Japan International Cooperation Agency
Ministry of Industry, Mines and Energy (MIME)
Electricity Authority of Cambodia (EAC)
Kingdom of Cambodia

The Follow-up Study on the Establishment of the Specific Requirements for Electric Power Technical Standards on Hydropower for the Study for Establishment of Electric Power Technical Standards and Guidelines in The Kingdom of Cambodia

Final Report (Summary)

October 2009

Electric Power Development Co., Ltd.
Tokyo, Japan
The Chugoku Electric Power Co., Inc.
Hiroshima, Japan

Table of Contents

List of Tables

List of Figures

ABBREVIATIONS

Abbreviation	Description
CDC	Cambodia Development Council
DIME	Department of Industry, Mines and Energy
EAC	Electricity Authority of Cambodia
EDC	Electricite du Cambodge
EIA	Environmental Impact Assessment
F/S	Feasibility Study
GREPTS	General Requirements of Electric Power Technical Standards
IA	Implementation Agreement
IEC	International Electrotechnical Commission
IPP	Independent Power Producer
JICA	Japan International Cooperation Agency
KEPCO	Korea Electric Power Corporation
kW	Kilo Watt
kWh	Kilo Watt hour
MAFF	Ministry of Agriculture, Forestry and Fisheries
MEF	Ministry of Economy and Finance
MIME	Ministry of Industry, Mines and Energy
MLMUPC	Ministry of Land Management , Urban Planning and Construction
M/M	Minutes of Meeting
MOE	Ministry of Environment
MOU	Memorandum of Understanding
MOWRAM	Ministry of Water Resources and Meteorology
MPWT	Ministry of Public Works and Transport
MRD	Ministry of Rural Development
NGO	Non-Governmental Organization
ODA	Official Development Assistance
PPA	Power Purchase Agreement
Pre-FS	Pre-Feasibility Study
REE	Rural Electricity Enterprise
SREPTS	Specific Requirements of Electric Power Technical Standards
WB	World Bank

1. Introduction

1.1 Outline of the Study

The Follow-up Study (hereinafter referred to as "the Study") on the Establishment of the Specific Requirements for Electric Power Technical Standards on Hydropower for the Study for Establishment of Electric Power Technical Standards and Guidelines has been carried out since October 2008 under the Minutes of Meeting (hereinafter referred to as "the M/M") dated June 25, 2008 between Japan International Cooperation Agency (hereinafter referred to as JICA), and Ministry of Industry, Mines and Energy (hereinafter referred to as MIME) and Electricity Authority of Cambodia (hereinafter referred to as EAC) in the Kingdom of Cambodia (hereinafter referred to as "Cambodia"). MIME and EAC as well as Electricite du Cambodge (hereinafter referred to as EDC) have played the role as the counterpart agencies of the Study.

This Final Report describes the outcomes of the First to Third Field Works performed in Cambodia by the JICA Study Team during the period from November 2008 to August 2009, and outline of the development approach and the contents of the draft of Specific Requirements of Electric Power Technical Standards for Hydropower (hereinafter referred to as "SREPTS for Hydropower") as well as its Explanation Sheets and Glossary, which have been developed based on the outcomes in the Field Works and Home Works.

1.2 Background of the Follow-up Study

In Cambodia, EAC which plays roles in the licensing procedure, and regulation and supervision of power supplier, was established based on the Electricity Law promulgated on February 2, 2001. In this Law, it was set up that electric power service providers have to abide by the Electric Power Technical Standard issued by MIME. However, since the Technical Standard had not been prepared at that time, JICA conducted "the Study for Establishment of the Electric Power Technical Standards and Guideline in the Kingdom of Cambodia" from June 2002 to February 2004. In this study, the General Requirements of Electric Power Technical Standard (hereinafter referred to as "GREPTS") was prepared. Then GREPTS was promulgated as a ministerial regulation in July 2004.

It was imperative for EAC, as the regulatory agency, to improve itself and prepare specific requirements for the standard so that GREPTS would be widely followed by power business enterprises. Under such circumstances, JICA conducted "the Technical Assistance Project for Capacity and Institutional Building of the Electric Power Sector in Cambodia" through the period from September 2004 to September 2007. In the Project, the draft Specific Requirements of Electric Power Technical Standards (hereinafter referred to as "SREPTS") for Thermal Power Generating Facilities and Transmission and Distribution Facilities were prepared as they were important and required urgently at that time. These SREPTSs were promulgated by MIME as ministerial

regulations in July 2007. As a result, EAC improved its processing capabilities. However, SREPTS for Hydropower has not been prepared so far.

On the other hand, hydropower development in Cambodia has been growing against the backdrop of rapid growth of domestic power demand at around 20% a year in these five years. Foreign IPPs, for example from China, Vietnam and South Korea, and domestic IPPs have already planned development of hydropower projects, and some of them are under operation or implementation. However, EAC is currently in the situation that it cannot execute licensing and facility inspection procedures with uniform, compatible and transparent standards, because the SREPTS for Hydropower has not been prepared yet.

In these circumstances, the Government of Cambodia requested the Government of Japan to conduct "the Follow-up Study on the Establishment of the Specific Requirements for Electric Power Technical Standards on Hydropower for the Study for Establishment of Electric Power Technical Standards and Guidelines". Then the Study was commenced by JICA Study Team in October 2008 under the M/M dated June 25, 2008 between JICA, and MIME and EAC.

1.3 Objectives of the Study

The Study is to be conducted aiming at the following two (2) major objectives which were agreed in the M/M signed on June 25, 2008 between JICA and MIME/EAC for sound implementation of hydropower development in Cambodia.

- Establishment of Specific Requirements on Electric Power Technical Standards (SREPTS) for Hydropower which covers the fields of civil engineering works, hydromechanical works, electrical works and electro-mechanical works for hydropower projects
- Improvement of capability of EAC, which is regulatory agency for licensing procedures on hydropower projects, through the Study for establishment of SREPTS for Hydropower

1.4 Scope and Schedule of the Study

The Study has been carried out for the power sector in the Kingdom of Cambodia based on the scope and schedule described in the M/M of June 25, 2008 between JICA and MIME/EAC. The Scope of the Study agreed in the M/M covers the items listed below:

(1) Collection and analysis of following data

- Actual condition of hydropower installations and other related facilities
- Construction, operation and maintenance records
- Licensing procedure and system of hydropower project

(2) Confirmation of contents of GREPTS, existing SREPTS and other related materials

(3) Preparation of draft SREPTS on hydropower in English

(4) Support translation of the drafted SREPTS for hydropower into Khmer

(5) Holding seminar for explanation of SREPTS for hydropower target at parties concerned

The Study Team carried out the Study during the period from the commencement in October 2008 to the submission of Final Report in October 2009.

1.5 Counterpart Agencies

The Study has been implemented with MIME and EAC which are the two original counterpart agencies of the Study as the signers in the M/M of June 25, 2008 with JICA.

EDC, which is in charge of construction, operation and maintenance of the major power generation, transmission and distribution facilities in the power systems of Cambodia, has been also an important agency relating to the Study and, therefore, EDC has taken part in the Workshops and the activities of Working Groups in the Study.

1.6 JICA Study Team

The names and positions of the member of JICA Study Team are shown in **Table 1.6-1**.

Table 1.6-1 List of Members of JICA Study Team

Name	Position
Shigeru NAKAMURA	Team Leader / Institutional Framework
Yutaro MIZUHASHI	Hydropower Civil Engineering (Dam)
Hajime BUTSUHARA	Hydropower Civil Engineering (Waterway and Powerhouse)
Tatsuya KUNISHI	Hydropower Civil Engineering (Hydromechanical Equipment) (for the First and Second Field Work in Cambodia)
Akira IRIE	Hydropower Civil Engineering (Hydromechanical Equipment) (for the 2.5th and Third Field Work in Cambodia)
Masafumi IORI	Electrical Engineering (Electrical Equipment) (for the First Field Work in Cambodia)
Hideaki MORISHITA	Electrical Engineering (Electrical and Electromechanical Equipment) (for the Second and Third Field Work in Cambodia)
Eiji TSUCHIYA	Electrical Engineering (Control System)
Hitomi OHASHI	Coordinator (for the First and Second Field Work in Cambodia)
Ryuichi SHINODA	Coordinator (for the Third Field Work in Cambodia)

1.7 Basic Policy for the Study

The Study for preparation of the draft SREPTS for Hydropower has been conducted with the following basic policies:

(1) To maintain compatibility and consistency with the existing GREPTS, SREPTSs and relevant laws/regulations

(2) To prepare the draft SREPTS for Hydropower with clear status and scope

(3) To prepare the draft SREPTS for Hydropower and its Explanation Sheet suitable for the present situation of Cambodia

(4) To develop the draft Glossary for the draft SREPTS for Hydropower in a practical manner

(5) To support the translation work into Khmer to be performed mainly by the counterpart agency. The technology transfer shall be done by doing the translation work in cooperation with JICA Study Team. In this sense, the two Working Groups for civil work and electrical work formed by JICA Study Team, MIME, EAC and EDC shall be the main bodies for the translation work.

1.8 Composition of Final Report

The Main Report of Final Report has been prepared with the composition and contents as follows:

"Chapter 1 Introduction" summarizes the outline of the Study by JICA Study Team. At the end of Chapter 1, "Section 1.9 Summary of Study Output" describes summary of outcomes obtained though the Study.

"Chapter 2 Policies and Future Plans on Power Sector in Cambodia" describes outlook of the current status, policies and future plans for development of the power sector in the Kingdom of Cambodia in which SREPTS for Hydropower will play a role after its promulgation based o the draft prepared by the Study.

"Chapter 3 Enforcement Status of Existing GREPTS and SREPTS" describes the current framework and application status of the existing technical standards for electric power currently enforced in the Kingdom of Cambodia. Then, "Chapter 4 Current Situation of Approval and Licensing System on Hydropower Business" describes the current framework and execution status of the approval and licensing system in the field of hydro electric power business which is closely related to the technical standards for hydropower. "Chapter 5 Current Situation of Existing Hydropower Facilities" describes the results of inspection and assessment on the situation of existing hydropower stations by the JICA Study Team in the view point of application of the SREPTS for Hydropower.

"Chapter 6 Basic Policies of the Study on SREPTS for Hydropower" discusses the major targets set in the Study on preparation of the draft SREPTS for Hydropower as well as the draft Glossary and the draft Explanation Sheet and basic policies and methodologies for achieving such targets in terms of technical and operational approaches.

"Chapter 7 Record of Activities during Field Works in Cambodia" describes the outline records of the Workshops, Working Group Meetings and Seminars conducted and performed in the First, Second, 2.5th and Third Field Works of the JICA Study Team. Then, "Chapter 8 Framework of Draft SREPTS for Hydropower" describes the contents and results of discussions on the major issues for preparation of the draft SREPTS for Hydropower made in the Workshops and Working Group Meetings during the First and Second Field Works.

"Chapter 9 Policy and Outline of Draft Glossary of SREPTS for Hydropower" describes the policy for preparation and outline of the draft Glossary which constitutes a part of the draft SREPTS for

Hydropower. "Chapter 10 Policy and Outline of Draft SREPTS for Hydropower" describes the policy for preparation and outline of the text of draft SREPTS for Hydropower. Then, "Chapter 11 Policy and Outline of Draft Explanation Sheet of SREPTS for Hydropower" describes the policy for preparation and outline of the draft Explanation Sheet which also constitutes a part of the draft SREPTS for Hydropower.

Finally, "Chapter 12 Recommendations on Improvement of Approval and Licensing System on Hydropower Business" discusses some recommendations regarding the measures for proper arrangement and implementation of flow or institutional framework of the approval and licensing system of hydropower business.

1.9 Summary of Study Output

The outcomes of the Study performed under the process, purposes and policies described in the previous sections of Chapter 1 are summarized as follows;

1.9.1 Preparation of Draft SREPTS for Hydropower (Chapter 6 to Chapter 11)

The following four (4) items are the considered to be the major issues in the Study for development of the Draft SERPTS for Hydropower to be performed taking into consideration the current framework of the existing GREPTS and relevant laws and regulations as well as the objective of the Study:

Issue-1: To maintain compatibility and consistency with the existing GREPTS, SREPTSs and relevant laws/regulations

Issue-2: To clarify the status and scope of SREPTS for Hydropower

Issue-3: To prepare the draft SREPTS for Hydropower and its Explanation Sheet suitable for the present situation of Cambodia

Issue-4: To develop Glossary for the SREPTS for Hydropower in a practical manner

As the result of the Study and discussions with the Cambodian side Counterpart Team taking account of the four issues listed above, the draft of SREPTS for Hydropower, Explanation Sheet and Glossary have been prepared in the manner described below.

(1) Draft Glossary of SREPTS for Hydropower

The draft Glossary of SREPTS for Hydropower was prepared in accordance with the basic policy explained below:

There are not so many existing hydropower facilities in the Kingdom of Cambodia, so the Cambodian engineers and/or technicians do not have abundant experiences in design, construction, operation and maintenance of these facilities. Considering this situation, brief explanations are attached to the technical terms which appear in the SREPTS for Hydropower so that the member of Cambodian side counterpart team may understand names, contents of design standards of hydropower facilities and phenomena which occur in those facilities, and may translate those terms into Khmer more easily.

At the request of the Cambodian side counterpart team, figures and photographs are attached to some technical terms to help them understand forms and functions of structures.

(2) Draft SREPTS for Hydropower Facilities

The draft SREPTS for Hydropower was prepared in accordance with the basic policy explained below:

i) The draft SREPTS for Hydropower consists of the following four (4) parts including an independent Part for examinations and inspections as shown follows;
   - Part 1 : General Provisions;
   - Part 2 : Civil Structures and Hydromechanical Equipment;
   - Part 3 : Electrical Facilities; and
   - Part 4 : Examination and Inspection.

ii) The draft SREPTS for Hydropower has been prepared so as to maintain consistency with the provisions of the existing GREPTS and SREPTS for Thermal Power and Transmission and Distribution Facilities in principle.

iii) As the particular provisions, the flowing are prepared in Chapter 2 of Part 1;
   - Assignment of Chief Engineers
   - Environmental Protection (to comply with the existing environmental laws and regulations)
   - Order of Remedy for Conformance to Technical Standards
   - Obligation for Reporting
   - Safety and Technical Training
   - Exemptions for Small Projects
   - Exemptions for Projects under Implementation
   - Exemptions for Projects under Operation
   - Exception of Exemptions (for reporting, monitoring and inspections)

iv) In “Part 2 Civil Structures and Hydromechanical Equipment”, “Chapter 4: Fundamental Requirements” are provided to describe provisions regarding fundamental requirements for preventing civil structures and hydromechanical equipment from threatening public safety. The provisions for structures and reservoirs as well as effect to downstream areas are provided from the following three viewpoints;
   - Facilities shall be safe against disasters,
   - Facilities shall be safe against loads, flow of water and change of flow rate, and
   - Facilities shall fulfill the required function.

v) In “Part 3 Electrical Facilities”, the provisions are provided concerning the technical and safety requirements for electrical facilities in hydropower plants. In order to cover complete

contents, Part 3 has been prepared, as the provisions for hydropower, so as to also cover the contents stipulated in the existing SREPTS for Thermal Power Facilities and Transmission and Distribution Facilities without contradiction with the existing SREPTS.

(3) Draft Explanation Sheet of SREPTS for Hydropower Facilities

The draft Explanation Sheet of SREPTS for Hydropower was prepared in accordance with the basic policy explained below:

The draft Explanation Sheet of SREPTS for Hydropower is prepared to explain meanings and backgrounds of provisions in the draft SREPTS for Hydropower to promote its understanding and to use it properly. The draft Explanation Sheet of SREPTS for Hydropower describes backgrounds of main standards, technical terms which require an explanation to illustrate the point of the draft SREPTS, and the process which numerical values in the draft SREPTS for Hydropower were selected, while an explanation of technical terms which the JICA Study Team judged unnecessary was omitted. The composition of the draft Explanation Sheet is the same as the main body of the draft SREPTS for Hydropower so that its users can easily understand its contents considering users' convenience.

1.9.2 Recommendations on Improvement of Approval and Licensing System on Hydropower Business (Chapter 12)

Based on the information and results of discussions obtained through the Study, the following recommendations are proposed against the current status and issues of the approval and licensing system for electric power businesses:

1) Development of a guideline for the procedures for development and operation of hydropower projects from investigation to operation and maintenance including the following aspects:

   As the contents of a procedure guideline mentioned above include the fields for which laws and regulations are already exist such as ones for execution of EIA, and plural number of governmental agencies are related to these issues, inter-organizational coordination is required among the related agencies for preparation of a procedure guideline.

2) Development of a manual for examination and inspection

   In order to properly operate the provisions of examination and inspection in Part-4 of the draft SREPTS for Hydropower, it is recommended to develop a manual which clarifies the detailed procedures and methods of examination and inspection on hydropower facilities.

3) Development of safety and security guideline for workers of operation and maintenance at hydropower stations

   The draft SREPTS for Hydropower stipulates the requirements for safety of hydropower facilities in principle. On the other hand, regarding the personal safety, it is recommended for the public sector to prepare a safety guideline as a standard document for proper preparation and operation of safety manual by individual power companies.

4) Capacity building for hydropower engineers of regulatory agencies (MIME, EAC, EDC)

Sufficient experiences are required for technical judgments for hydropower stations and, therefore, qualified engineers who have capability in technical examination and evaluation. However, the number of hydropower engineers, particularly in the field of civil engineering, is very limited in Cambodia. Therefore the capacity building for hydropower engineers of the regulatory agencies would be a issue to be solved under the situation of expected progress of hydropower development.

5) Establishment of certification and registration system of qualified engineers

The general provisions in the draft SREPTS for Hydropower provides with an Article of assignment of chief engineers. In this connection, it is desirable to establish a system of registered engineers which determine procedures and conditions for registration and assignment of chief engineers.

Also, an Article of the draft SREPTS for Hydropower stipulates the obligation of owner to provide his engineers and technicians with safety and technical training. In this connection, it is desirable to establish a public system of qualification, certification and registration of engineers in order to maintain or improve technical level of the maintenance and operation staff and to maintain safety conditions of power stations continuously.

In particular, hydropower projects to be developed in the near future may have dams with spillway gates, and it is required that the operation of spillway gates, which are strongly related to the safety of downstream area, shall be done by a qualified operators in a responsible manner.

2. Policies and Future Plans on Power Sector in Cambodia

2.1 Organization of Power Sector in Cambodia

The Electricity Law of the Kingdom of Cambodia, which was promulgated on February 2, 2001, covers allover issues in the electric power business from the electric power supply services to the end use of electricity and defines the basic policies concerning operation of electric power business, conditions required for investment by private sector for development and operation, promotion on operation of electric power supply facilities by private sector, and the fundamental rules for competition in the power market. The Electricity Law provides MIME with the authorities to control the policy framework, strategic measures and framework planning for the power sector, and declared the establishment of EAC as an independent authority which should execute the responsibilities determined in the Electricity Law in order to achieve stable electric power supply services in nationwide areas. EDC is the largest electric power company in Cambodia who is operating the major power generation plants, transmission systems and power distribution systems in Cambodia. Moreover, some independent power producers (hereinafter referred to as “IPPs”) and the Rural Electricity Enterprises (hereinafter referred to as “REEs”) are operating power supply business

in the power sector. **Fig. 2.1-1** below shows the organization framework of the power sector in Cambodia.

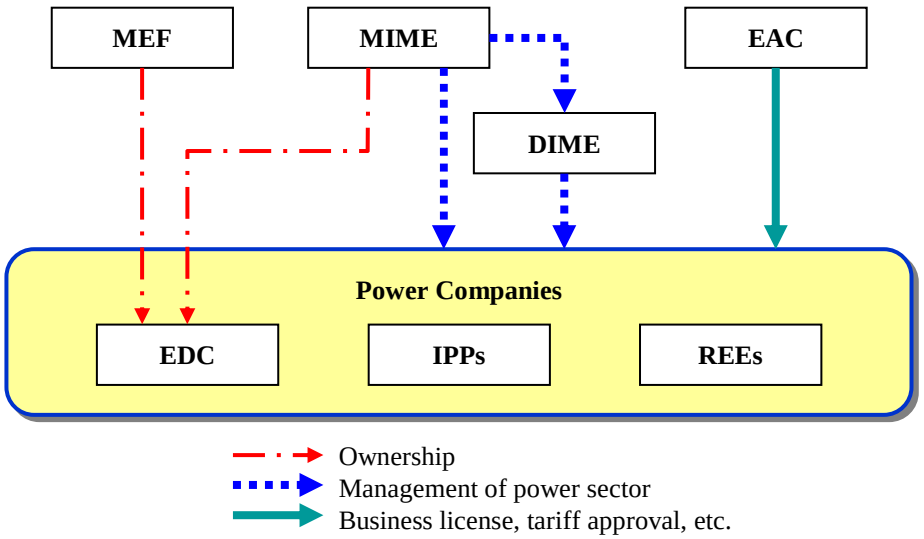


Fig. 2.1-1 Organization Framework of Power Sector

2.2 Current Status and Issues in Power Sector

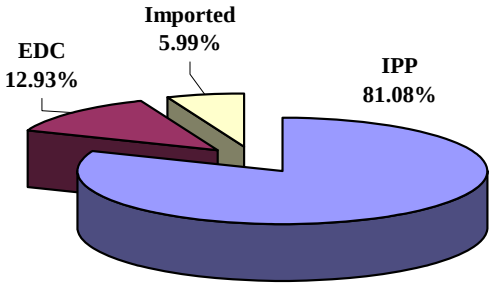
2.2.1 Current Status of Power Sector

The electricity demand in Cambodia is growing rapidly with annual growth rate of 21.5% for energy supply and 22.3% for peak power demand in average of 5 years from 2003 to 2007. In particular, the highest record of growth rate is being updated year by year and reached to 26.7% and 27.5% for energy supply and peak power demand respectively in 2007.

The electricity generation record of Cambodia by supplier is shown in **Fig. 2.2.1-1**. The electricity purchased from IPPs shares 81% of the total electricity generation in Cambodia and EDC generates by his own power stations only 13% of electricity and the remaining are being supplied by the electricity imported from Thailand and Vietnam.

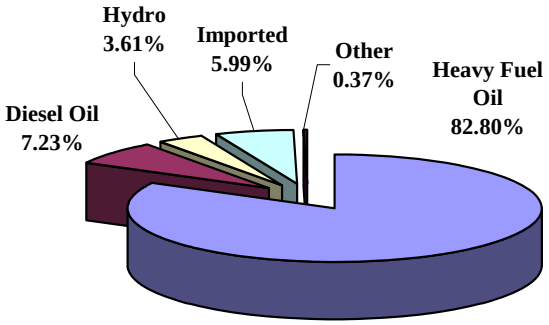
The electricity generation record of Cambodia by energy sources is shown in **Fig. 2.2.1-2**. The electricity generated by the power plants using imported oil such as heavy fuel oil and diesel oil plants shares as high as 90% of total energy generation in Cambodia, and this condition provides the power sector with unstable conditions in terms of energy security. The two (2) hydropower plants existing in Cambodia are generating only 4% of total electricity generation in Cambodia.

The balance between the power demand and supply is currently being achieved barely by purchasing energy from IPPs without maintaining sufficient reserve margin under the rapid growth of power demand over 20%/year. Also, the aged diesel power plants have been retiring since 2005 and the power supply contract with some IPPs is to be terminated. Under these circumstances, it is required for the power sector of Cambodia to reinforce the supply capacity.



Source: Annual Report 2006, EAC

Fig. 2.2.1-1
Energy Generation by Supplier (2006)



Source: Annual Report 2006, EAC

Fig. 2.2.1-2
Power Generation by Source (2006)

Electricity tariff is at a high level in Cambodia compared with those in the neighboring countries. The average electricity tariff of EDC was as high as US¢18.2/kWh in 2007. This high tariff rate in Cambodia could be mainly attributed to the fact that the electric energy is being supplied mainly by small scale diesel generators which consume high price imported fuel as well as low efficiency of isolated power supply systems and high power losses in distribution networks.

In the above regard, it is strongly required for the power sector of Cambodia to develop or purchase cheaper electric energy from the available resources in the country or importing neighbor countries.

2.3 Policy and Strategy for Development of Power Sector

The Government of Cambodia set the policy of "Cambodia Power Sector Strategy 1999-2016" in 1999 under the support of World Bank in order to reinforce the power sector and solve the above mentioned issues. Since then, promotion of hydropower development has been one of the key policies for energy security and efficient use of domestic energy resources. However, only 13 MW of hydropower in total has been developed in Cambodia so far. This situation of a low hydropower development level achieved until now could be attributed to the disadvantage of hydropower comparing with diesel power plants in terms of required time and relatively high initial investment cost for development as well as distribution of potential areas which are generally located far from demand centers in case of hydropower. On the contrary, the thermal power plants of which more than 95% are diesel power plants have been installed until recently in order to catch up the rapid growth demand.

Under the circumstances mentioned above, it is recognized by the Government of Cambodia that the medium to large scale power development is required for stable power supply for the future. In this sense, the Government of Cambodia is promoting the power development by private sector with IPP scheme mainly implemented by foreign investors in order to overcome the lack of capital in the domestic power sector for development of medium to large scale power projects. Potential of hydropower in Cambodia is at a high level as much as 10,000 MW or more comparing the current

total installed capacity of Cambodia which is around 300 MW. Taking into account this condition of domestic energy resource potential, hydropower development is set as one of the strategies to achieve the target of electrification in Cambodia.

2.4 Current Status of Hydropower Development Plans including IPP

2.4.1 Power Demand Forecast

According to the available power demand forecast in Cambodia prepared by MIME in 2007 based on the demand forecast by World Bank and KEPCO in 2006, the future peak power demand is expected as shown in the table below.

Table 2.4.1-1 Power Demand Forecast in Cambodia

(MW)

Year	Prepared by World Bank/KEPCO			Revised by MIME	
	Low Case	Base Case	High Case	Selected Case	Annual Average Increase
2005	134	134	134	129.96	-
2010	404	467	502	431.74	60 MW/year (2005-2010)
2015	768	1009	1155	1349.12	182 MW/year (2011-2015)
2020	1070	1610	1985	2400.88	210 MW/year (2016-2020)

Source: Power Development Master Plan, World Bank/KEPCO, MIME

According to the above table, it is required for the power sector of Cambodia to achieve annual average development capacity of more than 60 MW/year, 182 MW/year and 210 MW/year for the period from 2005 to 2010, 2011 to 2015 and 2016 to 2020 respectively. These development capacities are rather large compared with the current total installed capacity of 314 MW in Cambodia at the end of 2007 according to Annual Report of EAC. In this sense, strategic policy is required for the implementation of power development in Cambodia.

2.4.2 Available Resources for Hydropower Development

It was reported that the major natural resources for power generation available in Cambodia is hydropower with potential of 10,000 MW or more according to the annual report of EAC for 2007. The potential of 10,000 MW is not of abundant compared with neighbor countries such as Vietnam and Lao PDR due to the topographic conditions of Cambodia in general. However, the hydropower capacity already developed in Cambodia is very limited to be only around 13 MW and 10,000 MW is large enough compared with the current total installed capacity of around 314 MW in 2007.

2.4.3 Power Development Plan and Hydropower Development Plan

Power Development Plan (PDP) for 2008-2021 is shown in **Table 2.4.3-1**. According to PDP, power import from the neighboring countries such as Vietnam, Thailand and Laos PDR is planned with a high increasing rate. This will cause a high dependency on the imported energy and consequently a high risk in energy security. On the other hand, some hydropower projects such as Kamchay, Kirirom III, Stung Atay and Lower Russey Chrum are planned to be developed by IPPs for starting

operation after the year 2013. Hence, 2,025 MW of the total capacity of hydropower projects planed to be commissioned by the year 2021 shares more than 55% of 3,676 MW, the overall total capacity of the projects on PDP for the years from 2008 to 2021. In summary, it is the strategic plan for the power sector of Cambodia to procure the required energy by the power import from the neighboring countries for the coming several years and, after that, to utilize hydropower, which is the major source of domestic renewable energy, as much as possible in parallel with development of coal thermal plants step by step. It shall be noted, however, that the development of Lower Se San II and Lower Sre Pok II projects is planned by the Vietnamese investor mainly for power export to Vietnam with a limited domestic supply.

Table 2.4.3-1 Power Development Plan (PDP) 2008-2021

Year	Power Station	Type	Expansion Capacity (MW)	System Capacity (High Case) (MW)	Peak Demand (MW)	Reserve. Margin (%)
2008	SR-BB-BMC - Thai	Import	80	267	271	18.8
	Kampong Cham - Vietnam	Import	25			
2009	Phnom Penh - Vietnam (Increase)	Import	200	272	271	0.0
2010	Stung Treng – Lao PDR	Import	10	650	502	29.6
	Kamchay	Hydro	193			
	Kampong Cham - Vietnam	Import	10			
2011	Kirirom III	Hydro	18	650	561	15.9
	Coal SHV	Coal	100			
2012	Stung Atay	Hydro	120	977	719	36.0
	Caol SHV	Coal	100			
2013	Retirement - C3 (GM)	(DO)	3	1,026	800	28.4
	Coal SHV	Coal	100			
	Lower Russei Chrum	Hydro	338			
	Upper Ressei Chrum	Hydro				
2014	Coal SHV	Coal	100	1,203	979	22.9
2015	Stung Tatay	Hydro	246	1,382	1,155	19.6
	Coal SHV	Coal	100			
	Stung Treng – Lao PDR	Import	20			
	Kampong Cham - Vietnam	Import	22			
2016	Lower Se San II	Hydro	420	1,597	1,302	22.6
	Lower Sre Pok II	Hydro				
2017	Stung Chay Areng	Hydro	240	1,650	1,435	15.0
2018	Coal SHV	Coal	300	1,800	1,600	10.0
2019	Sambour	Hydro	450	2,110	1,746	20.8
2020	Kampong Cham - Vietnam	Import	31	2,567	1,985	29.3
2021	Coal/Gas SHV	Coal/Gas	450	2,567	2,195	16.9
		Import	398			
	Total	Hydro	2,025			
		Coal	1,253			
			3,676			

Source: EDC Annual Report (2007)

3. Enforcement Status of Existing GREPTS and SREPTS

3.1 Current Status of Electric Power Technical Standards

In Cambodia, the Electricity Law was promulgated on February 2, 2001 and, consequently, the institutional framework for approving and licensing of electric power businesses and for controlling and regulating electric power service providers has been established. Under this Law, the electric power service providers have to abide by the Electric Power Technical Standard issued by MIME. However, since the Technical Standard had not been prepared at that time, the draft GREPTS was prepared in February 2004 with cooperation of JICA, and based on the draft, the GREPTS was promulgated as a ministerial regulation of MIME in July 2004.

It became imperative for EAC, as the regulatory agency established under the Electricity Law, to improve itself and to prepare specific requirements for the electric power technical standard so that GREPTS would be widely followed by power business enterprises. Under such circumstances, the draft SREPTS for Thermal Power Generating Facilities and Transmission and Distribution Facilities, which were important and required urgently at that time, were prepared also with the cooperation of JICA, and based on the draft, the these SREPTS were promulgated as a ministerial regulation of MIME in July 2007. As a result, EAC improved its processing capabilities. However, SREPTS for Hydropower, which is required under such circumstances that the development of hydropower is being promoted, has not been prepared so far.

3.2 Enforcement Status of GREPTS

General Requirements of Electric Power Technical Standards (GREPST) was issued by MIME under "the Prokas (No.470) on Establishment of General Requirement of Electric Power Technical Standards of the Kingdom of Cambodia" dated July 16, 2004 and promulgated on August 16, 2004.

The GREPTS provides the principles of Electric Power Technical Standards and has the following main purposes:

1) To specify the technical, design, and operational criteria of Electrical Power Facility, House Wiring and Electrical Appliance,

2) To ensure that the basic rules for supply of electricity are fair and non-discriminatory for all Consumers of the same category, and

3) To maintain the technical standards (levels) of Electrical Power Facility, House Wiring and Electrical Appliance installed in the Kingdom of Cambodia.

The GREPTS provides the following provisions in Clause 4 "Enforcement" and, therefore, the Specific Requirements of Electric Power Technical Standards (SREPTS) shall conform to these provisions.

1) All persons who are related to electric power supply, electrical works, use of electricity, manufacturing electric power facilities, trading in the facilities in the Kingdom of Cambodia shall strictly follow the Technical Standards.

2) In planning of electric power projects, the feasibility studies shall be made to examine the long term technical, economical and financial viability, and social acceptability.

3) The design, manufacturing, assembling and procurement of power facilities should be such that the facilities can be operated with the designated performance for a long time.

4) During installation of the electric power facilities and equipment and construction of the facilities, enough attention shall be paid in selection of the materials and construction management during the construction work.

5) In operation and maintenance of the electric power facilities, enough attention for maintaining the required performance of the power facilities for long time and to protect the environment in the surrounding areas, shall be paid.

6) Licensees of power utilities shall employ qualified electrical engineers or technicians as appropriated for supervision, operation and maintenance of the power facilities as provided in the Technical Standards and other regulations.

3.3 Enforcement Status of SREPTS

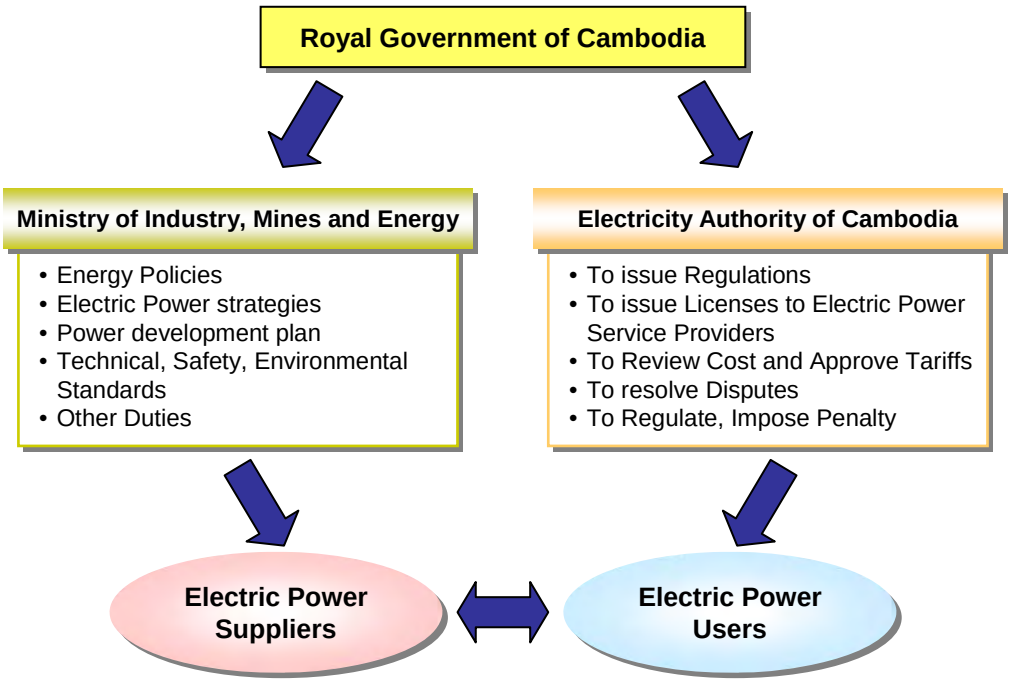
The Specific Requirements of Electric Power Technical Standards (SREPTS), that provides specific provisions in detail, is being prepared for the areas covered by GREPTS step by step in cooperation with JICA. Considering the immediate needs for development of power generating facilities, SREPST for thermal power generating facilities and transmission and distribution facilities was prepared as the first phase and issued by MIME for implementation under “the Prokas (No.701) on Establishment of Specific Requirements of Electric Power Technical Standards of Kingdom of Cambodia” dated July 17, 2007.

During the period from the promulgation of SREPTS for thermal power facilities and transmission and distribution facilities on July 17, 2007 until August 2008, EAC issued the 46 Consolidated Licenses, 7 Generation Licenses including one for Sinohydro Kamchay Hydroelectric Project Co., Ltd. issued on August 31, 2007, 5 Distribution Licenses, and 2 Special Purpose Transmission Licenses according to the information of EAC. These licenses include the condition that the licensee shall abide the requirements in the existing technical standards. In this sense, the GREPTS and SREPTS are operated as a part of the licensing system. On the other hand, the licensing process to be conducted for verifying conformity of power facilities to the requirements in GREPTS and SREPTS is an issue for EAC. In this regard, as the safety and technical training being provided for Small and Medium Licensees are in progress and being expanded according to EAC, improvement of the licensing system is expected for effective application of SREPTS in the future.

4. Current Situation of Approval and Licensing System on Hydropower Business

4.1 Current Status of Electricity Law and relevant Regulations

The Electricity Law stipulates that MIME shall be responsible for setting and administering the government policies, strategies and planning for the power sector. Also, under the Electricity Law, EAC was established as the Regulator of the power sector being granted with the right to be an autonomous agency to carry out the duties stipulated in the Electricity Law including the licensing to electric power service providers and issuing Regulations, Procedures, Rules, Orders and Decisions as well as performing the right to resolve complains and disputes related to the provision of services and the use of electricity. The Electricity Law promotes the private ownership of the facilities for providing electric power services in the country leading to the establishment of competition wherever feasible within electric power sector. The role sharing status between the two organizations of MIME and EAC in the power sector provided in the Electricity Law is shown in **Fig. 4.1-1** below.



Source: EAC Annual Report (2007)

Fig. 4.1-1 Role Sharing between MIME and EAC

Here, the Electric Power Services means services in electricity sector provided by one party to other parties. Electricity Power Service does not only mean provision of "Electricity" by suppliers to the consumers or generation, transmission or distribution services provided by one service provider to other service providers but also mean any electricity work such as the installation of electrical equipments and network, operation and maintenance, the services in relation to providing the electric power services, implementation of any work for electric power services etc., which one electric

service provider delivers to other electric service providers or to consumers. The Electricity Law has granted the right and authorities to EAC to govern these relations between the Delivery, Receiving and Use of Electricity.

4.2 Current Licensing System for Providing Electric Power Services

Each electricity service provider is required to have a license issued by EAC and to abide by the provisions of the Electricity Law and those of its license, regulations and procedures set by EAC. The licenses for electric power services are to be issued by EAC to individual or legal entities giving the right to provide electric services as per the provisions defined in the license as "the Conditions of License."

There are eight (8) types of licenses as follows:

(1) The Generation License

(2) The Transmission License

(3) The Distribution License

(4) The Consolidated License

(5) The Dispatch License

(6) The Bulk Sale License

(7) The Retail License

(8) The Subcontract License

Numbers of each type of licenses issued and currently valid as of 2007 are summarized as shown in **Table 4.2-1** below.

Table 4.2-1 Types and Number of Licenses

No.	Type of License Issued	Number of License Issued			Licenses valid at end of 2007
		up to 2006	during 2007	Total	
1	Consolidated License consisting of Generation, Distribution and Transmission Licenses (for EDC)	1		1	1
2	Generation License	20	2	22	14
3	Special Purpose Transmission License		1	1	1
4	Distribution License	13	2	15	16
5	Rental License	1		1	1
6	Consolidated License consisting of Generation and Distribution Licenses	116	36	152	147
Total		**151**	**41**	**192**	**180**

Source EAC Annual Report (2007)

4.3 Current Status and Problems of Licensing System for Hydropower Business

4.3.1 Current Status of Licensing on Hydropower Business

According to the information from EAC and EDC, the current status of licensing system and procedure for hydropower business is described as follows:

(1) The following four (4) hydropower plants are being granted with the Generation License or Consolidation License from EAC:

1) O'Chum Hydropower plant (completed in 1993 / EDC)
2) Kirirom-1 Hydropower Plant (completed in 2001 / IPP)
3) Mondul Kiri Rural Electrification Project including two (2) micro-hydropower plants (completed in October 2008 / Electricity Unit of Mondul Kiri Province)
4) Kamchay Hydropower Project (under construction / IPP)

(2) For the hydropower development by IPP scheme, the following procedure is generally applied for implementation and commissioning at present.

1) IPP investor proposes a project plan for obtaining a concession agreement for its development and providing electric power service with the Government of Cambodia.

MIME, CDC (Cambodia Development Council) and MEF are responsible for this step.

There are two (2) steps in this procedure as follows:

- Implementation Agreement (IA)
- Power Purchase Agreement (PPA)

After initial agreement on PPA between the IPP and EDC who is the off-taker for IPP business, EDC will submit a draft PPA to EAC indicating power tariff and purchase conditions (take or pay condition).

2) After the agreement on PPA between a developer of hydropower project (IPP) and EDC, EAC will issue licenses of power generation business to IPP to generate and sell electricity to EDC. However, there were no technical examination and inspection or evaluation by EAC or MIME based on specific criteria since no SREPTS for Hydropower has been prepared for the present.

(3) Prior to the commencement of commercial operation of a power generating project including IPP project, project owner (project operator) and EDC jointly develop operating procedures addressing operational interfaces between two parties including the method of day to day communication, notification of key personnel list, clearances and switching practices, outage schedule, capacity and energy reporting, operations logging, procedures in relation to dispatch of the facility. The operation procedures shall be established properly so as to be consistent with

the design of the project and the connected power grid facilities, the Grid Code of EDC and the technical limits of operation.

4.3.2 Problem in Licensing System for Hydropower Projects

EAC recently issued a license for Mondul Kiri rural electrification project including two micro-hydropower plants in October 2008. In this licensing procedure, EAC examined the power tariff of the project for supplying electricity to the isolated power system. On the other hand, the commissioning test was conducted on technical matters for starting the operation of power generation by the Engineer (consultant) on behalf of MIME. Currently, EAC does not have a capacity to inspect and examine the hydropower project for licensing from the technical point of view, because no Technical Standards or other reference documents are available for hydropower projects and no hydropower engineers are available at EAC.

On the other hand, as shown in **Table2.4.3-1**, there are many hydropower projects planned to be developed until the year 2021, and the commissioning of the priority hydropower projects are scheduled by the middle of 2010's. Many of the planned hydropower projects are categorized to be large scale having installed capacities more than 50 MW in accordance with a criteria of hydropower scale adopted in Cambodia. As such large scale projects have impacts to stability and security of power system and also safety of reservoir and downstream areas.

In the above context, it is required for the power sector of Cambodia to develop or improve the capacity of technical inspection and examination for licensing as well as monitoring of hydropower projects before such time when many hydropower projects are commissioned. In order to achieve this target, it is essential to prepare the practical licensing and monitoring systems for hydropower projects to be adopted during their life period including construction, commissioning and operation stages. For establishment of such licensing and monitoring systems, it is required to prepare Specific Requirement of Technical Standards for Hydropower as the reference for technical inspection and examination in the process of licensing and monitoring of projects in view of conformity with the technical requirements.

Concerning the environmental impact assessment (EIA), MOE promulgated "Environmental Impact Assessment Process" as a ministerial decree in 1999. According to this decree, execution of EIA is required for the power plants over 5 MW and hydropower projects over 1 MW, and EIA has been or is being executed for the hydropower projects under study or investigation by IPP groups of China and Vietnam in accordance with the provisions in the decree of MOE. It is also important for the hydropower projects to be implemented in the future to abide the existing environmental law and relevant regulations. In this sense, it is necessary to provide an article that stipulates the requirement to abide the existing environmental law and regulations in the SREPTS for Hydropower in view of the environmental conservation.

5. Current Situation of Existing Hydropower Facilities

5.1 General Status of the Existing Hydropower Facilities

According to the annual report of EDC, the total electric installed capacity in Cambodia is around 300 MW excluding the capacity of imported power as of the end of 2007 and the most of them (94%) rely on imported oil, in contrast, hydropower account for only 4%.

According to "the WB Master Plan 2006", the potential hydro power in Cambodia was estimated around 10,000 MW. Although the hydro potential in Cambodia is high, there are only 2 mini and medium sized hydropower stations and 3 micro hydropower stations at 2 sites, and the total capacity is only around 13 MW.

The specification of the existing hydropower plants in Cambodia is in the table below.

Table 5.1-1 Existing Hydropower Plants in Cambodia

Category	Name	Capacity (kW)	Province	Operation
Mini hydro	O'Chum 2	960	Rattanak Kiri	1993
Medium hydro	Kirirom 1	12,000	Koh Kong	2001
Micro hydro	Mondul Kiri	370 (185 x 2)	Mondul Kiri	2008
	NEDO Hybrid	48	Kampong Cham	2005

Source: JICA Study Team

The geological formation of the central part of Cambodia, such as the capital city Phnom Penh and the Tonle Sap Lake, is flat and in low altitude, so that this area is not suitable for hydropower development in general. The areas suitable for hydropower development are both of the southwest mountain area along the Gulf of Thailand and the northeast mountain area near the border to Laos PDR and Vietnam. The existing one mini and one medium sized hydropower stations are located in these areas, and also the ongoing and planning stage projects are located there. The location of the existing hydropower plants are shown in **Fig. 5.1-1**.

Adapted from Google Map

Fig. 5.1-1 Map of the Existing Hydropower Plants Sites

The O'Chum 2 Hydropower Station located in Ban Lung town in Rattanak Kiri Province, northeast part of Cambodia, was constructed with the finance by the Government in 1993. Initially Department of Industry, Mine and Electricity (DIME), operated it for 10 years and it was transferred to EDC in 2003. As the O'Chum hydropower plant is not connected to the national grid, the electricity is consumed in the Ratanakiri Town within the isolated local grid of Ban Lung area.

The Kirirom 1 Hydropower Station is located in Kampong Speu Province, some 110 kilometers southwest of Phnom Penh. It was firstly constructed in 1968 with the aid from Yugoslavia in cooperation with a state owned enterprise in charge of development of water resources but destroyed due to the civil war, then left untreated for a long time. After that, under the 30 years BOT contract made between MIME and, the China Electric Power Technology Import and Export Co. (CETIC) in 2000, the power plant was renovated in 2001 and has been operated by CETIC. The electricity is being sent to Phnom Penh through the 115 kV transmission line which was constructed together with power plant by CETIC.

The Mondul Kiri hydropower plant was just completed in November 2008 with Japanese grant. It is located in the east plateau region near the Vietnam border and operated by Electric Unit of Mondul Kiri Province (EUMP). The electricity is consumed in Mondul Kiri Province within the isolated local grid.

A hybrid system constructed by NEDO (New Energy and Industrial Technology Development Organization) in 2004 and located in the vicinity of Kampong Cham town 80 km northeast from Phnom Penh consists of micro hydropower and solar power. It is under the control of the local community electricity unit now but there is no useful power generation due to the local problems and equipment failure.

5.2 Current Status of the Existing Hydropower Stations

The current status of each existing hydropower station in terms of conformity with the general technical requirements was investigated or studied by the JICA Study Team as described below:

5.2.1 O'Chum 2 Hydropower Station

Current operation and maintenance issues which are not satisfying the requirements for hydropower are follows in general.

- The regular measurement necessary for a fill dam maintenance, such as the measurement of leakage water, deformation, water pressure in the dam body and sand sedimentation in the reservoir is not implemented. (Monitoring and Inspection)
- The specific chief engineer is not nominated and there has not been the handover among the design, the construction and the operation. (Nomination of Chief Engineers)
- There are no records and information of the examination for commencement of construction, the inspection of dam foundation and the inspection prior to the first impounding. (Examination and Inspection)

- The monitoring is not implemented. (Requirement for Operation)
- The report to EAC is not implemented. (Obligation for Reporting)

5.2.2 Kirirom 1 Hydropower Station

As a provision that exempt existing hydropower facilities from the application of specific requirements will be provided in the draft SREPTS for Hydropower accepting continuous operation as long as the operation of the power station does not harm the public safety, the Kirirom 1 Hydropower Station can continue power generation. However, the Kirirom 1 Hydropower Project is required to follow EAC's recommendation to satisfy fundamental requirements stipulated in GREPTS and SREPTS for Hydropower.

As the result of site visit to Kirirom 1 Hydropower Project, no serious problems were detected from the visual inspection on the structures. It is recognized that no serious problem exists for operation of the power station in short run as the monitoring of structures such as dam is being performed properly. However, the following are recommended for the Kirirom 1 Project for improvement or confirmation;

- A fence at the switchyard shall be stretched to the designated height,
- To confirm compiling status of as-built drawings and design documents of civil structures and inspection and operation records at the power station
- To confirm rules of inspection and maintenance of civil structures
- To confirm the design method and process of the emergency spillway and the layout of dam and headrace tunnel which are not ordinary application to be subject to design evaluation by a regulatory agency.

5.2.3 Mondul Kiri Rural Electrification Project

The total output of this project is less than 1 MW, which is not applicable to an environmental impact assessment according to the Environment Law.

This project comes under a rural electrification project in an isolated grid and its trip affects a limited area. Therefore, Article 10 "Exemptions for Small Projects" of the draft SREPTS for Hydropower would be applied to this project in principle.

As this project is designed and constructed according to Japanese technical standards in principle, and the commissioning test was conducted on the items listed below before starting operation, it is judged that the project satisfy requirements of the draft SREPTS for Hydropower.

- Visual inspection of civil structures
- Operation test of gates
- Operation test of turbine-generator, diesel generator, parallel-in test, electric power supply test, energy stop test and alarm test

6. Basic Policies of the Study on SREPTS for Hydropower

6.1 Major Issues and Basic Policies of the Study

6.1.1 Major Issues in Preparation of SREPTS on Hydropower

The following four (4) items are the major issues in the Study for development of the draft SERPTS for Hydropower to be performed taking into consideration the current framework of the existing GREPTS and relevant laws and regulations as well as the objective of the Study:

Issue-1: To maintain compatibility and consistency with the existing GREPTS, SREPTS and relevant laws/regulations

Issue-2: To clarify the status and scope of the SREPTS for Hydropower

Issue-3: To prepare the draft SREPTS for Hydropower and its Explanation Sheet suitable for the present situation of Cambodia

Issue-4: To develop the draft Glossary of the SREPTS for Hydropower in a practical manner

In order to execute the above four (4) issues satisfactory in the development of the draft SREPTS for Hydropower and its Explanation Sheet and Glossary, the Study has been performed with the basic policies described below.

6.1.2 Basic Policies on Technical Issues

(1) Basic Policy for Issue-1

Issue-1: To maintain compatibility and consistency with the existing GREPTS, SREPTS and relevant laws/regulations

In preparation for the draft SREPTS for Hydropower, it is required to investigate and grasp the controversial point concerning the existing Electricity Law and the technical standards and also to examine the proper status of the SREPTS for Hydropower in terms of compatibility and consistency with the existing SREPTSs and GREPTS.

According to the Electricity Law enacted in 2001, functions and responsibilities of electric power service providers are stipulated in Article-5 and Article 42 respectively. Article-5 stipulates that "EAC shall ensure that the licensees shall use the standard related to technical operation, safety and environment, which is issued and published by MIME." and Article-42 stipulates that "each Licensees must comply with all conditions set forth in its License, the rules and regulations adopted by the Authority (EAC), and the laws of the Kingdom of Cambodia." Accordingly, the electric power service providers shall have the responsibility to comply with the technical standards for hydropower project throughout all stages including investigation, planning, design, construction, operation and maintenance, and EAC has the responsibility to ensure the compliance of electric power service

providers with the technical standards. Presently in Cambodia, there are lots of hydropower projects which are going to be executed by foreign IPPs and, therefore, it is necessary to investigate how MIME and EAC are implementing stipulations in the existing laws and regulations and also how EAC is ensuring compliance of IPPs with technical standards in accordance with Article-5 of the Electricity Law.

Generally, approval and licensing procedures for the power business and those procedures for environmental issues are closely related each other. In this sense, it is necessary to investigate how the procedures for these two matters are being implemented against foreign IPPs from China, Vietnam, etc. and how the existing systems in Cambodia in relation to the process of biddings, power purchase agreement, business licensing are implemented not only by MIME, EAC and EDC but also by the Ministry of Environment (MOE) and other relevant authorities.

(2) Basic Policy for Issue-2

Issue-2: To clarify the status and scope of the SREPTS for Hydropower

Generally, a hydropower technical standard stipulates “requirements on design and installation of civil structures and electrical facilities” and “requirements on inspections”, and the later is further divided into two categories; one is “completion inspection” to be performed at the end of construction stage and the other one is “regular periodical inspection” to be performed during the operation stage. Both of the SREPTS for Thermal Power and the SREPTS for Transmission and Distribution Facilities promulgated in 2007 stipulate only the requirements on design and installation but not stipulate the requirements on inspections. However, the requirements on inspections or inspection standards are important for hydropower projects particularly for civil structures in view of long-run behavior to be monitored at each stage during construction and operation. The scope of SREPTS for Hydropower is discussed with the counterpart agencies taking into consideration the above mentioned matters..

Moreover, as for the small hydro generation facilities stipulated in “Article-29 Renewable Energy, Portable Generators and Small Hydro Generations” of the GREPTS, the range of size (capacity) or definition of small hydro generations shall be clarified by discussing with the counterpart agencies to make clear the range of application of the SREPTS for Hydropower. On the other hand, Article 30 ”Pumped storage generating facilities” in GREPTS shall be exempted from the scope of work for the SREPTS for Hydropower.

(3) Basic Policy for Issue-3

Issue 3: To prepare the draft SREPTS for Hydropower and its Explanation Sheet suitable for the present situation of Cambodia

As for the standards for hydropower, there are three articles specifically stipulating the requirements on hydropower facilities in the GREPTS; these are Article-26 “Dams, Waterways, Powerhouses and

Other Facilities", Article-27 "Prevention of Damage caused by Hydroelectric Power Plant" and Article-28 "Hydraulic Turbines and Generators".

Each of the above mentioned articles stipulates so called "performance requirements" but not stipulates specific numerical requirements such as required strength, factor of safety for facilities. On the other hand, Article-28 stipulates the requirements only for hydraulic turbine and generator but no stipulations are available for main transformer, control equipments and switchgear as well as for measurement of insulation resistance and insulation withstand test which are common issues in the electrical works.

Taking into consideration the facts mentioned above, the draft SREPTS for Hydropower will be prepared with the following policies for both of civil structures and electrical facilities aiming to provide EAC with measures for implementing inspection and examination on hydropower facilities to be developed by power service providers properly:

Policies for preparation of the draft SREPTS for Hydropower and Explanation Sheet

- To prepare standards suitable for presents condition of Cambodia while the present international standards and Japanese technical standard for hydropower facilities will be examined for reference.
- To stipulate with more specific numerical descriptions and more detailed figures as much as possible instead of the manner of stipulations in the GREPTS such as "required strength", "shall be stable" and "shall be safe" etc., and to provide examples of calculations, drawings etc. in Explanation Sheet
- .To maintain compatibility with the SREPTS for Thermal Power and Transmission and Distribution Facilities as much as possible

(4) Basic Policy for Issue-4

Issue-4: To develop the draft Glossary for the SREPTS for Hydropower in a practical manner

As there are some technical terms which are not available in Khmer, Glossary for explanation of technical terms will be prepared in English and in Khmer in the Study.

This Glossary is to be prepared in the form of parallel translation of English and Khmer and have to be the base of Khmer version of the draft SREPTS for Hydropower prepared by the Cambodian side. Therefore, the technical terms to be incorporated into the Glossary will be selected from the draft SREPTS for Hydropower and its Guideline (Explanation Sheet) in a practical manner as much as possible by referring the existing similar glossaries.

The translation work into Khmer shall be performed mainly by the counterpart agency. However, technology transfer will be done by doing the translation work in cooperation with JICA Study Team.

In this sense, the two Working Groups for civil work and electrical work formed by JICA Study Team, MIME, EAC and EDC shall be main bodies for the translation work.

6.1.3 Basic Policies on Operational Issues

In the Study, close cooperation with the counterpart agencies, MIME, EAC and EDC is indispensable. In this context, the JICA Study Team planed to perform the Study according to the basic policies on operation issues as described below.

(1) Establishment of Working Group

It is important that the Cambodian side participates in the Study voluntarily in order to carry out technology transfer from JICA Study Team efficiently. In this context, two (2) Working Groups (WGs), which are Civil Work WG and Electrical Work WG, are to be established receiving the members from the counterpart agencies, MIME and EAC and relevant agencies such as EDC.

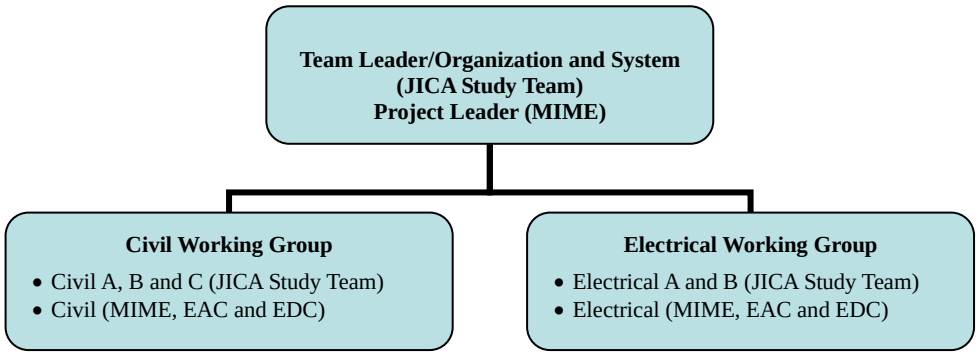


Fig. 6.1.3-1 Organization of Working Group

(2) Support for the Translation Work to Khmer

The translation work of draft SREPTS for Hydropower and its Explanation Sheet and Glossary shall be executed mainly by the counterpart agency. In order to proceed with the translation work effectively, the JICA Study Team supports the translation work through the Study.

6.2 Overall Study Flow

The Study was carried out in the eight (8) stages which consist of four (4) times of Home Work in Japan and four (4) times of Field Work in Cambodia as shown in accordance with "Overall Study Flow" shown below. The overall study flow is also described in **Fig. 6.2-1** in Page **29**.

Overall Study Flow

(1) Preparatory Home Work in Japan

1) Preparation and submission of Inception Report (Ic/R)
2) Review of the existing GREPTS and SREPTS on Thermal Power, and Transmission and Distribution Facilities
3) Preparation and submission of questionnaire

(2) First Field Work in Cambodia

1) The first Workshop
   i) Presentation and discussion on contents of Inception Report
   ii) Establishment of Working Group (WG)
2) Grasping and analyzing the current situation of existing hydropower facilities
3) Confirming policies and future plans on power sector and hydropower development plans including IPP
4) Grasping and analyzing the current situation of approval and licensing system on hydropower business
5) Grasping enforcement status of the existing GREPTS and SREPTS for Thermal Power and Transmission and Distribution Facilities
6) Preparation of framework of the draft SREPTS for Hydropower
7) Preparation of the draft Glossary in English

*) Technical transfer through the Field Work

(3) First Home Work in Japan

1) Review and finding issues on the First Field Work in Cambodia
2) Preparation and submission of Interim Report (It/R)

Cambodia side (MIME/EAC/EDC)

3) Translation of the draft Glossary in English into Khmer

(4) Second Field Work in Cambodia

1) The Second Workshop
   i) Presentation and discussion on contents of Interim Report (framework of the draft SREPTS for Hydropower)
   ii) Arrangement and agenda of the First Seminar
2) The First Seminar（explanation of the framework of draft SREPTS for Hydropower）
3) Preparation of the draft SREPTS for Hydropower in English
4) Preparation of the draft Explanation Sheet of the SREPTS for Hydropower in English
5) Providing recommendations on improvement of approval and licensing system on hydropower business

*) Technical transfer through the Field Work

(5) Second Home Work in Japan

1) Preparation and submission of Draft Final Report (Df/R)

Cambodia side (MIME/EAC/EDC)

2) Translation of the draft SREPTS for Hydropower into Khmer
3) Translation of the draft Explanation Sheet for the SREPTS for Hydropower into Khmer

(6) 2.5th Field Work in Cambodia

1) Supporting translation of the draft SREPTS and Explanation Sheet into Khmer by Cambodia side (MIME/EAC/EDC)

*) Technical transfer through the Field Work

(7) Third Field Work in Cambodia

1) The third Workshop
   i) Presentation and discussion on contents of Draft Final Report (Df/R) (the draft SREPTS for Hydropower)
   ii) Arrangement and agenda of Second Seminar
2) The Second Seminar (explanation of the contents of the draft SREPTS for Hydropower）
3) Supporting translation into Khmer

*) Technical transfer through the Field Work

(8) Third Home Work in Japan

1) Preparation and submission of Final Report (F/R)

Number of months elapsed	1	2	3	4	5	6	7	8	9	10	11	12	13
Year	2008						2009						
Month	10	11	12	1	2	3	4	5	6	7	8	9	10

Project Team

Home Work in Japan

Preparatory Home Work in Japan
1) Preparation and submission of Ic/R
2) Review of existing GREPTS and SREPTS for Thermal Power, and Transmisson and Distribution Facilities
3) Preparation and submission of questionnaire

1st Home Work in Japan
1) Review and finding issues on the 1st Field Work in Cambodia
2) Preparation and submission of It/R
3) Translation of Glossary in English into Khmer（Cambodia side）

2nd Home Work in Japan
1) Preparation and submission of Df/R
2) Translation of draft SREPTS for Hydropower into Khmer (Cambodia side)
3) Translation of Explanation Sheet of draft SREPTS for Hydropower into Khmer (Cambodia side)

3rd Home Work in Japan
1) Preparation and submission of F/R

Field Work in Cambodia

1st Field Work in Cambodia
1) The 1st Workshop
2) Grasping and analyzing the current situation of existing hydropower facilities
3) Confirming policies and future plans on power sector and hydropower development plans including IPP projects
4) Grasping and analyzing the current situation of approval and licensing system on hydropower business
5) Grasping enforcement status of existing GREPTS and SREPTS for Thermal Power and Transmission and Distribution Facilities
6) Preparation of framework of draft SREPTS for Hydropower
7) Preparation of draft Glossary in English

2nd Field Work in Cambodia
1) The 2nd Workshop
2) The 1st Seminar
3) Preparation of draft SREPTS for Hydropower in English
4) Preparation of draft Explanation Sheet of SREPTS for Hydropower in English
5) Providing recommendations on improvement of approval and licensing system on hydropower business

2.5th Field Work in Cammbodi
1) Supporing translation of the draft SREPTS and Explanation Sheet into Khmer by Cambodia side (MIME/EAC/EDC)

3rd Field Work in Cambodia
1) The 3rd Workshop
2) The 2nd Seminar
3) Supporting translation into Khmer

Report: Ic/R, It/R, Df/R, F/R

Seminar: 1st, 2nd

Workshop: 1st, 2nd, 3rd

Category	1	2	3	4	5	6	7	8	9	10	11	12	13
	2008			2009									
	10	11	12	1	2	3	4	5	6	7	8	9	10
1. Team Leader													
2. Civil Engineer （Dam）													
3. Civil Engineer （Waterway & Powerhouse）													
4. Civil Engineer （Hydromechanical Equipment）													
5. Electrical Engineer （Powerhouse Equipment）													
6. Electrical Engineer （Control System）													
7. Coordinator													

Fig. 6.2-1 Overall Activity Schedule

7. Record of Activities during Field Works in Cambodia

7.1 Activities during First Field Work in Cambodia

(1) Main Session of First Workshop (on November 05, 2008)

The First Workshop was taken place on November 05, 2008 at MIME's Conference Room with the following agenda. The Minutes Meeting of the First Workshop is presented in Appendix-1 of the main report.

1) Opening Address

H.E. Ith Praing, the Secretary of State for MIME, addressed an appreciation all the participants and also appreciated technical support from JICA for establishment of the SREPTS for Hydropower.

2) Introduction and Explanation of Inception Report

The JICA Study Team presented the introduction to the First Workshop and explained the outline and major points of Inception Report.

3) Discussion and Questions

After the explanation on Interim Report by JICA Study Team, the participants discussed the flowing issues:

- Scope of SREPTS for Hydropower in relation to the existing and ongoing hydropower projects
- Scope of SREPTS for Hydropower in relation to the inspection and examination standards
- Method of the technical transfer from JICA Study Team to the Counterpart Team
- Organization for the translation works of SREPTS for Hydropower and relevant documents into Khmer
- Establishment of Working Group
- Schedule and participants of Seminars

(2) Kick-Off Meeting for Working Group (on November 14, 2008)

Kick-Off Meeting of Working Group was held on November 14, 2008 at MIME's Meeting Room among the 16 members of Counterpart Team and JICA Study Team to establish Civil Working Group and Electromechanical Working Group. Eight (8) persons and seven (7) persons of the Counterpart Team were selected as the member of Civil Working Group and Electromechanical Working Group respectively. The Minutes of Working Group Meeting (Kick-Off Meeting) is presented in Appendix-2 of the main report.

The members of each Working Group assigned from the Counterpart Team are listed in as shown in **Table 7.1-1** below.

Table 7.1-1 Cambodian Side Member of Working Groups

Member of Civil WG	Member of Electromechanical WG
Mr. Theng Marith (EAC), Leader of C.WG	Mr. Ros Chenda (EDC), Leader of E. WG
Mr. Much Chhun Horn (MIME)	Mr. Chiv Hour (MIME)
Mr. Nong Sareth (MIME)	Mr. So Veasna (MIME)
Mr. Chea Narin (MIME)	Mr. Aun Hemrith (EDC)
Mr. He Sam Ol (MIME)	Mr. Phan Bunthoeun (MIME)
Mr. Leang Khemarith (MIME)	Mr. Pan Narith (MIME)
Mr. Heavf Chan Visal (EDC)	Mr. Teng Saroeun (EAC)
Mr. Suon Ponnarith (EAC)	

The major roles of Working Groups are expected as follows:

- To discuss any issues related to the preparation of draft SREPTS for Hydropower including the draft Glossary and the draft Explanation Sheet by JICA Study Team
- To translate the draft SREPTS for Hydropower and relevant documents into Khmer

(3) The 1st Meeting of Working Groups (on November 14, 2008)

After the Kick-Off Meeting of Working Group, the 1st Meeting was held for each of Civil Working Group and Electrical Working Group separately. The following were discussed in the 1st Working Group Meeting. The Memorandums of the 1st Working Group Meeting are presented in Appendix-2 of the main report.

- Draft table of contents of SREPTS for Hydropower
- Draft Glossary
- Activity schedule of Working Groups

(4) Supplemental Meeting for First Workshop (on November 20, 2008)

In order to discuss further the issues remained for further discussion in the main session of First Workshop on November 05, 2008, the Supplemental Meeting was taken place on November 20, 2008 at MIME's Meeting Room among the member of Working Group with the following agenda. The Minutes of Supplemental Meeting for First Workshop is presented in Appendix-1 of the mainreport.

- Framework and scope of the draft SREPTS for Hydropower
- Schedule of the Second Workshop and the First Seminar
- Schedule of remaining major activities after November 2008

(5) 2nd Meeting of Working Groups (on November 20, 2008)

After the Supplemental Meeting for First Workshop, the 2nd Meetings were held for each of Civil Working Group and Electromechanical Working Group separately. The following were discussed in the 2nd Working Group Meeting. The Memorandums of the 2nd Working Group Meeting are presented in Appendix-2 of the main report.

- Framework of the draft SREPTS for Hydropower
- Revisions on the draft Glossary

7.2 Activities during Second Field Work in Cambodia (January and February 2009)

(1) The 3rd Meeting of Working Groups (on January 20, 2009)

Prior to the Second Workshop, the 3rd Working Group Meeting was held on January 20, 2009 and the following were discussed in the meeting. The Memorandums of the 3rd Working Group Meeting are presented in Appendix-2 of the main report.

- Activities and schedule of Working Group during the Second Field Work of JICA Study Team
- Activities for preparation of the First Seminar
- Contents of revised framework of the draft SREPTS for Hydropower

(2) Main Session of Second Workshop (on January 22, 2009)

The Second Workshop was taken place on January 22, 2009 at MIME's Conference Room with the following agenda. The Minutes Meeting of the Second Workshop is presented in Appendix-1 of the main report.

1) Opening Address

H.E. Ith Praing, the Secretary of State for MIME, addressed an appreciation all the participants and also appreciated technical support from JICA for establishment of the SREPTS for Hydropower.

2) Explanation of Interim Report

The JICA Study Team presented the introduction to the Second Workshop and explained the outline and major points of Interim Report.

3) Discussion and Questions

After the explanation on Interim Report by JICA Study Team, the participants discussed the flowing issues:

- Framework of the draft SREPTS for Hydropower
- Agenda, schedule and arrangements of the First Seminar
- Schedule of activities of the Second Field Work of JICA Study Team

(3) The 4th Meeting of Working Groups (on January 30, 2009)

The 4th Working Group Meetings was held on January 30, 2009 and the following were discussed. The Minutes of the 4th Working Group Meeting are presented in Appendix-2 of the main report.

- Arrangements of the First Seminar and confirmation of the invitation list

- Discussion on the draft text of the SREPTS for Hydropower

(4) The 5th Meeting of Working Groups (on February 04, 2009)

The 5th Working Group Meetings was held on February 04, 2009 and the following were discussed. The Minutes of the 5th Working Group Meeting are presented in Appendix-2 of the main report.

- Contents of the presentation documents for the First Seminar in English and of preparation of the presentation document in Khmer
- Schedule of the translation work of the draft SREPTS for Hydropower into Khmer by the counterpart team
- Discussion on the draft text of the SREPTS for Hydropower

(5) The 6th Meeting of Working Groups (on February 11, 2009)

The 6th Working Group Meetings was held on February 11, 2009 and the following were discussed. The Minutes of the 6th Working Group Meeting are presented in Appendix-2 of the main report.

- Contents of the presentation documents for the First Seminar and arrangement of presenters of the counterpart team
- Discussion on the draft text of the SREPTS for Hydropower

(6) The First Seminar (on February 17, 2009)

The First Seminar was held on February 17, 2009 based on the results of discussions in the Second Workshop and the following were presented by the counterpart team and discussed among the participants.

- Current status of Electricity Law and the existing GREPTS and SREPTS and expected promulgation schedule of the SREPTS for Hydropower
- Current status of the licensing system for electric power service providers
- Framework and outline of the draft SREPTS for Hydropower

(7) The 7th Meeting of Working Groups (on February 19, 2009)

The 7th Working Group Meetings was held on February 19, 2009 and the following were discussed. The Minutes of the 7th Working Group Meeting are presented in Appendix-2 of the main report.

- Activities and schedule of Working Group after the Second Field Work of JICA Study Team
- Discussion on the draft text of the SREPTS for Hydropower

(8) Supplemental Meeting for Second Workshop (on February 19, 2009)

In order to discuss further the issues remained for further discussion in the main session of Second Workshop on January 22, 2009, the Supplemental Meeting was taken place on February 19, 2009 at MIME's Meeting Room among the member of Working Group with the following agenda. The

Minutes of Supplemental Meeting for the Second Workshop is presented in Appendix-1 of the main report.

- Activities and schedule of Working Group after March 2009 and in the Third Field Work of JICA Study Team
- Discussion matters related to recommendations for improvement of the approval and licensing system for hydropower business.

7.3 Outline of First Seminar (on February 17, 2009)

The First Seminar was held in the manner as described below:

(1) Outline of the First Seminar

1) Date and Time: February 17, 2009 from 8:30AM to 12:30PM
2) Place: Conference Room at Phnom Penh Hotel
3) Participants: 76 persons from the following organizations (see Appendix-3)
   - Counterpart Agencies (MIME, EAC and EDC) and JICA
   - Ministries related to hydropower development
   - Provincial Department of Industry, Mines and Energy (DIME) related to hydropower development
   - Private groups related to hydropower development (IPP groups)
   - Other organizations related to hydropower development such as Cambodian National Mekong Committee
4) Major Agendas
   - Current enforcement status of the existing GREPTS and SREPTS
   - Current status of Electricity Law and Licensing System for Electric Power Business
   - Purpose of establishment of SREPTS for Hydropower
   - Framework of the draft SREPTS for Hydropower

(2) Program of the Seminar

1) Key Note Address by Mr. Yukiharu Kobayashi, Deputy Chief Representative, JICA Cambodia Office
2) Opening Address by H.E. Suy Sem, Minister, Ministry of Industry, Mines and Energy
3) Presentation by Counterpart Agencies
   - Introduction by Dr. Bun Narith, Deputy Director General of Energy, MIME
   - Present Status of GREPTS and the existing SREPTS by Mr. So Veasna, MIME
   - Present Status of Electrical Law and Licensing System by Mr. Theng Marith, EAC
   - Purpose of SREPTS for Hydropower by Mr. Much Chhun Horn, MIME

- Framework of Draft SREPTS for Hydropower by Mr. Chea Narin and Mr. Pan Narith, MIME

4) Questions and Answers

5) Closing Address by H.E. Ith Praing, Secretary of State, Ministry of Industry, Mines and Energy

(3) Major Discussions

The discussions were made among the participants of the Seminar after the presentation of the Counterpart Team. In the discussion session, the following comments were provided with from the participants;

- An IPP group from China provided with a query that the framework of the SREPTS for Hydropower was explained in the presentation of this Seminar but what have been the policies in preparation of the technical standards relating to contents of specific requirements. Also, an IPP group from Vietnam provided with a comment that the SREPTS shall be of suitable for the situation in Cambodia and shall not be a copy of Japanese technical standards of which requirements are at a too high level.

In reply to the query, MIME explained as follows:

- MIME also considers it is important to prepare technical standards suitable to the situation in Cambodia by not simply copying some foreign technical standards. In this regards, MIME will deliver a copy of the draft of SREPTS for Hydropower to the participants of this Seminar in order to collect opinions from the participants.

In the Closing Address of the Seminar, H.E. Ith Praing of MIME provided the participants with the statements including the following:

- In the preparation of the SREPTS for Hydropower, the aspects of safety, quality and sustainability including environmental conservation and dam safety are important. In this sense, it is desirable to have satisfactory results by studying the provisions of SREPTS for Hydropower from such important aspects.
- The power sector of Cambodia is giving a priority on the hydropower development by the private sector, so that participation of many IPP groups is expected in the Second Seminar.

7.4 The 2.5th Field Work in Cambodia (June and July 2009)

(1) Working Group Meeting No.8 (on June 16, 2009)

Working Group Meeting No.8 was held on June 16, 2009 and the following were discussed in the meeting. The Minutes Working Group Meeting No.8 is presented in Appendix-2 of the main report.

- Schedule of the 2.5th Field Work of JICA Study Team
- Confirmation of progress of the translation work of SREPTS and Explanation Sheet

(2) Working Group Meeting No.9 (on June 24, 2009)

Working Group Meeting No.9 was held on June 24, 2009 and the following were discussed in the meeting. The Minutes Working Group Meeting No.9 is presented in Appendix-2 of the main report.

- Confirmation of progress of the translation work of Explanation Sheet
- Method to ensure quality of the translation work into Khmer

(3) Working Group Meeting No.10 (on June 29, 2009)

Working Group Meeting No.10 was held on June 29, 2009 and the following were discussed in the meeting. The Minutes Working Group Meeting No.10 is presented in Appendix-2 of the main report.

- Confirmation of progress of the translation work of Explanation Sheet
- Activity schedule by the end of August 2009

The JICA Study Team delivered the 20 copies of Draft Final Report (Summary Report, Main Report and Annex) to MIME in the Meeting. In addition, 50 copies of Annex were prepared for delivery to the expected participants of the Second Seminar.

(4) Working Group Meeting No.11 (on July 06, 2009)

Working Group Meeting No.11 was held on July 6, 2009 and the following were discussed in the meeting. The Minutes Working Group Meeting No.11 is presented in Appendix-2 of the main report.

- Confirmation of activity schedule by the end of August 2009
- Confirmation of progress of the translation work of Explanation Sheet

7.5 The Third Field Work in Cambodia (July and August 2009)

(1) Working Group Meeting No.12 (on July 14, 2009)

Working Group Meeting No.12 was held on July 14, 2009 and the following were discussed in the meeting. The Minutes of Working Group Meeting No.12 is presented in Appendix-2 of the main report.

- Reconfirmation of the schedule of activities by the end of August 2009
- Confirmation of progress of the translation work of Explanation sheets

(2) Working Group Meeting No.13 (on July 21, 2009)

Prior to the Third Workshop, Working Group Meeting No.13 was held on July 21, 2009 and the following were discussed in the meeting. The Minutes of Working Group Meeting No.13 is presented in Appendix-2 of the main report.

- Confirmation of progress of the translation work of Explanation sheets

- Activities and schedule of Working Group during the Third Field Work of JICA Study Team
- Activities for preparation of the Second Seminar

(3) Main Session of Third Workshop (on July 22, 2009)

The Third Workshop was taken place on July 22, 2009 at MIME's Conference Room with the following agenda. The Minutes Meeting of the Third Workshop is presented in Appendix-1 of the main report.

1) Opening Address

H.E. Ith Praing, the Secretary of State for MIME, addressed an appreciation all the participants and also appreciated technical support from JICA for establishment of the SREPTS for Hydropower.

2) Explanation of Draft Final Report and the draft SREPTS for Hydropower

The JICA Study Team presented the outline and major points of Draft Final Report and the draft SREPTS for Hydropower.

3) Discussion and Questions

After the explanation of Draft Final Report and the draft SREPTS for Hydropower by JICA Study Team, the participants discussed the flowing issues:

- Major provisions of the draft SREPTS for Hydropower
- Agenda, schedule and arrangements of the Second Seminar
- Schedule of activities of the Third Field Work of JICA Study Team

(4) Working Group Meeting No.14 (on July 28, 2009)

Working Group Meeting No.14 was held on July 28, 2009 and the following were discussed. The Minutes of Working Group Meeting No.14 is presented in Appendix-2 of the main report.

- Confirmation of contents of draft Minutes of the Third Workshop
- Confirmation of progress of the translation work of Explanation sheets
- Preparation of the Second Seminar
- Proposed revisions on the contents of draft SEPTS for Hydropower r

(5) Working Group Meeting No.15 (on August 04, 2009)

Working Group Meeting No.15 was held on August 4, 2009 and the following were discussed. The Minutes of Working Group Meeting No.15 is presented in Appendix-2 of the main report.

- Confirmation of contents of draft Minutes of the Third Workshop
- Confirmation of progress of the translation work of Explanation sheets
- Preparation of the Second Seminar

- Proposed revisions on the contents of the draft SEPTS for Hydropower r

(6) The Second Seminar (on August 06, 2009)

The Second Seminar was held on August 6, 2009 based on the results of discussions in the Third Workshop and the following were presented by the counterpart team and discussed among the participants.

- Purpose and outline of SREPTS for Hydropower
- Contents of the draft SREPTS for Hydropower (Part-1 to Part-4)

(7) Follow-up Meeting for Third Workshop (on August 07, 2009)

In order to discuss further the issues remained for further discussion in the main session of Third Workshop on July 22, 2009, the Follow-up Meeting was taken place on August 7, 2009 at MIME's Meeting Room among the member of Working Group and the representative of JICA Cambodia Office with the following agenda. The Minutes of Follow-up Meeting for Third Workshop is presented in Appendix-1 of the main report.

- Revisions on the draft SREPTS for Hydropower agreed in the Third Workshop
- Revisions on the draft SREPTS for Hydropower and Explanation Sheet agreed in the WG Meetings held after the Third Workshop
- Revisions on the draft SREPTS for Hydropower suggested in the Second Seminar
- Schedule after the Follow-up Meeting

(8) Working Group Meeting No.16 (on August 11, 2009)

Working Group Meeting No.16 was held on August 11, 2009 and the following were discussed. The Minutes of Working Group Meeting No.16 is presented in Appendix-2 of the main report.

- Confirmation of the agreed post revisions on the draft SREPTS for Hydropower and the draft Explanation Sheet
- Recommendations proposed in Draft Final Report (Chapter 12)
- Request of Follow-up Activities for execution of GREPTS and SREPTSs

7.6 Outline of Second Seminar (on August 06, 2009)

The Second Seminar was held in the manner as described below:

(1) Outline of the Second Seminar

1) Date and Time: August 6, 2009 from 8:30AM to 16:30PM
2) Place: Conference Room at Phnom Penh Hotel
3) Participants: 90 persons from the following organizations (see Appendix-3 of the main report)

- Counterpart Agencies (MIME, EAC and EDC) and JICA
- Ministries related to hydropower development (MOE, MOWRAM, MRD, etc.)
- Provincial Department of Industry, Mines and Energy (DIME) related to hydropower development
- Private groups related to hydropower development (IPP groups)
- Other organizations related to hydropower development such as Cambodian National Mekong Committee

4) Major Agendas
   - Purpose of the SREPTS for Hydropower
   - Contents of the draft SREPTS for Hydropower

(2) Program of the Seminar

1) Welcome Address by Dr. Bun Narith, Deputy General Director, General Department of Energy, MIME
2) Key Note Address by Mr. Yusuke Murakami, Senior Representative, JICA Cambodia Office
3) Opening Address by H.E. Ith Praing, Secretary of State for MIME
3) Presentation by Counterpart Agencies
   - Introduction and purpose of SREPTS by Dr. Bun Narith, Deputy Director General, MIME
   - Outline of the draft SREPTS for Hydropower by Mr. Much Chhun Horn, MIME
   - Explanation of the draft SREPTS (Part-1) by Mr. Chea Narin, MIME
   - Explanation of the draft SREPTS (Part-2) by Mr. Theng Marith, EAC
   - Explanation of the draft SREPTS (Part-3) by Mr. So Veasna, MIME
   - Explanation of the draft SREPTS (Part-4) by Mr. Suon Ponnarith and Mr. Teng Saroeun, EAC
4) Questions and Answers
5) Comment of JICA Study Team
6) Summary and Conclusion (MIME/EAC)
7) Closing Remarks by H.E., Say Phirum, Under Secretary of State, MIME

(3) Major Discussions

The discussions were made on the contents of draft SREPTS for Hydropower among the participants of the SecondSeminar after the presentation of the Counterpart Team for each part. The major topics of the discussions are summarized below;

1) Regarding Article-2 “Purpose”, a participant from a Vietnamese group of power sector made a comment that it is impossible to develop a hydropower project if we have to follow strictly the provisions stipulated in Article-2 of the draft SREPTS for Hydropower, which require no adverse effect to surrounding environment. In response to this comment, it was agreed among the

participants to add the following sentence at the end of Article-2 respecting the purpose of Article-2;

"The owner shall proceed with a project in its planning, design, construction and operation giving the utmost respect to the above purposes."

2) Regarding Article-6 "Environmental Protection", a participant from MOE made a comment that the actual law and regulations to be followed by owners shall be clarified in Article-6. In response to this comment, a member of the Counterpart Team explained that such clarifications are to be provided in Explanation Sheet but not in the SREPTS for Hydropower itself because such laws and regulations are under control of the other ministries but not by MIME or EAC.

   Also a participant from MAFF made comment that more attention shall be paid to the environmental issues in hydropower development. In response to this comment, JICA Study Team explained for clarification that the draft SREPTS for Hydropower requires an owner to follow the existing environmental laws and regulations and also the owner shall take appropriate measures for environmental conservation in accordance with conditions suggested by the approved EIA report.

3) Regarding Article-24 "Loads" in Part-2, a participant from a relevant Ministry made a comment that application of international standards such as standards for earthquake sometimes push up the project cost as no earthquake occurs in Cambodia. In response to this comment, JICA Study Team explained that SREPTS for Hydropower stipulates the minimum technical requirement against earthquake taking into account the seismic conditions in Cambodia and the international practice, and such minimum requirement does not affect so much to the project cost.

4) Regarding the entire Articles in SREPTS for Hydropower, a participant from a IPP group made a comment asking whether American, European and Chinese consulting companies can understand and follow technical standards established by the Japanese study team. In response to this comment, JICA Study Team explained that SREPTS for Hydropower was established refereeing the internationally recognized standards used in other countries.

After the above discussions, it was confirmed that all of the participants basically agreed to the contents of draft SREPTS for Hydropower at the end of the Seminar.

8. Framework of Draft SREPTS for Hydropower

8.1 Outline of Discussions regarding Framework of Draft SREPTS for Hydropower

The parties agreed on the composition of a draft SREPTS for Hydropower as follows in the Second Workshop held on January 22, 2009 in the Second Field Work in the Kingdom of Cambodia;

(1) The draft SREPTS for Hydropower consists of four parts of which Part-4 covers provisions regarding examinations and inspections;

Part-1 : General Provision

Part-2 : Civil Structures and Hydromechanical Equipment

Part-3 : Electrical Facilities

Part-4 : Examination and Inspection

(2) Part-1 includes provisions of exemptions for small hydropower projects and projects under implementation and the existing projects.

Based on the agreement, the parties have held Working Group (WG) meetings in weekly basis in the Second Field Work in the Kingdom of Cambodia at the MIME meeting room, and confirmed the following regarding the contents of the draft SREPTS for Hydropower through discussions in Civil WG and Electrical WG between the JICA study team and the counterpart team members.

8.2 Items discussed and confirmed in Working Group Meetings

8.2.1 Articles for Examination and Inspection

It was agreed among the parties that a new part titled “Examination and Inspection” is to be established as Part 4 to describe provisions for examinations and inspections.

As for civil engineering facilities, Part-4 of SREPTS for Hydropower stipulates the provisions for “in-progress inspection”, “completion inspection” and “periodical inspection”.

As for electromechanical facilities, Part-4 only provides provisions for tests to be performed during installation work and at commissioning, because the maintenance work of electrical facilities after commissioning shall be performed in accordance with the provisions stipulated in “Safety Policy” in General Provision of Part-3 “Electrical Facilities”

8.2.2 Application of SREPTS for Hydropower to Small Hydropower Projects

One of the purposes of SREPTS for Hydropower is to prevent hydropower facilities from threatening public safety and, this purpose shall be maintained any hydropower projects regardless of their development scale. In this context, the JICA Study Team prepared a draft provision in the Second Field Work in the Kingdom of Cambodia to exempt small scale hydropower facilities from the subject of SREPTS for Hydropower based on the following two conditions and the Cambodian side counterpart team agreed to the proposal:

- Construction, operation and failure of a hydropower station shall not affect the public safety.
- Failure of a hydropower station shall not seriously affect to the connected power grid or a hydropower plant is separated from the existing power grid.

8.2.3 Application of SREPTS for Hydropower to Existing Hydropower Station

The JICA Study Team prepared, based on the provision in Article 5 of the existing GREPTS, a draft of such exceptional provision that permits operation of existing hydropower facilities till the time of

those renewal or replacement unless they are harmful to public safety. This draft provision was discussed in the meeting during Second Field Work and agreed by the Cambodian side counterpart team.

8.2.4 Application of SREPTS for Hydropower to Projects under Implementation

The JICA Study Team prepared a draft of such exceptional provision that may exempt any hydropower facilities under implementation from the application of this SREPTS at the time of its enforcement on condition that the owner shall try to do his utmost so that such hydropower facilities conform to this SREPTS as much as possible. This draft provision was discussed in the meeting during Second Field Work in the Kingdom of Cambodia, and agreed by the Cambodian side counterpart team.

However, the JICA Study Team added a provision which stipulates that the owner shall be always responsible for reporting, and monitoring and inspections regardless of any exemptions described in Clauses **8.2.2** to**8.2.4**.

8.2.5 Provisions for Requirements related to Existing Environmental Regulations

The JICA Study Team prepared a draft of such provision that instructs owners to implement studies, investigations, construction and operation of a hydropower facility complying with the requirements set by the Environmental Law and other related laws and regulations. This draft provision was discussed in the meeting during Second Field Work in the Kingdom of Cambodia and agreed by the Cambodian side counterpart team.

8.2.6 Conformance with existing GREPTS and SREPTS

In the Kingdom of Cambodia, the GREPTS and SREPTS for Thermal Power Generating Facilities and for Transmission and Distribution Facilities have been established and enforced already. Although the provisions in the SREPTS for Hydropower will be prepared so as to conform to the provisions in the existing GREPTS and SREPTS, there may be such cases that a provision of the SREPTS for Hydropower contradicts the existing provisions. In this regard, it was agreed with Cambodian side that the JICA Study Team will prepare a draft SREPTS for Hydropower accepting some discrepancies with the provisions of existing GREPTS and SREPTS for such case that a contradiction is inevitable.

9. Policy and Outline of Draft Glossary of SREPTS for Hydropower

9.1 Basic Policy

The draft Glossary for SREPTS for Hydropower was prepared in accordance with the basic policy explained below:

There are not so many existing hydropower facilities in the Kingdom of Cambodia, so Cambodian engineers and/or technicians do have abundant experiences in design, construction, operation and maintenance of these facilities. Considering this situation, brief explanations are attached to the technical terms which appear in the SREPTS for Hydropower so that the Cambodian side counterpart team may understand names, contents of design standards of hydropower facilities and phenomena which occur in those facilities, and may translate those terms into Khmer more easily. At the request of the Cambodian side counterpart team, figures and photographs are attached to some technical terms to help them understand forms and functions of structures.

9.2 Glossary for Civil Structures and Hydromechanical Equipment

Brief explanations were attached to the technical terms which appeared in the draft SREPTS for Hydropower and/or the JICA Study Team judged necessary according to the following criteria;

1) Technical terms which mean structures and phenomena peculiar to hydropower facilities and are not explained in a general dictionary, and
2) Technical terms which require explanations as they have different meanings from ones generally used.

The glossary for civil structures and hydromechanical equipment were arranged alphabetically entirely in one without categorizing as it was difficult to classify them into categories.

9.3 Glossary for Electrical Equipment

Regarding the technical terms of the electrical facilities, the terms of which an explanation is indispensable were selected among the technical terms used in Part 3 of the draft SREPTS for Hydropower. The technical terms were classified into the following five (5) categories and arranged in alphabetical order.

1) General Terms
2) Physical Terms
3) Mechanical Terms
4) Electrical Terms
5) Electric Wires and Cable Terms

Terms which are out of the above categories of items 2) to 5) above are classified into the category 1) General Terms.

Some important mechanical terms of the turbine, which is the major equipment in hydropower plants,, are added to the draft Glossary with explanation and photographs, even if such terms are not used in the draft SREPTS for Hydropower.

10. Policy and Outline of Draft SREPTS for Hydropower

Based on the result of discussion with Cambodian side counterpart team described in Chapter 8 of this report, the draft SREPTS for Hydropower consists of the following four (4) parts as follows;

- Part 1 : General Provisions
- Part 2 : Civil Structures and Hydromechanical Equipment
- Part 3 : Electrical Facilities
- Part 4 : Examination and Inspection

The JICA Study Team prepared provisions of the draft SREPTS for Hydropower as shown in Annex of this report (separate volume) considering the following manners as basic policies;

- referring electric power technical standards of Lao PDR and Vietnam, for which JICA has conducted the studies, as well as those of Japan, the U.S.A, and European developed countries and international standards such as IEC; and,
- conforming to the provisions in existing GREPTS and SREPTS.

10.1 Part1 1: General Provisions

General requirements related with hydropower development were collected in “Part 1 General Provisions”. Part 1 describes the following contents based on the result of discussions with the Cambodian side counterpart team regarding the framework of the draft SREPTS for Hydropower as explained in Chapter 8.

“Chapter 1: General Provisions” describes definitions of technical terms used in the draft SREPTS for Hydropower, purposes of the SREPTS for Hydropower scopes of its application, and conformity with other standards and codes as general terms. Regarding the latter two items, the following matters were considered.

1) Generally, national standards and codes are for stipulating fundamental requirements regarding safety and performance of facilities but not for defining technical applications. In this context, this chapter refers to possibility of alternative technical approaches.
2) This chapter stipulates that specific items shall comply with internationally recognized standards and codes or any other equivalent ones so as to satisfy the requirements of the SREPTS for Hydropower.

“Chapter 2: Particular Provisions” was prepared to stipulate requirements for implementation of hydropower projects and conditions for exemption of the SREPPTS for Hydropower as follows:

1) The five provisions are provided in “Section 1 Requirements for Project Implementation” in Chapter 2 as follows
   i) Assignment of chief engineers responsible for the technical matters in the fields of design, construction, installation, operation and maintenance

ii) Obedience to the existing laws and regulations prescribing environmental protection and conservation

iii) Order of remedy for conformance to requirements in the SREPTS for Hydropower to be issued by EAC

iv) Obligation of reporting by project owners;

v) Obligation of an owner to providing engineers and/or technicians with safety and technical training by project owners

2) Exemption clauses are prepared to exempt small scale hydropower projects from the provisions in the SREPTS for Hydropower in order not to disturb rural electrification, and also for hydropower projects under implementation and under operation in order not to disturb electric power supply provided that such projects are not harmful for the public safety.

10.2 Part 2: Civil Structures and Hydromechanical Equipment

Part 2 stipulates technical requirements regarding civil structures and hydromechanical equipment and consists of the following seven chapters;

- Chapter 3: General provisions
- Chapter 4: Fundamental requirements
- Chapter 5: Dams
- Chapter 6: Waterways
- Chapter 7: Powerhouse and other facilities
- Chapter 8: Reservoirs
- Chapter 9: Downstream Areas

Outline of the provisions in each chapter of Part 2 are described as follows.

Prior to describing technical standards for specific structures, “Chapter 3: General Provisions” was provided to define technical terms used in “Part 2: Civil Structures and Hydromechanical Equipment.”

“Chapter 4: Fundamental Requirements” describes provisions regarding fundamental requirements for preventing civil structures and hydromechanical equipment from threatening public safety such as;

1) prevention of overtopping at the non-overflow section of dams;
2) dam stability;
3) prevention of failure of waterways, powerhouse and other facilities;
4) prevention of damage to ground surrounding a reservoir; and
5) prevention of damage to upstream and downstream areas.

Requirements for individual structures described in Chapter 5 and after were established from the following viewpoints;

- Structures and equipment shall be safe against disasters;

- Structures and equipment shall be safe against loads, the flow of water and a change in the flow rate; and
- Structures and equipment shall fulfill their function.

The draft Explanation Sheets describe detailed explanations of each provision and give users information to interpret and use the SREPTS for Hydropower.

10.3 Part 3 : Electrical Facilities

"Part 3: Electrical Facilities" has been prepared in order to stipulate technical requirements of electrical equipment in the draft SREPTS for Hydropower, Part 3 consists of following.

- Chapter 10: General Provision
- Chapter 11: Electrical Equipment for Hydropower Station
- Chapter 12: Auxiliary Equipment
- Chapter 13: Electrical Facilities for Station Service
- Chapter 14: Electrical Facilities for Outgoing Line
- Chapter 15: Measurement and Protective Device

In Part 3 of the draft SREPTS for Hydropower, the required technical and safety provisions are prepared in a manner employing concrete numerical values as much as possible taking basic strategy and the results of discussions with the counterpart mentioned in Chapter 6 and Chapter 8 of this report into consideration.

- Required technical standard, safety policy and prevention of pollutions
- Definitions which are to be used in "Part 3: Electrical Facilities" of he draft SREPTS for Hydropower
- Insulation level, thermal strength, structure, performance and installation
- Grounding work and pressure oil and compressed air supply system
- Prevention of electrical shock, fire, risk to the other facilities, protective measure against abnormal condition, electrical/magnetic interferences and restriction of installation at special locations of the station service
- Prevention of electrical shock, fire, hazard to other electrical wires, hazard by collapse of supporting structure, hazard by high pressure gas, prohibition of installation for dangerous facilities, electrical/magnetic interferences and prevention of electric power outage of the outgoing line
- Measuring device and protective device

10.4 Part 4: Examination and Inspection

10.4.1 General

"Part 4 : Examinations and Inspections" is established to describe requirements for a purpose, items and procedure of examinations and inspections accepting the results of discussions with the Cambodian side counterpart team.

This part consists of three chapters; "Chapter 16: General Provisions," "Chapter 17: Civil Engineering Structures and Hydromechanical Equipment," and "Chapter 18: Electrical Equipment."

Items of examinations and inspections are described in the following three phases; "in-progress inspection", "completion inspection", and "periodical inspection".

10.4.2 General Provisions

"Chapter 16: General Provisions" describes as follows.

"The Authority" is defined to be MIME or an organization with which MIME charged qualifications for examinations and inspections. "The Owner" is defined as described in Article 1 in Chapter 1 of Part 1. "The Inspector" is a person who belongs to MIME or nominated by MIME.

In-progress inspection, completion inspection, and periodical inspection are defined, and provisions regarding an independent inspection conducted by the owner and on-the-spot inspection by the authority are described. Purposes of examinations and inspections in each phase are described.

10.4.3 Civil Structures and Hydromechanical Equipment

The examinations and inspections should be implemented not only on the facilities but also on the natural conditions such as geological condition of foundations in a timely manner at each development stage (construction stage, completion stage and operation stage) in order to evaluate and ensure the function and safety of the facilities.

1) Section 1 : In-progress Inspection
2) Section 2 : Completion Inspection
3) Section 3 : Periodical Inspection

10.4.4 Electrical Equipment

the requrements of the examinations and inspections for the electrical facilities are stipulated only for during installation work or before commercial operation. The periodical examinations and inspections to be performed after commencement of commercial operation are out of scope in the draft SREPTS for Hydropower. As for the examinations and inspections for the electrical facilities to be performed before commercial operation, purpose, procedures and criteria for measurement of grounding resistance, insulation resistance, dielectric strength test, operation test and load test are stipulated.

11. Policy and Outline of Draft Explanation Sheet of SREPTS for Hydropower

The draft Explanation Sheet for the draft SREPTS for Hydropower is to be prepared to explain meanings and backgrounds of provisions in the draft SREPTS for Hydropower to promote its understanding and to use it properly. The draft SREPTS for Hydropower has been prepared to stipulate specific technical requirements which shall be satisfied by any hydropower facilities. Generally, it is popular now, as a result of the leader ship of World Trade Organization (WTO) for elimination of non tariff barrier on international trades, that national technical standards of each country may provide only performance requirements as the mandatory ones and specific numerical requirements may be stipulated in a separate guideline as the voluntary ones. In this context, also the JICA Study Team has prepared the draft SREPTS for Hydropower basically stipulating the performance requirements, although it includes specific numerical requirements as much as possible taking into account the situation in the Kingdom of Cambodia. Under these circumstances, the draft Explanation Sheet of the SREPTS for Hydropower describes backgrounds of main standards, technical terms which require an explanation to illustrate the point of the draft SREPTS, and the process which numerical values in the draft SREPTS for Hydropower were selected.

In Part-1, the draft Explanation Sheet describes purposes and reasons for establishment of the text of Part 1 “General Provisions” in the draft SREPTS for Hydropower, and a background referring to related provisions of the GREPTS. To promote understanding of difficult technical terms and sentences, explanations are attached to them and reference documents such as relevant provisions in the existing GREPTS are referred to.

In Part 2 of the draft Explanation Sheet, the scope of application for the text of “Part 2: Civil Structures and Hydromechanical Equipment” in the draft SREPTS for Hydropower is explained by showing grounds for numerical values, carrying figures and photographs which express concrete concepts and examples, and comparing the draft SREPTS for Hydropower with foreign standards and codes.

In Part 3 of the draft Explanation Sheet, detailed explanations for applied technical standards in Part 3 “Electrical Facilities” of the draft SREPTS for Hydropower are described with illustrations, drawings, tables and pictures as much as possible for easy understanding of technical contents.

In Part 4, the draft Explanation Sheet explains provisions regarding a purpose, item and procedure of examination and inspection which are stipulated in “Part 4: Examinations and Inspections” of the draft SREPTS for Hydropower.

12. Recommendations on Improvement of Approval and Licensing System on Hydropower Business

12.1 Current Situation and Problems in Approval and Licensing System

As mentioned in Chapter 4 of this report, the current status of the licensing system for electric power business is described as follows:

Each electricity service provider is required to have a license issued by EAC and to abide by the provisions of the Electricity Law and those of its license, regulations and procedures set by EAC. The licenses for electric power services are to be issued by EAC to individual or legal entities giving the right to provide electric services as per the provisions defined in the license as "the Conditions of License."

On the other hand, the hydropower development plans are going to be implemented as the IPP projects with the following procedures;

(1) IPP investor proposes a project plan for obtaining a concession agreement for its development and providing electric power service with the Government of Cambodia. MIME, CDC (Cambodia Development Council) and MEF are responsible for this step.
There are two (2) steps in this procedure as follows:
- Implementation Agreement (IA)
- Power Purchase Agreement（PPA）

After initial agreement on PPA between the IPP and EDC who is the off-taker for IPP business, EDC will submit a draft PPA to EAC indicating power tariff and purchase conditions (take or pay condition).

(2) After the agreement on PPA between a developer of hydropower project (IPP) and EDC, EAC will issue licenses of power generation business to IPP to generate and sell electricity to EDC. The power generation license issued by EAC includes the provision that requires the licensees to abide the technical standards. In this sense, it is understood that the GREPTS and SREPTS are incorporated in the licensing system.

(3) Prior to the commencement of commercial operation of a power generating project including IPP project, project owner (project operator) and EDC jointly develop operating procedures addressing operational interfaces between two parties including the method of day to day communication, notification of key personnel list, clearances and switching practices, outage schedule, capacity and energy reporting, operation logging, procedures in relation to dispatch of the electricity. The operation procedures shall be established properly so as to be consistent with the design of the project and the interconnection facility, the Grid Code of EDC and the technical limits of operation.

It is required to pay attention to the following issues when we apply the current approval and licensing system for electric power businesses to the development of hydropower projects:

1) Even at the preparation stage for project implementation from a proposal of a hydropower development plan by an IPP investor until starting the construction though an Implementation Agreement (IA) with the Government of Cambodia, it is important for the Government to conduct examination on the results of Feasibility Study (F/S) and Environmental Impact Assessment (EIA) in order to monitor the status of project preparation and to evaluate viability of the project. In particular, the pre-examination and evaluation are important for the hydropower projects with a reservoir because it affects to the surrounding areas and downstream areas.
2) On the other hand, the draft SREPTS for Hydropower provides the provisions related to technical requirements and the contents of examinations and inspections for safety and quality in each of the design, construction and operation stages, but does not cover required procedures at the project preparation stage including conducting F/S and EIA and their reporting.
3) Furthermore, it is necessary to develop engineers who are capable for technical examination and evaluation since hydropower projects vary in plan and design depending on the conditions at development sites and, consequently, sufficient experiences are required for technical judgment.
4) The current hydropower development plan in Cambodia includes large scale projects with reservoirs. In addition to the technical issues, many other critical issues including land acquisition, resettlement of people and environmental impact in the reservoir area and downstream areas are involved in the hydropower project with a reservoir in general, and there shall be many governmental agencies related to these issues.
5) In addition, a drastic decreasing of river discharge was pointed out at the existing O' Chum 2 hydropower station. This is considered due to environmental conservation issue of the upstream river basin.

12.2 Recommendations

Based on the information and results of discussions obtained through the Study, the following recommendations are proposed against the current status and issues of the approval and licensing system for electric power businesses mentioned in **12.1** above:

(1) Development of a guideline for the procedures for development and operation of hydropower projects from investigation to operation and maintenance including the following aspects:
   - Procedures for execution, reporting, examination and approval of F/S
   - Procedures for execution, reporting, examination and approval of EIA
   - Procedures for pre-examination, approval and monitoring on action plans of environmental conservation measures, compensation for affected people, resettlement
   - Procedures for submission, examination and approval of detailed design of hydropower facilities

- Procedures for examination and inspection on hydropower facilities and reporting during construction/installation stage
- Procedures for examination/inspection and reporting of monitoring results on hydropower facilities during operation and maintenance stage
- Procedures for submission, examination and approval of reservoir operation plan for power generation and flood control
- Procedures for submission, examination and approval of operation rules for spillway gates and other discharge gates and valves

As the items listed above include the contents for which laws and regulations are already exist such as ones for execution of EIA, and plural number of governmental agencies are related to these issues, an inter-organizational coordination is required among the related agencies for preparation of a procedure guideline.

On the other hand, the issues related to environmental conservation of upstream basin is an area-wide issue beyond responsibility of hydropower developers. For this issue, it is necessary to take integral policy measures by setting regulations and control systems in view of basin-wide environmental conservation measures, and such measures are beyond the extent of recommendation in the field of hydropower development.

(2) Development of a manual for examination and inspection

In order to properly operate the provisions of examination and inspection in Part-4 of the draft SREPTS for Hydropower, it is recommended to develop a manual which clarifies the detailed procedures and methods of examination and inspection on hydropower facilities.

(3) Development of safety and security guideline for workers of operation and maintenance at hydropower stations

The draft SREPTS for Hydropower stipulates the requirements for safety of hydropower facilities in principle. On the other hand, regarding the personal safety, it is common way that each electric power company prepares an own safety work manual for securing and improving safety of workers. In this regard, it is recommended for the public sector to prepare a safety guideline as a standard document for proper preparation and operation of safety manual by individual power companies.

(4) Capacity building for hydropower engineers of regulatory agencies (MIME, EAC, EDC)

As mentioned above, sufficient experiences are required for technical judgments for hydropower stations and, therefore, qualified engineers who have capability in technical examination and evaluation. However, the number of hydropower engineers, particularly in the field of civil engineering, is very limited in Cambodia. Therefore the capacity building for hydropower engineers of the regulatory agencies would be an issue to be solved under the situation of expected progress of hydropower development.

(5) Establishment of certification and registration system of qualified engineers

The general provisions in the draft SREPTS for Hydropower provides with an Article of

assignment of chief engineers. This Article stipulates the obligation of the owner to assign the chief engineers. In this connection, it is desirable to establish a system of registered engineers which determine procedures and conditions for registration and assignment of chief engineers.

Also, an Article of the draft SREPTS for Hydropower stipulates the obligation of owner to provide his engineers and technicians with safety and technical training to be arranged by the owner by himself. However, it is desirable to establish a public system of qualification, certification and registration of engineers in order to maintain or improve technical level of the maintenance and operation staff and to maintain safety conditions of power stations continuously. In particular, hydropower projects to be developed in the near future may have dams with spillway gates, and it is required that the operation of spillway gates, which are strongly related to the safety of downstream area, shall be done by a qualified operators in a responsible manner.