared a standard time schedule and respective roles sheet for field surveys and instructed the counterparts in their purpose.

2.2.2 Guidance/Instruction related to the Procedure for FS Field Surveys

The JICA Study Team accompanied FS personnel on trips to 12 TCs and provided the following guidance/instruction related to the FS field survey procedure.

(1) Procedure for preparation of site sketches

(a) Problems

Certain counterparts had an errant sense of road direction in preparing site sketches. The sketches they produced were seriously lacking in the accuracy needed for reflection in the preparation of drawings in the deskwork stage.

(b) Methods of instruction

The team also made the following proposal to correct an errant sense of road direction in preparation of site sketches.

(i) Finding a distant object (e.g. mountain) to represent north and drawing the line of the road by referring to that one.

(ii) Always placing a compass on the paper and drawing the line of the road by rotating the paper in the northern direction as indicated by a compass.

(c) Effects

The counterparts became able to reflect the direction of roads more accurately in their site sketches. As a result, they were able to draw the site situation during deskwork without confusion.

(2) Decision of method (equipment) of distance measurement and position finding

(a) Problems

The counterparts were not sure which method (equipment) was the best for each place, and also did not have a good understanding of items such as laser binocular and the global positioning system (GPS) measurement error. As a result, and the distance measurement and position finding took a lot of time, and the accuracy of site survey was not so sufficient.

(b) Methods of instruction

Table 2-2 shows the instruction provided to the counterparts in respect to ascertaining which of the measurement methods (equipment) is the best for the place in question. And the Team also reconfirmed that the counterparts knew of the measurement error of the GPS (around 2m) and maximum and minimum scopes (10m – 400m) of laser meters.

Table 2-2 Best measurement method (equipment) for each type of place

Type of Place	**Measurement method (equipment)**
Measurement of the distance of distribution line installation outside the TC and of the TC scale	Vehicle odometer
Measurement of distance (10 - 400 m) in a vertical orientation on the main road in the TC	Laser binocular
Measurement of distance in a parallel orientation on the main road in the TC	Digital roller measure
Measurement of distance (0 - 10 m) in a vertical orientation on the main road in the TC	Digital roller measure, Pacing

(c) Effects

Understanding of the effective match-ups of place and method as well as measurement error enabled the counterparts to make measurements with higher levels of accuracy and efficiency.

(3) More efficient survey procedures

(a) Problems

In some cases, counterparts overlooked places that required measurement, and so had to measure sites two or three times. This made the survey work more inefficient.

(b) Methods of instruction

- Upon arrival in the TC, a meeting was held for the application of a unified procedural approach for the survey by the team. The places requiring measurement and the target measurement time (duration) were confirmed with the counterparts. In addition, at the end of each survey, a meeting was held on the site to have counterparts check whether or not they had omitted any measurements.
- Economists made rough sketches of sites indicating the position of public facilities in TCs while conducting interview surveys. The JICA Study Team instructed the counterparts in using these rough sketches as a means of preventing measurement omissions and reducing the time needed to prepare site sketches.

(c) Effects

The counterparts understood:

(i) Importance that time is managed efficiently and information is exchanged to accommodate meetings.
(ii) The method of using rough sketches.

As a result, they reduced the incidence of measurement omissions and repeated measurement of the same place, and therefore they became able to survey more efficiently.

2.2.3 Guidance/Instruction related to the Procedure for FS Deskwork

The JICA Study Team provided the following guidance/instruction for FS deskwork procedure for 12 TCs that had already been surveyed.

(1) Method of scale calculation

(a) Problems

- In the preparation of drawings, while referring to site sketches, the first task is to make calculations to determine the scale so that the drawings fit on A4-size paper as much as possible. Some counterparts needed a lot of time to perform this scale calculation when beginning a drawing, because they were not good at calculation.
- Some counterparts possess scaling rulers. However, they didn't use the scaling rulers efficiently, and also needed a lot of time to prepare drawings because scaling rulers are made with each notation according to the corresponding distance.

(b) Method of instruction

- After discussion with the counterparts on procedure for efficient preparation of drawings, the JICA Study Team prepared and proposed a scale conversion table. This table presents the results of scale conversion based on advanced calculation using the Microsoft Excel to omit the calculation work for scale conversion.
- The counterparts were also instructed in the use of a scaling ruler.

(c) Effects

The counterparts became able to determine the scale to be used in the drawing and the length of lines on the drawing within a shorter time by using the scale conversion table and a scaling ruler.

(2) Procedure for selection of distribution line routes

(a) Problems

The FS personnel did not all share the same perspective on the selection of distribution line routes, which may cause incorrect construction cost calculation results.

(b) Method of instruction

The JICA Study Team confirmed the basic procedure for such selection at ESCOM with ESCOM engineers, and held a seminar to instruct the DOE engineers in it. Table 2-3 shows the items of instruction regarding selection of distribution line routes.

Table 2-3 Instruction in selection of distribution line routes

Distribution line type	Instruction
33kV(11kV) distribution lines	Selection of wire types and routes that keep the voltage drop within the scope stipulated in the Electricity Supply Regulation in Malawi (i.e., plus or minus 6% against rated voltage[1])
	Curtailment of the distance of new distribution line installation to the minimum requisite in order to hold down construction costs
	Selection of routes along access roads that facilitate construction and maintenance
	Confirmation of the presence or absence of electrification plans in the nearest phase (after Phase 5) in unelectrified TCs other than those targeted along roads; if there is more than one candidate route for distribution line extension, precedence should be accorded to that to TCs for which there are electrification plans, in order to hold down construction costs in phases after Phase 5.
400/230V distribution lines	Selection of wire types and routes that keep the voltage drop within the scope stipulated in the Electricity Supply Regulations in Malawi (i.e., plus or minus 6% against rated voltage)
	Curtailment of the distance of new distribution line installation to the minimum requisite in order to hold down construction costs
	Extension of lines to public facilities and maize mills, markets which will be surely electrified
	Notation of obstacles (e.g., trees, telephone lines, and transmission lines) on drawings, and assurance of sufficient distribution line distance from them, in order to hold down construction costs (due to the incidence of additional costs for tree-felling, etc., in distribution line construction)
	Installation of distribution-use transformers close to maize mills which have the biggest electricity demand in order to reduce the influence of the voltage drop of new distribution line
	Avoidance of installation of aerials across school grounds and graveyards because it is basically not approved

(c) Effects

The counterparts became capable of selecting distribution line routes. As a result construction costs were reduced.

[1] In the Electricity Supply Regulations in Malawi, the permissible range of voltage fluctuation in supply to 400/230 V customers is set at within plus or minus 6%. It was assumed that, in conformance with this range, the same rate of plus or minus 6% would also be applied for fluctuation in supply through 33kV (11kV) distribution lines.

(3) Voltage drop calculation procedure

(a) Problems

The counterparts did not have a full understanding of the basic idea behind voltage drop calculation, and consequently were not able to cope with applied cases not covered by the voltage drop calculation system like that load are dispersed [e.g. electrification of more than two separate TCs with the same 33kV(11kV) distribution line].

(b) Methods of instruction

The JICA Study Team instructed the counterparts not only in the calculation of voltage drop on the Microsoft Excel sheet but also in the underlying perspective on the distribution of line current and the equation for calculating the voltage drop at distribution lines.

(c) Effects

The counterparts became able to understand the basic concept behind voltage drop calculation, and became able to handle applied cases, such as calculation of voltage drop in the event of electrification of more than two separate TCs with the same 33kV (11kV) distribution line. As a result, they were able to include more exact values of the voltage drop in FS reports.

(4) Procedure for determination of the number and capacity of transformers

(a) Problems

Transformers cost more than other distribution equipment, and the procedure for determining the number and capacity therefore has a substantial influence on the cost calculation results. As noted in Section 2.2.1, the procedure for determining the numbers and capacity of transformers were not clearly defined, and this raised the risk of inappropriate determinations of this number and capacity.

(b) Methods of instruction

(i) The JICA Study Team furnished guidance in the procedure for determination of the requisite the number and capacity of transformers on the basis of the unit demands for the electrified target facilities. It was decided to apply the following as basic

premises in the determination of the requisite number and capacity of transformers.

- The results from the Socio-Economic Survey made at the time of the Master Plan Study were used as the standard values for the unit demands among public facilities, shops, and ordinary households[2] as well as for the estimated initial rate of connection.
- Because the distribution facilities will be operated by ESCOM after completion of the Phase 5 construction, the ESCOM design standard values were applied for the diversity factor[3] (diversity factor = 0.7).
- The ESCOM design standard values were also applied for the unit demands of maize mill and the estimated initial rate of connection. (The unit demands of maize mill =25kVA/40kVA, the estimated initial connection rate= 1.0)
- The results from the Master Plan Study were used as the standard values for maximum-operating rate [4] of transformers. (The standard values for maximum-operating rate = 80%)

(ii) In cases entailing installation of more than one distribution-use transformer, the JICA Study Team asked the counterparts to confirm the supply area of each transformer and repeatedly perform the work of determining the requisite capacity based on the number of facilities, maize mill, etc. within the area.

(c) Effects

The counterparts realized the importance of these calculations and came to understand the method of determining the number and capacity of transformers. As a result, they became able to determine the appropriate transformer number and capacity, and thereby curtail the degree of error in cost calculation to the minimum.

[2] Shops, and ordinary households aren't the target for electrification on MAREP phase 5, however they are counted for demand forecast because they will be electrified in the future.
[3] The factor that indicates the dispersed level of maximum electric power used by customers
[4] The ratio that indicates the allowable load for transformer against the nominal capacity in operation

2.2.4 Assessment of Results of FS Implemented after Provision of the FS Support, and related Guidance/Instruction

This section sets forth the assessment of the results of FS implemented for 17 TCs after provision of the support, and the items of guidance/instruction provided to the counterparts.

(1) FS reports

As shown in Table 2-4, the drawings of site situation prepared on the basis of the FS results required revision in a few places due to factors such as incorrect symbols and misentries.

Table 2-4 Number of places requiring revision in the results of the Phase 5 FS implemented after the first field survey

Category	Type of mistake	Number of points
Drawings of site situation	Omission of candidate sites for installation of distribution-use transformers	0
	Omission of extended distribution line distance	0
	Incorrect symbol	10
	Misentry	7
	Mistaken scale	0
Calculation tools	Voltage drop calculation	1
	Cost calculation	0
	Transformer number and capacity	10

Nevertheless, the results reflected the points of guidance/instruction overall, and showed improvement in the following respects.

- Use of symbols stipulated in the FS implementation manual
- Unification of perspectives on selection of distribution line routes
- Notation of obstacles such as trees, telephone lines, and transmission lines
- Input of accurate data into the calculation tools
- Management of each file to be stored in a separate folder

The JICA Study Team provided instruction about the places requiring revision while going through each such item with the counterparts.

(2) Field surveys

Table 2-5 presents the average time spent on field surveys per TC as derived from an analysis of the time spent on the surveys in all 54 TCs. It can be seen that this time has gradually decreased though the average time spent on field surveys depends on weather conditions or characteristics of the location. This indicates that the technical transfer for efficient survey performance, such as avoidance of repeating measurement of the same point, is steadily taking effect.

Table 2-5 Average time required for field surveys per TC (time spent on survey work in TCs)

	Before the provision of FS support	During the provision of FS support	After the provision of FS support
Average time (minutes /1 TC)	149	137	114
Number of TCs surveyed (TCs)	23	13	18

2.2.5 Calculation Results for Project Cost, etc.

In the follow-up study, the JICA Study Team calculated the distribution line extension and number of transformers in Phase 5, and made an estimate of the construction cost. Table 2-6 present the results of the Phase 5 cost estimate, etc. together with counterparts. The construction cost is estimated to average about 110,000 US$ per TC. This would be less than half as high as the corresponding cost estimate of 245,000 US$ made at the time of preparation of the Master Plan study. The following may be cited as the main factors behind this big decrease in estimated construction cost compared to the time of the Master Plan study.

(1) At the time of the Master Plan study, estimates were made of the requisite distribution line extension distance using rough maps (on a scale of 1:1,000,000) that did not contain the most recently constructed and planned distribution lines. In the Study, on the other hand, field surveys were conducted at all TC to be electrified in Phase 5. This provided an accurate grasp of the extension distance from the subject TC to the existing distribution line, and the distance was found to be shorter as a result.

(2) The demand forecast decreased by 28% relative to that made at the time of the Master Plan study, and this led to a commensurate decline in the requisite transformer number and capacity.

Table 2-6 Outline of calculation results for project cost, etc.

Category		Calculation results
Project costs	Local currency	653,090×10^3MK
	Foreign currency	5,937×10^3US$
Extended distribution line length	33kV(11kV)[5]	831.0km
	400/230V	82.2km
Number of transformers	100kVA	33
	50kVA	53

[5] The 11kV voltage is used for 5 TCs in phase 5 TCs. However distribution equipment of 33kV type are used in those TCs because there is a plan for changing the voltage from 11kV to 33kV in the future.

Chapter 3 Revision of Rural Electrification Plan

3.1 Improvement of Electricity Demand Forecast Method

The JICA Study Team improved the electricity demand forecast method through discussions with the counterparts.

Because of schedule restrictions, the JICA Study Team used a simple version method for the Phase 5 electricity demand forecast, and established a full version for Phase 6 and later which the results of Socio-Economic Survey of TCs were reflected to as much as possible.

3.1.1 Basic Policies for Electricity Demand Forecast

(1) The forecast duration is until 2020 along with the Master Plan.
(2) The end-user method that can easily reflect demand conditions in non-electrified TCs is adopted.
(3) Shops and households in TCs are also targets for the electricity demand forecast.

3.1.2 Basic Assumption for Electricity Demand Forecast

(1) The base of calculation is the Socio-Economic Survey conducted in 2001.
(2) All public facilities and existing maize mills in TCs immediately connected after electrification.
(3) "The number of household using the TC" is used for calculation of estimated maize mill increment.
[The increase ratio of the number of maize mill in the Master Plan is 1 set/30.5 households]
(4) The increase ratio (1.27%/year) of the number of households in the Master Plan is used for increment calculation of the number of households.
(5) The prospective number of the sheller of maize mill is not considered in the electricity demand forecast.
(6) The electric devices for the demand forecast are 15 types, according to the results of the Socio-Economic Survey of TCs.
(7) The average power consumption of each electric device is calculated from the results of the Socio-Economic Survey of TCs.

(8) The electric devices for the demand forecast are shown in Table 3-1. The average power consumption of each device was calculated from the results of Socio-Economic Survey.

Table 3-1 Electric devices used in electricity demand forecast

Electric Device	Power Consumption（W）
1) Incandescent Light	100
2) Fluorescent Light	40
3) Cooking Device	2,500[6)]
4) Refrigerator	280
5) Radio	10
6) Cassette/CD Player	30
7) Television	80
8) Video Cassette Recorder	20
9) Electric Iron	1,000
10) Electric Heater	1,200
11) Electric Fan	50
12) Air Conditioner	1,000
13) Mill	20,000
14) Computer	200
15) Others	200

[6] 1,600W was used in the electricity demand forecast system for Phase 6 and later because of later analysis.

3.1.3 Electricity Demand Forecast for Phase 5

(1) Policies

(a) The completion year of the electrification construction is 2004, and the electricity demand targeted to 54TCs of Phase 5 is forecasted from that year.

(b) The target facilities for the demand forecast are follows.

○Public Facility（17 facilities）

Secondary School	Police Post
Primary School	Police Unit
Teacher's Development Center	Admarc
Staff House	Government Office
Hospital	Church
Health Center	Mosque
Clinic	Court
Post Office	Other Public Facilities
Police Station	

○Business Entity (2 facilities)

Maize Mill	Shop

○Household

(c) Electricity demand forecast is calculated both considering a maize mill increment and not considering the increment for a TC.

(2) Assumption

(a) The JICA Study Team calculates electricity demand forecasts using the unit demand for each facility as a complete power consumption pattern for 2020, and then decreases the demand to 2004 using a household increase ratio.

(b) The JICA Study Team sets the power factors at 0.9 for a household and 0.8 for a maize mill in a transformer calculation.

(c) The connection ratio of shops and households is 50%.

(3) Supposition of the Unit Demand

Based on the results of Socio-Economic Survey of TCs, the JICA Study Team assumed the unit demands for 17 public facilities, maize mill, shop and household.

(4) System

The JICA Study Team established the electricity demand forecast system for Phase 5 on the Microsoft Excel using the assumed unit demands. All inputting operation is only the number of targeted facilities on the sheet used in the FS also, and the system automatically calculates the electricity demand forecasts until 2020 and a necessary transformer capacity. These results will be used for the determination of a transmission capacity.

(5) Verification of Results

Compared with the results of the system and the Master Plan at the year 2020, the average max capacity is 27.9% less and the average power consumption is 29.3% less. Since the DOE staff and ESCOM staff have felt that the results in Master Plan study were too high they judged that the results in the Study were more realistic.

3.1.4 Electricity Demand Forecast for Phase 6 and later

(1) Policies

(a) The completion year of electrification constructions of Phase 6 is 2007, and the target TCs for the electrification demand forecast are 171 TCs. The TCs which have been electrified after the Master Plan are excluded.
(b) The increment of electricity demand is calculated based on household growth and increase of the number of electric devices in a facility.

(2) Assumption

In addition to the facilities in the electricity demand forecast for Phase 5, the electricity demands for Phase 6 and later were forecasted on the following assumptions:

(a) From the results of Socio-Economic Survey, the power consumptions in electrified TCs are balanced almost 17 years after electrification. Therefore, the unit demand of each facility is assumed as a state at 17 years after electrification.
(b) Gradually, an electric device is purchased in each facility.
(c) The households are divided into two types, wealthy households and ordinary households. The ratio of the number of these types is 5:95.
(d) Based on the results of Socio-Economic Survey of TCs, the connection ratio of shops is 50% and that of household is 40%.
(e) The yearly power consumptions are calculated by multiplying assumed working days in a week of each facility, the assumed daily power consumption and 52 weeks.
(f) Verification of results of the electricity demand forecast for 171 TCs were calculated by the electricity demand forecast system for Phase 6 and later. Comparing with the results by the system and the Master Plan at the year 2020, the average maximum demand is 28.0% less and the average power consumption is 39.1% less alike the verification of results of Phase 5.

3.2 Revision of Method for TC Electrification Prioritization

In the Master Plan, a market fee was used as a criterion for prioritization of electrification and the higher market fee was, the higher the priority was. But the JICA Study Team revised the method for TC electrification prioritization through discussions with the counterparts.

3.2.1 Criteria for TC Prioritization

The JICA Study Team examined the criteria to determine non-electrified TC prioritization for electrification and weights through discussions with counterparts as follows. The criteria and weights are shown in Table 3-2.

- Although there are physical ways such as areas and length of a TC to express TC scale, the electricity demand can, in addition to physical scale, express immanent scales such as the number of public facilities and households in a TC.
- The electricity demand as a criterion is yearly power consumption (MWh/year) that directly reflects future income, not maximum power (kW).
- Since the targets of the DOE are public facilities, the ratio of the electricity demand in public facility towards the total electricity demand in a TC becomes one of the criteria.
- Because distance from existing distribution line influences difficulty of a construction and increase and decrease of construction cost, this becomes one of the criteria.

Table 3-2 Criteria and weights for prioritization of non-electrified TC

Criterion	Weight
Amount of electricity demand (kWh)	10
Distance from existing distribution line (km)	2
Public facility demand ratio (%)[7)]	1

3.2.2 TCs for Phase 6

From the mentioned results, the JICA Study Team determined TCs for Phase 6. Because of the DOE policy, the 2 highest TCs in each district, 49 TCs in total, were selected. The list of TCs for Phase 6 is shown in Table 3-3.

Compared with the 53 TCs which were selected in Phase 6 in the Master Plan, the same 19 TCs were selected but the remaining 34 TCs were different. The JICA Study Team thinks the reasons for this are as follows.

(1) There are TCs which have been electrified by ESCOM.
(2) Some TCs under new distribution lines in Phase 4 have been electrified.
(3) Since amount of electricity demand was given a bigger weight, almost all TCs are prioritized by the scale of the demand.

[7] Electricity demand in public facilities / Total electricity demand in the TC

For Phase 7 and later, the DOE staff will determine TCs to electrify by themselves using the electricity demand forecast system and the method for TC priority.

Table 3-3 TCs for Phase 6

Region	District	TC Name
Northern	Chitipa	Kameme
		Chesenan
	Karonga	Lupembe
		Tilora
	Rumphi	Nchenachena
		Muluju
	Nkhata Bay	Ruarwe
		Usisya
	Mzinba	Luwelezi
		Engutwini
Central	Kasungu	Simlemba
		Kamboni
	Nkhotakota	Kasitu
		Msenjere
	Ntchisi	Kamsonga
		Chinguluwe
	Dowa	Kasuntha
		Mukukula
	Salima	Siyasiya
		Chitala
	Lilongwe	Kasiya
		Nsaru
	Mchinji	Gumba
		Mikundi
	Dedza	Magomelo
		Chiluzi
	Ntcheu	Sharpvalle
		Kaloga
Southern	Mangochi	Mkumba
		Chiponde
	Machinga	Malundani
		Ngokwe
	Balaka	Phimbi
		—
	Zomba	Zaone
		Mpyupyu
	Chiradzulu	Ndunde
		—
	Blantyre	Linjidzi
		Chigwaja
	Mwanza	Kasuza
		—
	Neno	—
		—
	Thyolo	Thomasi
		Chipho
	Mulanje	Chambe
		Mathambi
	Phalombe	Chitekesa
		Nambazo
	Chikwawa	Kakoma
		Kanyinda
	Nsanje	Chididi
		Masenjere

3.3 Technical Transfer of Electricity Demand Forecast Method

3.3.1 Outline of Electricity Demand Forecast and Forecast Method

The JICA Study Team lectured the counterparts on the objectives, concepts, types and each feature of the forecast method in the electricity demand forecast, and explanations and indications of problems in the electrification demand forecast method in the Master Plan. Through the lectures and discussions, counterparts deeply understood the electricity demand forecast and its method. In addition, they clearly understood the objectives and the contents of the socio-economic survey which will be necessary after Phase 6, such as necessity of logical viewpoints and the establishment of the survey method considering analyses after surveys.

3.3.2 Method for TC Electrification Prioritization

In the same lecture as the electricity demand forecast, the JICA Study Team lectured to counterparts on the selection method of non-electrified TCs and problem points and proposed the concept of the TC prioritization as mentioned in 3.2.2.

Based on the agreement with counterparts, the JICA Study Team made the TC selection file and also lectured on the system and operation method.

Furthermore, since counterparts have to select non-electrified TCs after Phase 6 and later by themselves, the JICA Study Team made a work file for practice which was a copy of the TC selection file. The JICA Study Team believes counterparts will be able to accurately select TCs by practicing repeatedly the work file.

Meanwhile, the functions and directions of the TC selection file are explained in detail in the FS implementation manual.

Chapter 4 Technical Transfer related to Project Management

4.1 Problems with Phase 4 and countermeasures

Project management was divided into five major stages: FS, detailed design, procurement of equipment, construction, and inspection.

Successful RE project requires the smooth performance of not only FS but also each of the subsequent stages. This, in turn, demands a firm apprehension of the problems arising in the Phase 4 construction now under way and the preparation of appropriate measures to prevent analogous ones from occurring in Phase 5 and succeeding phases. In response, action was taken to identify the major problems with the Phase 4 project management through both a field survey conducted at a Phase 4 construction site (i.e., Nambuma TC) and interviews with the DOE and ESCOM.

Table 4-1 presents the problems with project management in Phase 4 and items of countermeasure proposal and instruction for the counterparts.

Table 4-1 The Problems with project management in Phase 4
and Items of countermeasure proposal and instruction

Stage	Main problems in Phase 4	Main reason	Items of countermeasure proposal and instruction for the counterparts
FS	The DOE was not able to gain a good grasp of the situation on the site.	FS was not carried out.	・ Instruction regarding the importance of FS ・ Technology transfer regarding the implementation of FS ・ Instruction in basic items of project management ・ Increase more electrical engineers assigned to the work of Phase 5 examination in RE unit.
Detailed design	The lack of FS also meant that the DOE did not know how much material (and equipment) each TC needed and the level of requisite cost. This led to an imbalance between the material already ordered and that actually needed.	FS was not carried out.	
	The DOE was not able to properly investigate the detailed design prepared by ESCOM as the party in charge of it.	・ FS was not carried out ・ Insufficient understanding of basic items of project management ・ Poor establishment of organization	
	ESCOM submitted design results to the DOE in the format of its own choice. As a result the DOE can't do examination of the detailed design sufficiently.	A format was not established for the documents submitted to the DOE by ESCOM	・ Items of project management using an overall basic flow ・ Proposal of a format for documents submitted by ESCOM to the DOE ・ Increase more electrical engineers assigned to the work of Phase 5 examination in RE unit.
Procurement of material	The Phase 4 material has still not been delivered in its entirety. In fact, construction has been suspended in some places due to the unavailability of some articles for RE project (wire and transformers) in ESCOM warehouses.	・ Shortage of funds ・ Selection of less-experienced supplier	
Construction	Even when modifications were made in the transition from the stage of detailed design stage to that of construction, in almost all cases, ESCOM went ahead with the construction without notifying the DOE of the changes.	・ Insufficient understanding of basic items of project management ・ Poor establishment of organization	
	A format was not established for the documents submitted to the DOE by ESCOM after the construction. ESCOM submitted design results to the DOE in a format of its own choice. As a result the DOE can't do examination of the construction sufficiently.	A format was not established for the documents submitted to the DOE by ESCOM	
Inspection	The reports on construction results did not contain breakdowns of the construction cost for each TC or other detailed itemizations of the work in the form of drawings, etc. As a result the DOE can't do examination of the construction sufficiently.	・ Insufficient understanding of basic items of project management ・ Poor establishment of organization	

4.2 Countermeasure Proposals and Guidance/Instruction in Phase 5 and Later

In light of the aforementioned problems in Phase 4, the JICA Study Team proposed the countermeasures noted below for subsequent project management in Phase 5 and later to the counterparts, and provided related guidance/instruction.

(1) Guidance/instruction in basic items of project management using the overall basic flow

To lead a project to success, the DOE, as the construction consigner and examining institution, must first and foremost have a full understanding of the overall flow of project management. Nevertheless, as shown in Table 4-1, numerous problems arose at all stages of projects in Phase 4, and this suggests that the DOE did not have a sufficient understanding of the basic items of project management. For this reason, the JICA Study Team compiled the fundamental sequence of steps in project management in the form of a basic overall flow. Through discussion with them utilizing this basic overall flow, the counterparts were instructed in the basic items of project management, as follows.

- The DOE must have the firm carrying out the detailed design submit the design results in a fixed format.
- The construction company must obtain an advance approval from the DOE for any changes from the stage of detailed design in that of construction.
- The construction company must not commence the construction until the design submitted by the detailed design firm has been approved by the DOE.
- The DOE must have the construction company submit a bill of quantity, total cost sheet, and drawings after the construction has been completed. After that, DOE must evaluate and approve them.

Figure 4-1 shows the basic overall flow.

(2) Proposal of the format

The construction cost calculations at the stages of detailed design and construction should be performed exactly by using the appropriate format. The format is extremely important because one mistake can make a big impact on the total cost. In Phase 4, nevertheless, such a format was not established. In response, the JICA Study Team prepared a format for the detailed cost estimation report (total cost) required for detailed design in Phase 5, and explained it to the DOE side.

The following points were taken into account in preparation of the format.

(a) Detailed cost estimation report (total cost)

(i) The format was arranged so that the detailed design company could enter values for the construction cost and other items in the FS results below those for the detailed design results, to enable comparison between the two.

(ii) A "reason for change" box was incorporated to enter the reason for any significant change from the FS results in the detailed design, by the detailed design company, so that the DOE can examine the reason.

(iii) In the interest of clearly noting the responsibility of the DOE and detailed design company, the format also included a box for signature by the personnel in charge at each by the reason that the construction company can’t evaluate unjust the construction cost.

Figure 4-2 shows the format for the detailed cost estimation report (total cost) which the JICA Study Team suggested.

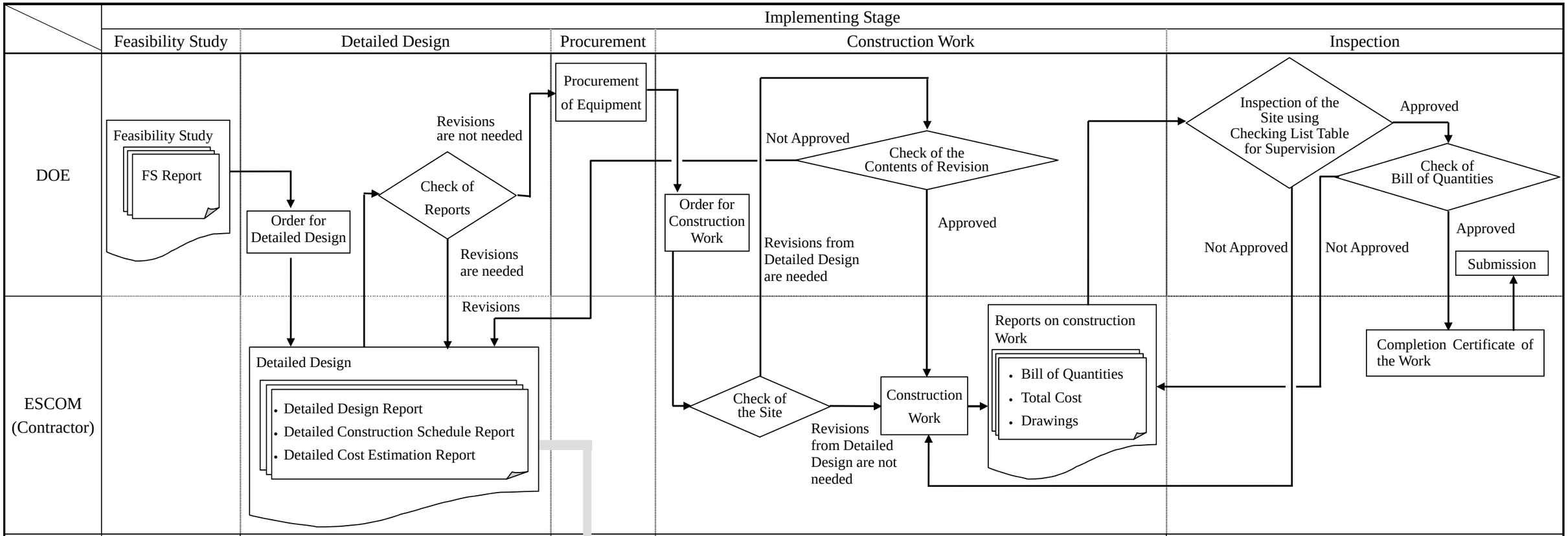
(b) Bill of quantities

(i) Separate formats were each prepared for 33kV(11kV) and 400/230V lines, 100kVA and 50kVA transformers to enable closer investigation by the DOE.

(ii) ESCOM is going to implement the detailed design and construction in Phase 5, as it did in Phase 4. Therefore, the latest data obtained from ESCOM were used for the breakdown of material.

Figure 4-3 shows the format for the bill of quantities which the JICA Study Team suggested.

The Basic Flow of Project Management on MAREP Phase V



Contract for Detailed Design

Contract on Detailed Design should include:

a) Contract for Consultant's Services
b) Description of the Services (Scope of works)
c) Reporting Requirement
d) Key Personnel and Subcontract
e) Duties of the Employer
f) Cost Estimates in Local Currency
g) Form of Bank Guarantee for Advance Payment

*Cost estimates in foreign currency were omitted in above contract because ESCOM will be selected as the contractor on Phase 5. However that provision should be included in contract after Phase 6 if contractor is foreign company.

Detailed Design Report etc

Detailed Design Report should include:

a) Single line connection diagram between the tapping point and the Target TC
b) Maps between the tapping points and the Target TC
c) Maps inside the Target TC as well as the Trading Center between the tapping points and Target TC

Detailed Construction Schedule Report should include:

a) Bar Chart for the 54 Target TCs

Detailed Cost Estimation Report should include:

a) Total cost
b) Bill of quantities on 33kV(11kV) lines
c) Bill of quantities on 400/230V lines
d) Bill of quantities for substation

Contract for Construction

Contract for Construction should be drafted by ESCOM and DOE, and should include:

a) Conditions of Contracts
b) Contract Data
c) Technical Specifications
d) Qualification Information
e) Letter of Acceptance
f) Bill of quantities-from the Detailed Design Report
g) Scope of works
h) Form of Agreement
i) Security forms (Bank Guarantee)
j) Drawings

* This manual was made by DOE

Figure 4-1 The Basic Overall Flow of Project

Detailed Cost Estimation Report (Total cost)

1 General Information

TC name:

Region:

District:

Date of Survey:

2 COST ESTIMATION

Stage	HV(km)	LV(km)	No.of Tx50	No.of Tx 100	50kVA Unit Cost	100kVA Unit Cost	HV COST	LV COST	Tx COST	Compensation Fee	TC COST(Total)
Detail Design											0
FS of DOE											0

3 Reasons for Mainly Changed Points from FS Results

Signatures

DOE _____

ESCOM:Leader _____

ESCOM: Person in Charge _____

Figure 4-2 The format for the Detailed Cost Estimation report (total cost)

Bill of quantities on 33kV/11kV lines at detail design

Enter information in green column

TC name

Length of the overhead line **km**

Date of Survey

(unit:MK)

	MATERIAL DESCRIPTION	TOTAL QUANTITY	UNIT PRICE	TOTAL PRICE
Main Material	100mm2 AAAC 'OAK'			
	7/8 GMSW			
	7/8 guy grips			
	Barbed wire			
	33kV 200Kg spindles			
	Binding stirrups (33kV)			
	Pilot spindles			
	33kV pin insulators			
	HV stay insulators			
	Disc insulators			
	Aluminium binding tape			
	M12/150 nuts & bolts			
	M16/150 bolts & nuts			
	M16/260 bolts & nuts			
	M16/300 bolts & nuts			
	M16 flat washers			
	M16 spring washers			
	18mm stay rods			
	M20/400 bolts & nuts			
	M20 flat wahers			
	M20 spring washers			
	M20/400 eye bolts & e/nuts			
	100mm2 Snail clamps			
	Tie straps			
	Clevis adaptors			
	Insulator hooks			
	Danger plates			
	9.0m wood pole			
	10.8m(s) wood pole			
	12.3m(H) wood pole			
	X11 cross arms			
	Stay baulk			
	SP 10 spacer block			
	X49 cross arm			
	33kV Air Break Switch			
	SUB-TOTAL			
Other Material				
	SUB-TOTAL			
Construction Cost	Manhrs for gang and Cost			
	Manhrs for OHL Supervisor &Cost			
	Hiring for Gang			
	Hiring for Supervisor			
	Allowed for fuel for gang			
	Allowed for fuel for Supervisor			
	SUB-TOTAL			
TOTAL				

Figure 4-3 The format for the Bill of Quantities on 33kV(11kV) lines at detailed design

4.3 The Schedule for Phase 5 and Phase 6 after Completion of FS for Phase 5

Table 4-2 shows the schedule for Phase 5 and Phase 6 after completion of FS for Phase 5.

This schedule was made by the JICA expert considering that the construction work for Phase 6 must start immediately after all construction work for Phase 5 is completed.

The DOE must always control the progress of RE projects according to the schedule in Table 4-2 and implement each stage after completion of FS for Phase 5.

Table 4-2 The schedule for Phase 5 and Phase 6 after completion of FS for Phase 5

Fiscal year		2004				2005				2006				2007or later
Month		4	7	10	1	4	7	10	1	4	7	10	1	
Phase 5	Contract for detailed design													
	Detailed design													
	Procurement													
	Contract for construction													
	Construction													
	Inspection													
Phase 6	Feasibility study													
	Contract for Detailed design													
	Detailed design													
	Procurement													
	Contract for construction													
	Construction													
	Inspection													

Chapter 5 Discussion of Institutional Issues and Economic Evaluation of Rural Electrification Projects

5.1 Setup of the Implementing Rules and Regulations of the Rural Electrification Act

After three RE-related bills—Rural Electrification, Electricity, and Energy Regulation bills—passed the congress in March 2004, the DOE stepped up its drafting of the Implementing Rules and Regulations. In this follow-up study, the JICA Study Team pointed out important aspects and drafted the Implementing Rules and Regulations.

(1) Issues to be discussed in drafting the Implementing Rules and Regulations

The following articles stipulated in the Rural Electrification Act must be carefully translated and clarified in the Implementing Rules and Regulations.

- Under the definition of the term “Rural Electrification”, the internal rate of return (IRR) of the project must be no more than 6%. But there is no explanation as to whether this IRR is the economic internal rate of return (EIRR) or the financial internal rate of return (FIRR).
- To have a concessionaire implement a RE project based on a concession agreement in the new structure of the power industry, it is necessary to introduce a methodology to evaluate the project economy from the investor’s standpoint.
- Regarding stipulations about licenses that a concessionaire must possess, there is a discrepancy between stipulations of the Rural Electrification and Electricity acts. Although the Rural Electrification Act says that the Act shall prevail over other acts, if such a discrepancy occurs, it is recommended to make the matter clear and avoid such vagueness.
- The DOE must clarify its policy for subsidy with attention to government financial capacity, fairness (or equitability) of tariffs, and profitability for concessionaires.
- It is necessary to clarify whether a concession fee is an intangible asset or annual expense. It is also necessary to discuss the creation of a mechanism for recovery of depreciation of the assets listed on the balance sheet of the government from a concessionaire and use of the recovered money as a revolving fund.
- It is easily conceivable that, during the project period, additional assets invested

by the concessionaire will be mixed with the initially invested assets owned by the government. Rules must be established regarding treatment of these mixed assets, when the project ends or is terminated.

(2) Draft Implementing Rules and Regulations

The Draft Implementing Rules and Regulations shown in this report (refer to Appendix) merely provide ideas for internal discussion in the DOE and do not constitute a completed document. Some of the important points of the draft are follows:

- The Implementing Rules and Regulations consist of five parts: General Provisions, Rural Electrification Management Committee, Rural Electrification Fund, Regulation of Rural Electrification, and Other Provisions.

- The part on the Rural Electrification Management Committee clarifies rules regarding responsibility of the committee and mechanism of funding from the fund, especially payment of the initial investment cost and operation-and-maintenance subsidy. However, with regard to SHS purchase guarantee, from now on, the DOE must discuss contents of the rules because an SHS financing mechanism has not yet been established. In addition, rules regarding remuneration for the committee members paid from the fund must be discussed and kept consistent with existing government and ministry guidelines.

- The part on Regulation of Rural Electrification clarifies the vagueness of the acts as to whether a concessionaire can possess multiple licenses. However, regarding the renewable energy license, only the issues for discussion are listed because the renewable energy bill has not yet been prepared.

- With regard to tariff regulation, the powers of the Malawi Energy Regulatory Authority and the DOE are clarified. The rules also clarify how the DOE will establish its policy for providing subsidies with a view to securing reasonable return for concessionaires and correcting any disparity of tariff levels.

- Regarding concession agreements, the draft rules present concrete ideas on procedures for selecting a concessionaire, issues to be clarified in the agreement, treatment of the concession fee, and termination of the concession. Basic ideas for the handling of responsibility, compensation, and assets when the project fails are also clarified.

5.2 Business Models for Rural Electrification

Due to the passage of the three RE-related bills, the power industry will be unbundled into three sub-sectors, i.e., generation, transmission, and distribution. Of these, the distribution sub-sector will be transformed into a power supply business based on concession agreements in both urban and rural areas. In this sectoral reform, in addition to ESCOM, newcomers are allowed to enter the future RE project. Since the RE business will be carried out under a concession agreement, ESCOM will also be able to solve the vague accounting separation in the company, which has caused a problem internally, and implement RE project as an independent distribution business.

5.3 Procedure for Approval of the Project

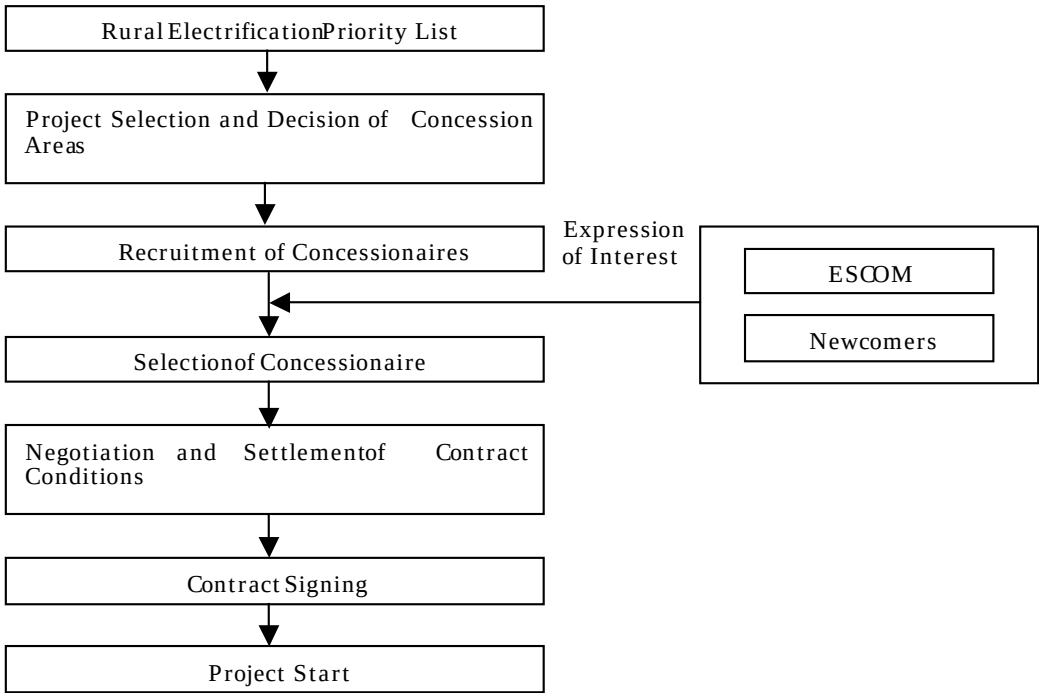
As shown in the Rural Electrification Act, the RE business will be a power distribution service with an additional investment based on a concession agreement for 20 years. Although the Rural Electrification Management Committee has the authority of approval of concession, the Rural Electrification Unit of the DOE, as secretariat, must carry out the necessary work.

Figure 5-1 shows the flow of the work which the secretariat must be engaged in.

The first stage extends from project identification to the listing of companies which have an interest in the project. The DOE will select RE project areas for the next phase based on the electrification priority list of trading centers (TCs) that was made in the Master Plan, and announce the profiles of the projects to recruit operators. If private companies are interested in the projects, they would express interest to the DOE, and the DOE will prepare the list of candidate companies.

As the next stage, the DOE must identify the most promising candidate from the list and clarify the detailed conditions for a concession agreement. In evaluating the conditions, the important points are the size, period, and termination of O&M subsidy. Concessionaires are definitely private entities and will assess project risks and expected return from the project carefully. The project risks here are factors of uncertainty, including size of demand, demand growth in the future, tariff levels, rate of tariff collection, and additional investment needed during the project period.

If the government and the private company agree upon all project conditions through this negotiation, a concession agreement would be signed between them.



Source: the JICA Study Team

Figure 5-1 Procedure for Selection of a Concessionaire

5.4 Evaluation Method for Economy of Project

As shown in the Master Plan Study, subsidies not only for the initial investment but also for O&M are prerequisites for running almost all RE projects. To solve this problem, the Rural Electrification Act allows operational O&M subsidy.

When the DOE selects a concessionaire, it must evaluate the economy of the project and estimate the size of the necessary subsidy. We propose the following bases for procedure and methodology of evaluation.

(1) Approval of an RE Project

The Rural Electrification Act stipulates that the IRR of the project must be no more than 6% under the definition of RE. In the Follow-up Study, this IRR must be calculated as an EIRR.

(2) Concession fee

The Rural Electrification Act stipulates that the concedante shall be entitled to be paid a concession fee by the concessionaire. The act also stipulates that this fee covers the monitoring and management costs and costs of channeling monies from the Rural Electrification Fund to the concessionaire.

In general, the term “concession fee” refers to the premium cost for receiving concession. In Malawi, however, we cannot expect RE projects to be unconditionally viable as a power business. In the short run, it may not be possible for private companies to pay a lot of premium money for RE projects.

(3) Depreciation of the facilities installed by the Rural Electrification Fund

For RE projects, necessary investment in facilities such as lines, poles, and transformers are made with money from the Rural Electrification Fund. While the government holds ownership of these facilities, a concessionaire can use them for project operation. These assets are listed in the book of the Rural Electrification Fund, and their value is devaluated (depreciated) every year. This depreciated value, in principle, must be recovered through income from the project operation and returned to the Rural Electrification Fund. This mechanism will produce capital money for reinvestment in the next project. In other words, the depreciation cost recovered from the project income will be accumulated in the Rural Electrification Fund as a revolving fund.

At the same time, it is very questionable how much of the depreciation cost of the facility can be recovered through income from the project operation, which is unviable without subsidy. As a basis for the RE scheme, on the other hand, it is necessary to transfer the depreciation cost to the concessionaire in the form of a leasing fee for the facility when the DOE assesses annual profit and loss of the project. Needless to say, this fee will be offset by the necessary operation subsidy to make the project viable. As a result, the fee cannot cover the depreciation cost and therefore may also be exempted in some cases.

(4) Operation &Maintenance (O&M) subsidy

There are two policy approaches for evaluating the size of necessary O&M subsidy. One is for the DOE to order the concessionaire to submit a financial statement annually and evaluate the necessary subsidy based on the statement. This method is less risky for the concessionaire, but presents, the DOE with the problem of how precisely it can assess the viability of the project. While the concessionaire holds all financial data, the only thing the DOE can do is to trace and examine these data and statement. In this context, the DOE, which is not involved in the project operation directly, has limited power, and the concessionaire has an advantage.

Another approach is for the amount of the O&M subsidy to be fixed in the conditions of the concession upon which the DOE and concessionaire agree. If more than two candidates apply for the auction, the one requesting less subsidy gets higher evaluation points. (Needless to say, the concessionaire must be selected upon consideration of a various factors, and the amount of the requested subsidy is only one of them.) On the one hand, fixing the size of the subsidy provides the concessionaire with an incentive in that, if it improves the efficiency of the operation, it can also increase its profit from the operation. On the other hand, both the government and the concessionaire hold some risks. From the standpoint of the concessionaire, even if it finds itself getting into deficit in revenue, it cannot receive more subsidy than the initially fixed amount. From the standpoint of the government, there is the risk that the concessionaire would abandon the project if it continued to suffer from income deficit.

(5) Separation of assets ownership and settlement when the project terminates

During the 20-year concession period, the concessionaire needs to invest additionally in the facility. Even though the government owns the original assets, renovation is necessary if they are completely depreciated. The concessionaire is responsible for this reinvestment, and renewed facilities are to be listed in the concessionaire's balance sheet and depreciated as annual operational cost. When the 20-year concession period is expired, the government must buy out the concessionaire's assets at the price of the residual value and terminate the contract, if the concessionaire does not renew it.

Chapter 6 Recommendations

6.1 Increase in the Staffing of the RE Unit of the DOE

As for the future, the schedule calls for the conclusion of contracts and commencement of the whole series of contract, detailed design, construction and other work for RE projects in Phase 5. There are two major types of examination work to be performed by the DOE in Phase 5, as follows:

- Examination of design drawings submitted by ESCOM;
- Examination of the calculations made by ESCOM for construction costs and cost breakdowns.

The examinations should be made by personnel with knowledge of electric engineering (for distribution lines). However, of the four persons currently in charge of contracting and examination work at the RE unit of the DOE, only one of them is an engineer with a thorough knowledge of electric engineering. A heavy work load is anticipated to arise in connection with examination. It would clearly be hard for the DOE to make accurate examinations with the current setup including only one such engineer. As such, it is considered necessary for the aforementioned RE unit to be staffed with more electric engineers assigned to the work of Phase 5 examination.

6.2 Electricity Demand Forecast and Continuous Analysis of TC Electrification Prioritization

The recommendations for the electricity demand forecast for future are shown below.

(1) Electricity Demand Forecast

All results of Socio-Economic Survey were not analyzed in the Study because of the time limitation. Therefore, for assuming more accurate unit demands, the DOE staff should analyze the sheets which could not be analyzed in the Study.

Firstly, the JICA Study Team recommends that the DOE staff conduct a socio-economic resurvey and analyze the results for grasping the conditions of electricity demand and increase of electricity devices more accurately.

Secondly, the duration of electricity demand forecast should be revised according to the phases.

Thirdly, the accurate number of household demand is required. The household data which were available in the Study was, as mentioned, "the number of households using the TC." Therefore, the DOE staff should grasp "the number of households in the TC" in the socio-economic resurvey and analyze more accurate electricity demand in TCs. For making unit demand for household more accurately, the JICA Study Team recommends that the DOE staff analyze the results of household in the electrified TCs in Socio-Economic Survey and review the ratio between the number of ordinary households and the number of wealthy households.

Fourthly, since the power consumption of a sheller of a maize mill is big as 20kW, the Study Team recommends that the DOE staff research the ratio of maize mills with or without a sheller and reflect the results in the electricity demand forecast.

(2) Method for TC Electrification Prioritization

The DOE staff should select TCs for Phase 7 and later. At this point, the JICA Study Team recommends following five items for TC Electrification Prioritization.

- The DOE staff should recalculate considering the results of distribution expansion in Phase 5 and Phase 6 as for prioritization of Phase 7 and later.
- The DOE staff should revise the weight of each criterion according to the DOE policies.
- A market fee should be included as a criterion if it is clear that a market fee has reasonable indications for correlations between a market fee and both economic activities and social positions.
- The DOE staff should include the 19 TCs which lack TC data in a socio-economic resurvey.
- The DOE staff should decide conditions for adding new TCs for electrification.

6.3 Setup of a new Organizational Structure of RE

(1) Preparation of the Implementing Rules and Regulations and relevant laws

The draft Implementing Rules and Regulations merely provide a basic idea and structure; they do not constitute a completed one. From now on, power experts and lawyers of the DOE must complete it based on this draft. As mentioned in the draft, there must be careful discussion of the possibility that some of the related rules might be available in the existing guidelines of the DOE or the government, and the need for consistency between these rules and existing rules and guidelines.

In addition, there are many deficiencies regarding the necessary institutional arrangement. Although there are high expectations for the use of renewable energy, law necessary to this end has not yet been prepared. For example, on one side, there is a rule regarding renewable energy licenses, and on the other, there is no clear definition of renewable energy. These problems must be solved as soon as possible.

(2) Implementation of a RE project based on a concession agreement, and the necessity of technical assistance

Several issues remain in implementing an actual RE project. Due to the passage of the three RE-related laws, RE projects will be implemented under a new scheme based on a concession agreement, but no such draft agreement is available yet.

The DOE must draft a model agreement as a template, but needs technical assistance from developed countries to do so. As JICA has already decided to continue its technical assistance by sending JICA experts, a professional who can transfer necessary technique regarding concession agreements must be included among these experts.

Appendix

[Appendix] Draft Implementing Rules and Regulations

PART I - GENERAL PROVISIONS

The succeeding rules and regulations shall include the general provisions to be followed in implementing rural electrification in Malawi.

Rule 1. Title and Scope

Section 1. Title

These rules and regulations shall be referred to as the "Implementing Rules and Regulations of the Rural Electrification Act".

Section 2. Scope

These rules are promulgated under the authority of the Department of Energy Affairs of the Ministry of Mines, Natural Resources and Environment, in consultation with relevant governmental agencies, ESCOM and other electric power industry participants, and consumers, to formulate such rules and regulations that are necessary to implement the objectives of the Act.

Rule 2. Declaration of Policy

The Government of Malawi is to:

(1) Pursue electrification in peri-urban and rural areas throughout the country;

(2) Diversify schemes for rural electrification projects;

(3) Encourage and enhance the private participation in the rural electrification market;

(4) Protect public interest in implementing rural electrification;

(5) Assure socially and environmentally compatible energy sources; and

(6) Promote use of new and renewable energy resources in power generation to reduce environmental burden.

Rule 3. Definition of Terms

As used in these Rules, the following terms shall have the following respective meanings:

(1) "Act," unless otherwise stated, means the Rural Electrification Act;

(2) "Authority" means the Malawi Energy Regulatory Authority established under Section 3 of the Energy Regulation Act;

(3) "Beneficiary" means a person who procures a credit guarantee under the Act;

(4) "Committee" means the Malawi Rural Electrification Management Committee;

(5) "Concedante" means the Department of Energy Affairs or other body as the Minister may designate by notice published in the Gazette;

(6) "Concessionaire" means a person or persons who have entered into a Concession Agreement to install, operate or maintain a rural electrification installation on behalf and as agent of a Concedante;

(7) "Concession Agreement" means an agreement concluded between a Concedante and a Concessionaire whereby the Concessionaire agrees to construct, install, operate or maintain a rural electrification installation on behalf and as an agent of the Concedante as noted in Section 28 of the Act;

(8) "Concession Area" means an area demarcated in the Concession Agreement over which a Concessionaire is granted exclusive right to construct, install, operate or maintain a rural electrification installation on behalf of a Concedante;

(9) "Credit Finance Manager" means the Credit Finance Manager to be appointed under Section 19 of the Act;

(10) "Department of Energy Affairs" of "DOE" means the Department of Energy Affairs of the Ministry of Mines, Natural Resources and Environment;

(11) "Fund," unless otherwise stated, means the Malawi Rural Electrification Fund;

(12) "Government" means the Government of Malawi;

(13) "Grant and Subsidy Agreement" means the agreement entered into between the Concedante and the Concessionaire for the purposes of channeling funds from the Fund to the Concessionaire for rural electrification and as noted in Section 21 of the Act;

(14) "Grid Extension Rural Electrification" means rural electrification installation that is connected to the interconnected system;

(15) “Interconnected System” means the high voltage national electricity system of 66kV and above, (or as may be prescribed by notice in the Gazette) including related substations and associated equipment and generation stations to which they are connected and any distribution system connected thereto;

(16) “Malawi Bureau of Standards” means the statutory body established under the Malawi Bureau of Standards Act;

(17) “Management fee” means the fee payable by a Concessionaire to a Concedante in accordance with Section 29 of the Act;

(18) “Micro hydropower station” means a hydropower station whose installed generation capacity is not less than 2kW but less than 100kW;

(19) “Mini hydropower station” is a hydropower station whose installed generation capacity is not less than 100kW but less than 500kW;

(20) “Minister,” unless otherwise stated, means the minister responsible for energy affairs;

(21) “Off-grid rural electrification” means rural electrification installation that is not connected to the interconnected system.

(22) “Public institutions” means electrification of government schools, hospitals, clinics, health centers, police stations, and other government offices and institutions;

(23) “Renewable energy resources” means solar home systems, micro, mini and small hydro electric power stations, and biomass, biogas, wind, and other thermal electricity generation systems and technologies;

(24) “Rural Electrification” or “RE” means grid extension or off-grid electrification and/or renewable energy resources <u>electrification whose economic internal rate of return (EIRR), which is calculated by economic analysis</u>, is no more than 6% p.a., and line capacity is lower than 66kV, and/or generator capacity is no more than 5MW;

(25) “Rural electrification program” means the rural electrification program prepared or compiled in accordance with Section 35 of the Act;

(26) “Rural electrification site” means a site where rural electrification installation is in progress or in commercial operation;

(27) “Rural Electrification Unit” means the Rural Electrification Unit in the Department of Energy Affairs;

(28) “Small hydropower station” means a hydropower station whose installed generation capacity is not less than 500kW and no more than 5MW;

(29) “Solar home system” means photovoltaic solar home system technology as noted in Section 32 of the Act; and

(30) “Solar Home System Purchase, Guarantee and Service Agreement” means the agreement entered into between the Concessionaire and the supplier of solar home system equipment for the purpose of purchase, guarantee and service of the same as noted in Section 32 of the Act.

PART II - RURAL ELECTRIFICATION MANAGEMENT COMMITTEE

Rule 1. Function and Responsibility of the Rural Electrification Management Committee

Section 1. Responsibility of the Committee

As noted in Section 6 of the Act, the Committee shall supervise all issues related to rural electrification and perform the following functions:

(1) Formulate policies for the planning and implementation of a comprehensive RE strategy and provide a mechanism for integration, rationalization, and coordination of various energy and electricity programs of the Government;

(2) Develop the Rural Electrification Master Plan, and update and revise it periodically to facilitate RE projects;

(3) Set criteria for candidate site selection in the development of the Master Plan, and review the criteria periodically;

(4) Develop RE programs in accordance with the Master Plan;

(5) Act as a source of technical, commercial and institutional advice to facilitate RE programs;

(6) Seek and access donor funding and soft credit for RE;

(7) Undertake publicity and marketing campaigns on new approaches to RE and related opportunities;

(8) Contract and oversee the construction and management of RE projects;

(9) Provide incentives for participation in RE projects by newcomers through its declaration of RE policy;

(10) Administer the Rural Electrification Fund and decide the allocation of financial sources from the fund;

(11) Monitor implementation of RE projects by Concessionaires;

(12) Carry out or commission studies and research to promote the development of RE;

(13) Advise relevant government agencies and authorities on:

a) the specifications, design and safety standards for RE systems, equipment and technologies;

b) the prices of SHS equipment, and tariffs and maintenance charges for RE; and

c) the appropriate amount to be appropriated by Parliament for the Fund.

(14) In liaison with the Authority, carry out evaluations and publish periodic reports of the activities and achievement of the Committee;

(15) Prepare, publish and submit to the Minister audited annual accounts of the Fund; and

(16) Do all such things as are necessary for achieving the purposes for which the Committee and the Fund are established.

Section 2. Function and responsibility of the Department of Energy Affairs

In addition to its existing power and functions, the DOE shall have the following functions and responsibility:

(1) Act as Secretariat for the Committee;

(2) Revise the Rural Electrification Master Plan periodically and prioritize un-electrified trading centers (TCs) for energization in each phase of the rural electrification program;

(3) Carry out feasibility studies for individual RE program phases;

(4) Evaluate the viability of new RE projects;

(5) Act as a project supervisor for the design, procurement, and construction stages of each RE project;

(6) Assess and review the necessary level of subsidies for individual RE projects from the following aspects:

a) Applicable concession schemes

b) Expected financial internal rate of return (FIRR)

c) Expected tariff level of the project and desirable range of tariff disparity among neighboring concession areas

d) Necessary level of O&M subsidy

(7) Develop a program to electrify public institutions using SHS in the Rural Electrification Master Plan and prepare a priority list of institutions from the following aspects:

a) Progress of the RE programs to electrify un-electrified trading centers

b) Order of application from each institution

c) Equitability among institutions

d) Cost and benefit

PART III - RURAL ELECTRIFICATION FUND

Rule 1. Management of the Fund

Section 1. Guiding principle

The purpose of the Fund is clearly stipulated in Section 13 of the Act, and the use of the Fund must be transparent and systematically managed.

Section 2. Budget planning

The DOE, as Secretariat for the Committee, shall prepare a budget plan for the next several years to keep a sound balance between necessary expenditure and foreseeable revenue. Also, the DOE must evaluate annual appropriations for RE projects from the following viewpoints:

(1) Prospect for revenue

a) Ordinary revenue for the Fund that is stipulated in Section 13 of the Rural Electrification Act

b) Leasing fee imposed on the government-owned assets used by a Concessionaire

(2) Prospect for outlay

a) New investment in the next phase of the RE program

b) O&M subsidy for existing RE projects

c) Cost of DOE work such as review of the Master Plan, implementation of feasibility studies for the next RE program phase, and supervision of RE projects

d) Other expenditure for implementing RE programs, including SHS credit guarantee and governmental monetary contribution to donor-funded RE projects

e) Cost and expenditures for managing the Committee and the Fund

f) Cost and expenditures for managing RE related research activities

Rule 2. Finance Mechanism of the Fund

Section 1. Guiding principle

Pursuant to Section 13 of the Act, the Fund shall channel monies to RE projects in the following forms.

(1) Capital cost of RE grid extension and off-grid electrification;

(2) Capital cost of SHS equipment to be acquired for public institutions; and

(3) O&M cost subsidy necessary for making an RE project viable.

(4) Research and consultancy assignment:

(5) SHS credit guarantee

(6) Remuneration for the Committee members

(7) DOE cost and expenditures for carrying out its RE-related works required and authorized by the relevant acts.

Section 2. Financing capital cost of extending the interconnected grid and installing off-grid systems

(1) The DOE, as a Concedante, shall decide an appropriate electrification method and design the project configuration. However, if a Concessionaire can contribute to the necessary capital cost, the project configuration may be changed through negotiation between the DOE and the Concessionaire.

(2) The assets which are installed with money from the Fund must be listed in the book of the Fund. However, if the Concessionaire contributes to the capital investment, its portion of the assets must be split and listed in the Concessionaire's book.

(3) The DOE shall recover the depreciation cost of the assets in the book of the Fund through income from the project operation.

Section 3. Financing capital cost of solar home system equipment installed in public institutions

(1) The DOE shall provide capital cost necessary for SHS equipment installation, but the ownership of the equipment shall be transferred to the institution in question.

(2) After the transfer of the ownership to the institution in question, that institution shall be responsible for the equipment, and operate and maintain it appropriately.

Section 4. Subsidizing operation and maintenance (O&M) cost of a rural electrification project carried out by a Concessionaire

(1) The Fund may subsidize the O&M cost of an RE project so that a Concessionaire can attain a certain level of financial rate of return (FIRR) during the concession period.

(2) The requisite amount of the O&M subsidy must be decided through negotiation between the DOE and a Concessionaire (or candidate Concessionaire). To prepare this negotiation, the DOE must evaluate a target FIRR as a hurdle rate to judge project viability in advance.

(3) The target FIRR, however, may vary from project to project because investor's expectation for the return also varies in accordance with the prevailing economic circumstances. Therefore, the DOE must set policies for this evaluation. There are two approaches for evaluating the size of necessary O&M subsidy. One is for the DOE to order the Concessionaire to submit a financial statement annually and evaluate the necessary subsidy based on the statement. Another is for the amount of the O&M subsidy to be fixed in the conditions of the concession upon which the DOE and Concessionaire agree. The DOE shall contemplate the advantages and disadvantages of each prospective approach and apply the best one for individual RE project in question. These policy approaches must be not fixed but flexibly applied for RE program phases and projects, because both market conditions and the economic climate surrounding RE business may change in the future.

Section 5. Providing credit guarantee for the capital cost of SHS equipment other than those to be acquired by Concessionaires.

(1) The DOE shall construct the detailed scheme for credit guarantee including the following aspects:

a) Organization and officials in charge of credit guarantee

b) Budget allocation

c) Eligible SHS technology and equipment for credit guarantee

(2) The DOE shall coordinate its activities with those of other institutions promoting the use of SHS, such as the Barrier Removal to Renewable Energy of Malawi (BAREM) and the Malawi Bureau of Standards and give the beneficiaries easier access to credit guarantee.

(3) The DOE shall encourage potential beneficiaries who have difficulties in accessing the grid to use SHS.

Section 6. Expenses for research and consultancy assignment to RE

(The DOE will draft this section.)

Section 7. Remuneration of the Committee members

(The DOE will draft this section.)

Section 8. DOE's cost of and expenditures for carrying out its RE-related works

(1) The DOE must separate cost and expenditures for RE-related work from those for other its ordinary work and not be allowed to use any Fund money for other purposes.

(2) Remuneration for DOE officials engaged in the RE shall be paid not from the Fund but from the ordinary government budget.

PART IV - REGULATION OF RURAL ELECTRIFICATION

Rule 1. License

Section 1. Guiding principle

Any persons who operate RE project under a concession agreement must fulfill all conditions required by the Rural Electrification, Electricity, and Energy Regulation acts.

Section 2. License necessary for a Concessionaire

(1) A Concessionaire who operates an RE project under a concession agreement must hold (a) necessary license(s) as follows:

a） Generation license

b） Distribution license

c） Renewable-energy-technology license

(2) In case a concessionaire uses an off-grid system, it must necessarily hold multiple licenses in accordance with the project scheme. With a mini-grid system, power generation and distribution are naturally integrated in the project scheme and the Concessionaire must hold generation and distribution licenses. In addition, if solar technology is used for power generation, the renewable-energy-technology license is also needed.

(3) As regards renewable energy technologies, the DOE shall evaluate characteristics of individual technologies, set guidelines for the system configuration using renewable technology, and advise the Authority for issuance of licenses.

Rule 2. Tariff-setting

Section 1. Guiding principle

While the Authority is responsible for the regulation and approval of tariffs, the DOE may take measures to reduce tariff disparity among concession areas in order to pursue consumer equitability.

Section 2. Reasonable return on Concessionaire’s equity

A Concessionaire is allowed to receive reasonable return on equity through the operation of an RE project under a concession agreement.

Section 3. Measures to reduce disparity of tariff levels

The Concedante can provide necessary measures to reduce tariff level disparity among RE Concessionaires throughout the country as follows:

(1) Adjustment of the concession fee with the approval of the Committee

(2) Adjustment of the facility leasing fee

(3) Adjustment of the O&M subsidy

Rule 3. Concession agreement

Section 1. Guiding principle

The Concedante shall select a Concessionaire through a transparent process, maximize the interest of the Concedante and Concessionaire, and pursue the rationality of the RE project operation.

Section 2. Procedure to select a Concessionaire for a new RE project

The procedure for approval of the project including the selection of the Concessionaire shall be in accordance with the following steps.

(1) Project identification: The DOE selects RE project areas for the next phase based on the electrification priority list of trading centers (TCs) shown in the Master Plan.

(2) Recruitment of Concessionaires: The DOE announces the profiles of the projects and requisite operators, i.e., Concessionaires.

(3) Expression of interest: Persons who are interested in the announced projects express their interest to the DOE, and the DOE prepares the list of candidates.

(4) The DOE identifies the most promising candidate from the list and defines the detailed conditions for a concession agreement

(5) Through the negotiation, the DOE and the candidate Concessionaire settle the contract conditions.

(6) The Concedante and the Concessionaire sign the contract, and Concessionaire commences operation of the project.

Section 3. Concession agreement

(1) The DOE shall draft a model Concession agreement to facilitate understanding of the Concession scheme among private companies.

(2) Concession agreements must clearly state the following items:

a) Conditions for the Concession including right, duties, and responsibilities.

b) Settlement of project failure due to the fault of the Concedante and/or the Concessionaire

c) Treatment of accidents caused by force majeure.

Section 4. Concession fee

(1) A Concessionaire must pay a concession fee in a lump sum to the Concedante once the concession agreement has been completed and approved by the Authority.

(2) The concession fee consists of various costs incurred by the Concedante and premiums:

a） Monitoring and management cost

b） Costs of channeling monies from the Fund to the Concessionaire

c） Costs of the RE project preparation

d） Premium of the project such as potential profit in the future

Section 5. Termination of the Concession Agreement

(1) As noted in Section 29 of the Act, the period of the Concession Agreement shall not be more than 20 years. However, subject to review of the project performance, agreement of the Concedante, and approval of the Commission, the Concessionaire shall be allowed to renew the Concession Agreement for the next period.

(2) When the project is interrupted by force majeure such as natural disasters and incidents for which the Concessionaire is not responsible, the Concessionaire shall be allowed to terminate the project without any penalty. Other detailed conditions for termination of the project must be clarified in each Concession Agreement.

(3) When the project is terminated due to the Concessionaire’s failure, the Concedante shall have the right to buy out the project assets owned by the Concessionaire at the price of remaining value and receive reasonable compensation from the Concessionaire. Detailed conditions for termination of the project must be clarified in each Concession Agreement.

(4) When the project is terminated due to the Concedante'sfault, the Concessionaire shall have the right to make the Concedante buy out Concessionaire's project assets at the price of remaining value, receive reasonable compensation from the Concedante, and disengage from the project. Detailed conditions for the termination of the project must be stated in each Concession Agreement.

Rule 4. SHS agreement

Section 1. Guiding principle

The SHS agreement shall set force the conditions for an RE project using SHS equipment and reduce potential project risks for Concedante, Concessionaire, and SHS supplier.

Section 2. Evaluation and establishment of SHS business models applied to RE Projects

The DOE shall evaluate various SHS business models applicable to RE projects, determine the advantages and disadvantages of individual models, and set up a suitable project scheme for a Concessionaire using SHS equipment.

Meanwhile, BAREM is currently conducting renewable energy projects, and the DOE shall absorb good practices and experience from them.

Section 3. SHS Purchase Guarantee and Service Agreement

(1) The DOE shall draft a model agreement to help the Concedante, the Concessionaire and the SHS supplier to understand the Concession scheme.

(2) The Concession agreement must state the following items:

a) Right and responsibility of the three parties: the Concedante, the Concessionaire and the SHS supplier

b) Qualification of the SHS equipment

c) Arbitration and settlement of dispute among the three parties.

Rule 5. Ownership of facilities

Section 1. Guiding principle

Except for SHS equipment installed in public institutions with money from the Fund, ownership of individual assets shall belong to the party who provided the money for installation or acquisition.

Section 2. Ownership

(1) The government holds ownership of the facilities, which were installed and acquired with monies from the Fund.

(2) The Concessionaire holds ownership of the assets for which it pays money. Some of these assets are those for which the Concessionaire contributed to the initial investment and made additional investment.

(3) The public institution holds ownership of the SHS equipment installed by the DOE in accordance with the RE programs.

Section 3. Leasing fee for facilities

(1) The Concedante may impose a leasing fee for the government-owned facilities on a Concessionaire, but the level of the fee must be adjusted with consideration of the project viability and necessary O&M subsidy.

(2) The leasing fee paid by a Concessionaire should be returned to the Fund and saved for financing projects in the next phase.

Section 4. Buy-out of assets

When the RE project is terminated for any of the following reasons, the Concedante shall buy out the residual value of the assets whose ownership belongs to the Concessionaire.

(1) Completion of the concession period

(2) Suspension of the project due to force majeure

(3) Suspension of the project due to Concessionaire’s fault

(4) Suspension of the project due to Concedante’s fault

PART V - OTHER PROVISIONS

Rule 1. Separability Clause

If any provision herein is subsequently declared unconstitutional, the same shall not affect the legality of the other provisions.

Rule 2. Effectuation

These Rules shall take effect beginning on _____.