

Appendix 1

Report of Field Survey 1

1. Takeo Grid Substation
2. Kampot Grid Substation
3. Kamchay Hydropower Plant

Report of Field Survey 1

Date: November 26, 2011

Participants: Shinohara, Hirose, Irie, Fukugaichi and Yamamoto

1. Takeo Grid Substation

Takeo Grid Substation (GS) was constructed by ADB Loan in 2009. Takeo GS is located between Vietnam and West Phnom Penh GS (GS4) and receives power from Vietnam through 230kV/2cct transmission line. The transmission line from Takeo GS to West Phnom Penh GS is also 230kV/2cct. The power for the demand in Takeo area is supplied by 22kV distribution lines.

There is one transformer, which is made in China, and the voltage ratio is 230kV/22kV and the capacity is 16 MVA. 10 distribution lines go out of the GS and the demand for Takeo area is approximately 4 MW.

In the Capacity Building for HV Transmission System in 2009 under JBIC loan, the Chugoku EPCO proposed installation of phase signs to substation facility and unification of the icons' color on monitors that shows whether switching devices are open or closed. The phase signs, which show that phase A is Red, phase B is yellow and phase C is black, were properly attached to the substation facility and the outdoor structure in the GS and the color of the icons was unified; the state of open is green and the state of close is red.

And a voltage detector which was delivered by the Chugoku EPCO in the Capacity Building Project was properly kept and used in the GS.



Figure 1 Takeo GS



Figure 2 Phase signs on outdoor structure and facility



Figure 3 State of switching devices (Green shows “open” and red shows “close”.)



Figure 4 Control room



Figure 5 Voltage detector

2. Kampot Grid Substation

Kampot Grid Substation (GS) is being constructed by KfW's support. The transmission line from Kamchay hydropower station, which held a ceremony to celebrate the completion in December 2011, is going to be connected to the GS.

Kampot GS is located between Sihanouk Ville and Takeo. The transmission line bound for Sihanouk Ville is being constructed by cooperation loan of JICA and ADB and the transmission line bound for Takeo is being constructed by KfW's support.

There is one transformer, which was made in India, and the voltage ratio is 230kV/22kV and the capacity is 30MVA (ONAN) or 50MVA (ONAF).

Construction of the outdoor facility was almost completed and the cubicle switchgear, in which circuit breakers for 22kV distribution lines are stored, was being installed in the house of the GS.



Figure 6 Kampot GS

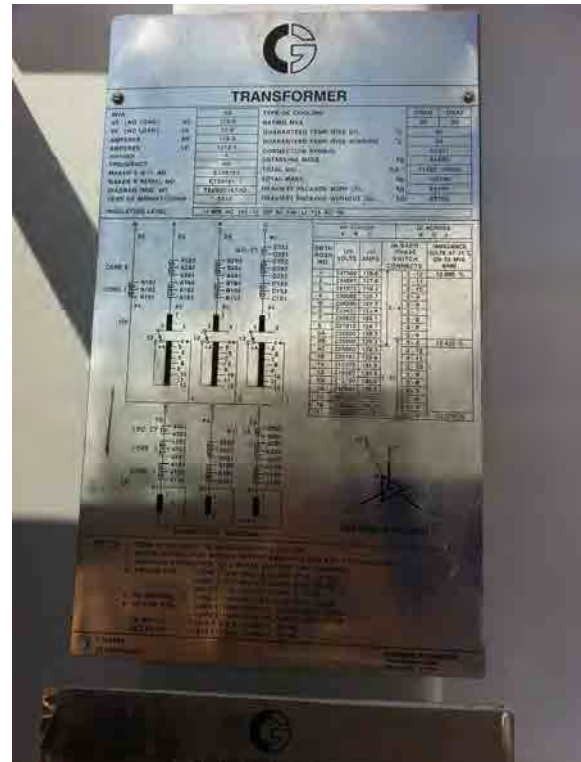


Figure 7 Nameplate of 230/22kV Transformer



Figure 8 Outdoor facility



Figure 9 Cubicle switchgear

3 . Kamchay hydropower plant

(1) Collected information

Period of BOT: 40years

Initial investment cost : 280MUS\$

Commencement of major construction: 18 September 2007

Commencement of operation (first unit): 26 September 2009

Commencement of full operation : December 2011 (Schedule)

Maximum output: 194,100kW

(PH1:60MWx3, PH2:31MWx3+0.8MWx1, PH3:0.4MWx1)

Annual generating power: 493GWh

Total reservoir capacity: 717,300,000m³

Type of a main dam: Concrete gravity RCC

Kamchay hydropower consists of a main power plant (PH1), a re-regulating reservoir power plant (PH2) and a small power plant just downstream of a main dam (PH3). Off-taker of electricity is EDC. PH1 connects to 230kV grid at Kampot S/S. PH2 and PH3 connect to 22kV grid at a local substation. PH2 and PH3 have commenced operation already. PH1 will commence operation in December 2011 (Ceremony is going to be held).

Yearly, Monthly and daily operation schedules must be approved by EDC. Output recorded every hour must be reported too. The yearly operation plan of 2012 has been already submitted to EDC, but not been approved yet.

Trial line charging (230kV) for PH1 is going to be conducted on 28th November and continuing operation. Then, load test (72 hours) for turbine and generator and related equipment will be scheduled.

(2) Result

Leakage water and/or seepage water were not observed at the downstream of the dam. Dam structures and foundation below it seem to be sound.

Facilities related to a main dam seem to be under construction.

Observation on PH1 was not possible because some works were conducted in the powerhouse.

PH2 and PH3 were in operation.



Figure 6 Main Dam and PH3 of Kamchay Hydropower

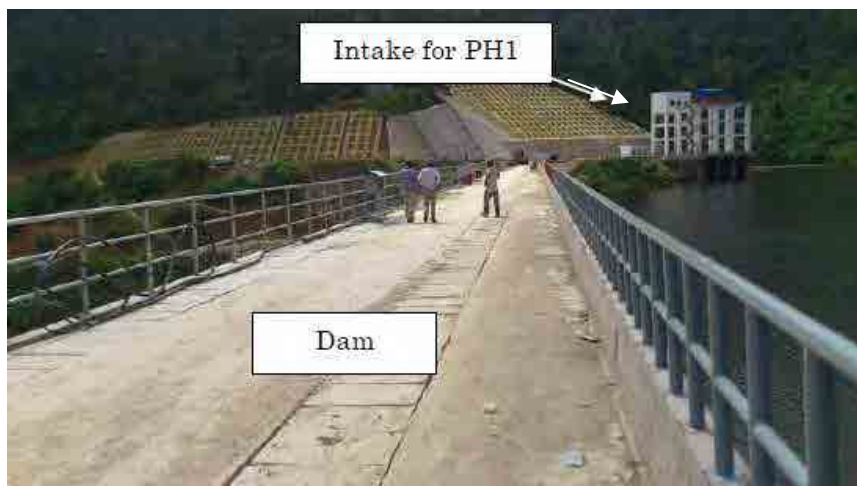


Figure 7 Intake of PH1



Figure 8 Water Level of Main Dam



Figure 9 Downstream



Figure 10 Reservoir of Main Dam of Main Dam



Figure 11 Re-regulating weir for PH1 (Weir for PH2)



Figure 12 Switchyard of PH2



Figure 13 Control room of PH2

Appendix 2

Report of Field Survey 2

1. 230kV Transmission line between Battambang and Phnom Penh and Grid Substations
2. Potential Sites of micro hydropower on Irrigation Systems

Report of Field Survey 2

Date: November 29 to 30, 2011

Participants: Shinohara, Irie and Hamada

1 . 230kV Transmission line between Battambang and Phnom Penh 230kV and Grid Substations

These facilities are being constructing according to the Power Transmission Agreement (PTA) signed on February 16, 2007 between EDC and Yunnan Southeast-Asia Economy and Technology Investment Industrial Co., Ltd. (transferred to Cambodian Power Grid Co., Ltd. (CPG) later). PTA is 25 years duration and BOT project. Table 1 shows the facility list.

Table 1 Facility list

Items	Details
Transmission Line	302km (West Phnom Penh – Kampong Chhnang – Pursat – Battambang), 230kV double circuit 2 x LG630/55 with OPGW
West Phnom Penh GS (GS4)	230kV x 2 circuits
Kampong Chhnang GS	Transformer 25MVA x 1unit (future: 2 units) Capacitor 2.5MVar x 2 units (future: 4 units) 230kV x 4 circuits (future: 5 circuits) 22kV x 4 feeders (future: 8 feeders)
Pursat GS	Transformer 25MVA x 1 unit (future: 2 units) Capacitor 2.5MVar x 2 units (future: 4 units) 230kV x 6 circuits (future: 7 circuits) 22kV x 4 feeders (future: 8 feeders)
Battambang GS	Transformer 230/115kV 90MVA x 1 unit (future: 4 units) Transformer 115/22kV 40MVA x 0 unit (future: 3 units) Capacitor 8MVar x 0 unit (future: 9 units) 230kV x 2 circuits (future: 4 circuits) 115kV x 2 circuits (future: 5 circuits) 22kV x 0 feeder (future: 18 feeders)

(1) Battambang Grid Substation (230kV)

Battambang Grid Substation (GS) is located toward around 11km north from Battambang city along National road no. 5 and the direct distance between it and existing 115/22kV GS constructed by Cambodia Power Transmission Line Co., Ltd. (CPTL) in 2007. As of November 2011, the construction of the GS was almost completed.



Figure 1 Battambang GS



Figure 2 115kV Circuit (Gas Insulated Switch)

(2) 230kV Transmission line

230kV transmission line is located in the west side of National road no. 5. Insulators are made of glass and the top of towers is color-coded into yellow and blue. As far as we can predict, each circuit will be named by the color such as “Yellow circuit” and “Blue circuit”. It will make it for O&M easy to identify each circuit.



Figure 3 230kV Transmission Line



Figure 4 Glass Insulator



Figure 5 Crossing National road No.5



Figure 6 Top of Tower (right: yellow, left: blue)

(3) Pursat GS

Pursat GS is located toward around 10km south from the city. As of November 2011, the construction of the main facilities at GS was completed and the construction of surrounding area and decoration of the building were doing.



Figure 7 Pursat GS



Figure 8 Towers (left: to Phnom Penh, middle: to O'soam, right: to Battambang)

2 . Potential Sites of micro hydropower on Irrigation Systems

(1) Methodology

Based on the document examination and information collected in Japan and Cambodia, candidate hydropower sites on the irrigation systems in the west area of the Tonle Sap Lake were selected and this site survey was conducted. Contents of survey are shown in the following table.

Table 2 Contents of Survey

Items	Methods
Location	Portable GPS
Space for hydropower facilities	Visual observation
Gross head	Convex or Line tape
Discharge	Estimation by Visual observation
Others	Irrigation information: Interview with local residents Land usage around candidate sites: Visual observation

(2) Results

Summary of the results and survey sheets including photos are shown in Attachment 1. Attachment 1 includes the output estimated on assumption that power plants can operate even in dry season. Number of candidate sites surveyed are 16 (sum of maximum output is approx. 390kW). Eight sites of them have the output of more than 10kW (13 – 180kW).

The characteristics of the potential sites are shown below.

- Some Unexploited head which can be used for hydropower were confirmed in the surveyed irrigation systems.
- Location of candidate sites is divided into dam and waterways.
- Because November is the beginning of dry season, reservoir water level is thought to be relatively high and water flow rate be relatively small.
- Water flow rate in dry season may be very small, detailed water flow rate should be measured for hydropower planning.
- The surrounding areas of the candidate sites are not electrified. Hence, the development of candidate sites can promote rural electrification.

Attachment 1: Summary of the results and survey sheets

Result of Site Survey and Prospected Hydropower Potential in Irrigation Systems, as of the End of Preliminary Dispatch to Cambodia

No.	Name	Condition	Province	Sub. Category	Info source ^{*0}	Dimension					Survey result							
						CA	Q	He	η_t	P	Location		Survey date	Q*	C	B	h	H
						km ²	m ³ /s	m	%	kW	X	Y		m ³ /s		m	m	m
1	Wat Tre irrigation weir	Weir Broken	Pursat	West Tonle Sap	JICA Survey 2009		0.03 ^{*1}	1.8 ^{*a}	80%	0.4	362433	1397105	29-Nov-2011	0.01	-	-	-	2.0
2	Moung Russei head works	Broken	Battambang	West Tonle Sap	JICA Survey 2009		0.03 ^{*1}	3.5	80%	0.0	332800	1413160	30-Nov-2011	0.01	-	-	-	3.9
3	Ream Kon irrigation gate	Broken	Battambang	West Tonle Sap	JICA Survey 2009		2.86 ^{*2}	1.5	80%	30.0	332700	1414155	30-Nov-2011	0.01	-	-	-	1.7
4	Po Intake	Broken	Battambang	West Tonle Sap	JICA Survey 2009		2.74 ^{*2}	2.7	80%	58.0	332019	1412909	29-Nov-2011	0.01	-	-	-	3.0
5	Dammak Anpil Weir	Usable MOWRAM 2006	Pursat	West Tonle Sap	JICA Survey 2009	4,480 ^{*0}	5.60 ^{*2}	4.0	80%	180.0	370423	1380719	30-Nov-2011	1.68	-	-	-	4.4
6	Wat Loung Weir	-	Kampong Chuonam	West Tonle Sap	JICA Survey 2009		-	-	-	-	-	-	-	-	-	-	-	-
7	Bos S'am Irrigation Weir	Usable New weir	Pailin	West Tonle Sap	REF 2011		2.03 ^{*1}	2.5	80%	39.8	239846	1434394	29-Nov-2011	0.61	1.84	63.4	0.03	2.8
8	Kamping Puoy Dam	Usable Gate old	Battambang	West Tonle Sap	NEDO		0.37 ^{*1}	4.5	80%	13.1	281093	1446241	29-Nov-2011	0.11	1.84	21.8	0.02	5.0
9	Basak reservir 27-1	Usable JPN 2010	Battambang	West Tonle Sap	NEDO / MOWRAM 2011	598 ^{*0}	0.77 ^{*2}	5.9	80%	35.6	318080	1389957	30-Nov-2011	0.23	-	-	-	6.6
10	Moung Russei irrigation gate 1	Usable	Battambang	West Tonle Sap	New		0.03	0.8	80%	0.2	334558	1396349	30-Nov-2011	0.01	-	-	-	0.9
11	Moung Russei irrigation gate 2	Usable	Battambang	West Tonle Sap	New		0.03	0.9	80%	0.2	331379	1396984	30-Nov-2011	0.01	-	-	-	1.0
12	Moung Russei irrigation gate 3	Usable	Battambang	West Tonle Sap	New		0.03	1.8	80%	0.4	328453	1397589	30-Nov-2011	0.01	-	-	-	2.0
13	Moung Russei irrigation gate 4-1	Usable	Battambang	West Tonle Sap	New		0.00	0.0	80%	0.0	325383	1398377	30-Nov-2011		-	-	-	
14	Moung Russei irrigation gate 4-2	Usable	Battambang	West Tonle Sap	New		0.73	2.9	80%	16.6	325458	1398375	30-Nov-2011	0.22	-	-	-	3.2
15	Moung Russei irrigation gate 4-3	Usable	Battambang	West Tonle Sap	New		0.03	0.9	80%	0.2	325475	1398181	30-Nov-2011	0.01	-	-	-	1.0
16	Moung Russei irrigation gate 4-4	Gate removed	Battambang	West Tonle Sap	New		0.03	0.1	80%	0.0	325399	1398222	30-Nov-2011	0.01	-	-	-	0.1
17	Moung Russei irrigation gate 5	Usable	Battambang	West Tonle Sap	New		4.00	0.5	80%	15.7	324988	1398218	30-Nov-2011	1.20	-	-	-	0.5
	--Potential Sites--																	
18	Batheay Irrigation 25-1	KR 2010		Near Phnm Penh	MOWRAM 2011													
19	Stung Tas Sal 25-2	IND Under prep.	Kampong Spue	Near Phnm Penh	MOWRAM 2011	495 ^{*0}	9.00 ^{*3}	13.6		750.0	398271	1289862	-	-	-	-	-	17.0
20	Tamouk Reservoir 34-3	KR 2004		Near Phnm Penh	MOWRAM 2011													
21	Kandar Stung 34-1	JPN 2007		Near Phnm Penh	MOWRAM 2011													
22	Krang Ponley Water Resources Development	Interview	Kampong Chhunang or Kampong															
	Total				Total					1,140.2								

*0 JICA Survey 2009: Master Plan of Rehabilitation of Irrigation and Drainage System, JICA, 2009

REF 2011: Interview with REF, November 2011

NEDO: Renewable Energy Master Plan Study, 2004

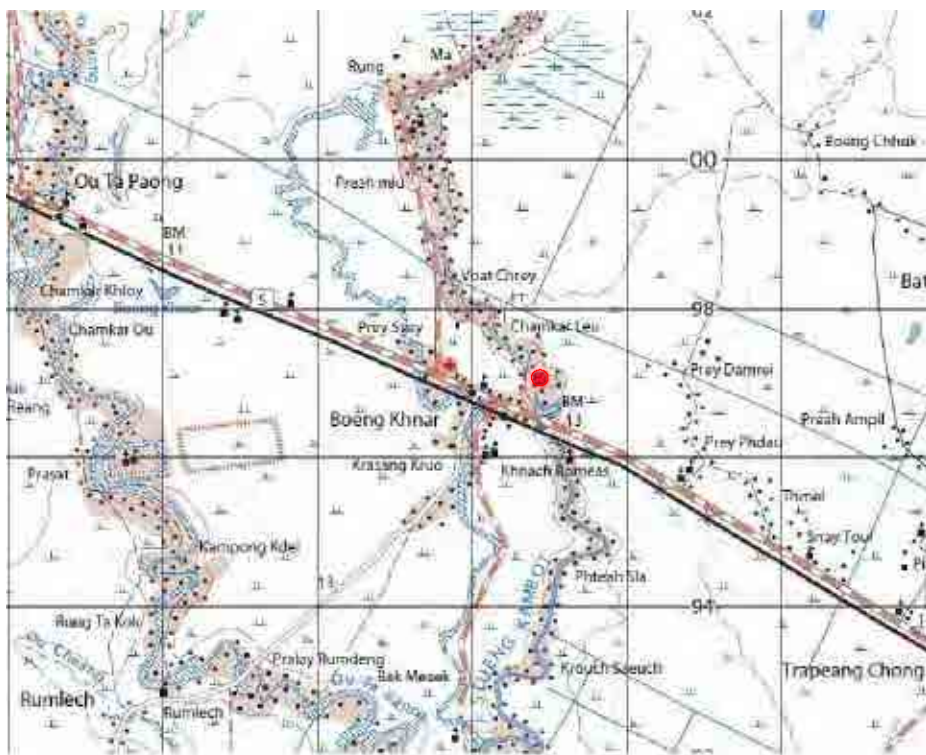
MOWRAM 2011: Interview with MOWRAM, November and December 2011

New: Found during the site survey

*1 River flow rate estimated in the site survey of the JICA Team in December x (100% / 30%) on 29 - 30 November 2011.







*2 Maximum Design flow of irrigation canal shown in existing report.

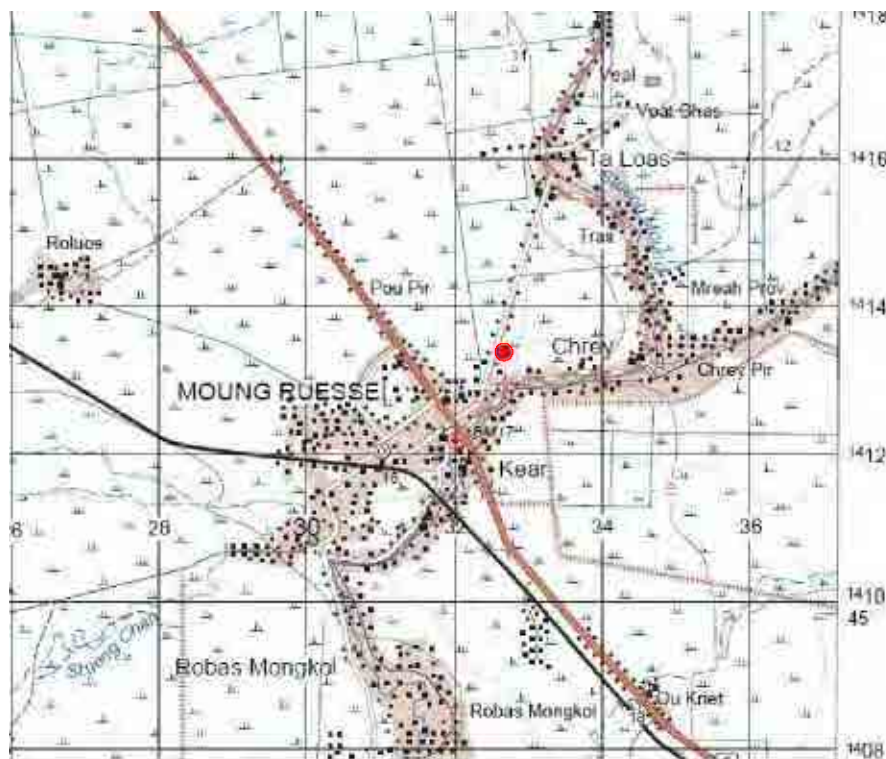
*3 Design Engineering Report STUNG TASCAL DAM PROJECT, APCOS, 2008



Result of site survey			
Observation Date	Year 2011 Mon 11 Date 29		
Observer	Mesure	Akira Irie	
name	Wrote	Takayuki Hamada	
Weather	Weather	1:clear, 2:fine, 3:cloudy, 4:rain	
	Wind	blows from	Down/s, Up/s, Left, Right
	Wind power	0:None, 1:light, 2:windy, 3:strong, 4:very strong	
Result	Obs. Discharge (m ³ /s)	0.01	
	Total area cross section (m ²)	-	
	Average Velocity (m/s)	-	
	Catchment Area (km ²)	-	
	Specific Q (m ³ /s/km ²)	-	
Measurement Site :			
Site Coordinate (GPS) (Garmin Datum: Indian-Thai)			
X	362433	Elevation (m) :	by GPS 15 m
Y	1397105	(accuracy):	by Alt. m
Gross Head	1.8 m (Source: JICA Study Team, Obs.)		
Design Q	see Summary	m ³ /s	
Estimated P	see Summary	kW (h =)	




SCHEME NAME (ID)	Wat Tre irrigation weir	
PROVIDENCE	Pursat	Notes)
RIVER NAME	STUENG KAMBOT	Weir seems to be broken and was not observed.
CATCHMENT AREA(km ²)	-	Right bank is preferable for a powerhouse space considering the existing gates.
EFFECTIVE HEAD (m)	1.8	Access road is not paved.
DRYSEASON DISCHARGE(m ³ /s)	0.03	Water flow velocity cannot estimated because it is too small.
DRYSEASON MAXIMUM OUTPUT(kW)	0.5	
Electrification condition of Households (Nos.)		
Map No.	5734	

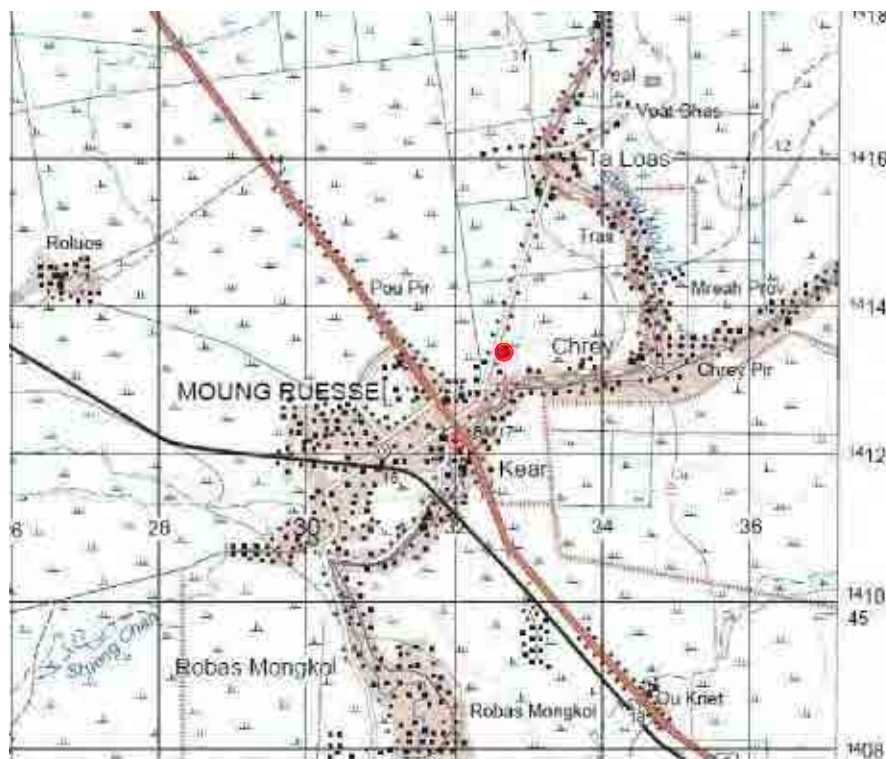
SCHEME NAME (ID)	Wat Tre irrigation weir		Photo Date	Year 2011 Mon 11 Date 29
 <p data-bbox="405 592 546 616">From upstream</p>	 <p data-bbox="1055 592 1218 616">From downstream</p>	 <p data-bbox="1720 592 1827 616">Intake area</p>		
 <p data-bbox="416 1038 535 1062">To upstream</p>	 <p data-bbox="1066 1038 1207 1062">To downstream</p>	 <p data-bbox="1644 1038 1901 1062">Powerhouse and outlet area</p>		
			<p data-bbox="1077 1414 1151 1437">Others:</p>	



Result of site survey				
Observation Date	Year 2011 Mon 11 Date 30			
Observer	Mesure	Akira Irie		
name	Wrote	Takayuki Hamada		
Weather	Weather	1:clear, 2:fine, 3:cloudy, 4:rain		
	Wind	blows from	Down/s,	Up/s, Left, Right
	Wind power	0:None, 1:light, 2:windy, 3:strong, 4:very strong		
Result	Obs. Discharge (m ³ /s)	-		
	Total area cross section (m ²)	-		
	Average Velocity (m/s)	-		
	Catchment Area (km ²)	-		
	Specific Q (m ³ /s/km ²)	-		
Measurement Site :				
Site Coordinate (GPS) (Garmin Datum: Indian-Thai)				
X	332800	Elevation (m) :	by GPS	16 m
Y	1413160	(accuracy):	by Alt.	m
Gross Head	3.5 m (Source: JICA Study Team, Obs.)			
Design Q	see Summary	m ³ /s		
Estimated P	see Summary	kW (h =)		






SCHEME NAME (ID)	Moung Russei head works		
PROVIDENCE	Pursat	Notes)	
RIVER NAME	STUENG MOUNG	Gates are removed.	
CATCHMENT AREA(km ²)	-	Power house can be installed on right or left banks of the dam (Right bank is preferable because road is located in left bank).	
EFFECTIVE HEAD (m)	3.5	Crest of the weir is used as a bridge.	
DRYSEASON DISCHARGE(m ³ /s)	0.03	Waterway upstream of the weir is used as a paddy field.	
DRYSEASON MAXIMUM OUTPUT(kW)	0	Access road is not paved.	
Electrification condition of Households (Nos.)		Water flow velocity cannot estimated because it is too small	
Map No.	5634		

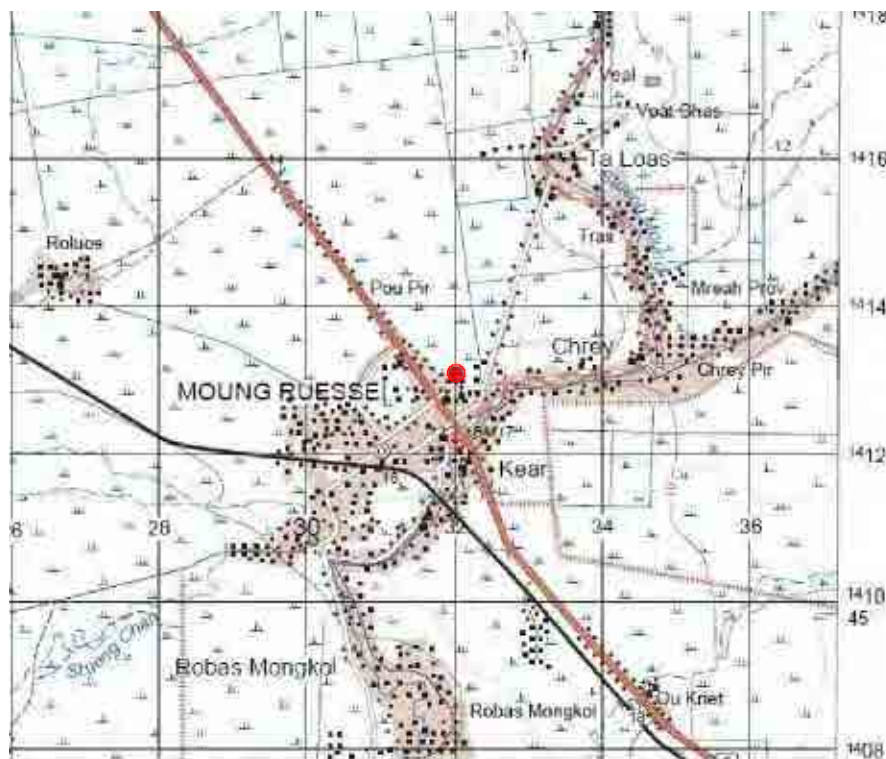
SCHEME NAME (ID)	Moung Russei head works		Photo Date	Year 2011 Mon 11 Date 30	
					
From upstream	From downstream	Intake area			
					
To upstream	To downstream	Powerhouse and outlet area			
					
	Others:				



Result of site survey				
Observation Date	Year 2011 Mon 11 Date 30			
Observer	Mesure	Akira Irie		
name	Wrote	Takayuki Hamada		
Weather	Weather	1:clear, 2:fine, 3:cloudy, 4:rain		
	Wind	blows from	Down/s,	Up/s, Left, Right
	Wind power	0:None, 1:light, 2:windy, 3:strong, 4:very strong		
Result	Obs. Discharge (m ³ /s)	-		
	Total area cross section (m ²)	-		
	Average Velocity (m/s)	-		
	Catchment Area (km ²)	-		
	Specific Q (m ³ /s/km ²)	-		
Measurement Site :				
Site Coordinate (GPS) (Garmin Datum: Indian-Thai)				
X	332700	Elevation (m) :	by GPS	13 m
Y	1414155	(accuracy):	by Alt.	m
Gross Head	1.5 m (Source: JICA Study Team, Obs.)			
Design Q	see Summary	m ³ /s		
Estimated P	see Summary	kW (h =)		








SCHEME NAME (ID)	Ream Kon irrigation gate	
PROVIDENCE	Pursat	Notes
RIVER NAME	STUENG MOUNG	Weir and gates are broken.
CATCHMENT AREA(km ²)	-	Power house can be installed on right or left banks of the dam.
EFFECTIVE HEAD (m)	1.5	Weir area seems to become a recreation spot.
DRYSEASON DISCHARGE(m3/s)	0.03	Access road is not paved.
DRYSEASON MAXIMUM OUTPUT(kW)	0	Some people are bothing.
Electrification condition of Households (Nos.)		Water flow velocity cannot estimated because it is too small.
Map No.	5634	

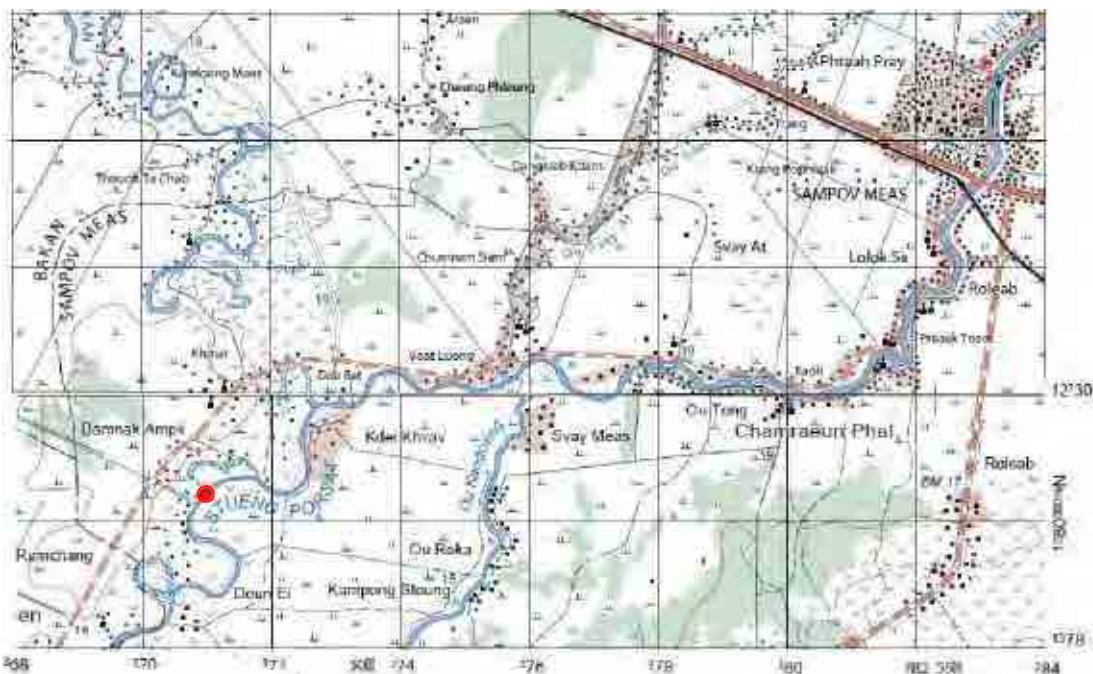
SCHEME NAME (ID)	Ream Kon irrigation gate		Photo Date	Year 2011 Mon 11 Date 30
 <p data-bbox="405 592 546 616">From upstream</p>	 <p data-bbox="1055 592 1218 616">From downstream</p>	 <p data-bbox="1720 592 1827 616">Intake area</p>		
 <p data-bbox="416 1038 535 1062">To upstream</p>	 <p data-bbox="1066 1038 1211 1062">To downstream</p>	 <p data-bbox="1644 1038 1906 1062">Powerhouse and outlet area</p>		
<p data-bbox="1077 1414 1151 1437">Others:</p>				



Result of site survey				
Observation Date	Year 2011 Mon 11 Date 29			
Observer	Mesure	Akira Irie		
name	Wrote	Takayuki Hamada		
Weather	Weather	①:clear, 2:fine, 3:cloudy, 4:rain		
	Wind	blows from	Down/s,	Up/s, Left, Right
	Wind power	①:None, 1:light, 2:windy, 3:strong, 4:very strong		
Result	Obs. Discharge (m ³ /s)	-		
	Total area cross section (m ²)	-		
	Average Velocity (m/s)	-		
	Catchment Area (km ²)	-		
	Specific Q (m ³ /s/km ²)	-		
Measurement Site :				
Site Coordinate (GPS) (Garmin Datum: Indian-Thai)				
X	332019	Elevation (m) :	by GPS	13 m
Y	1412909	(accuracy):	by Alt.	m
Gross Head	2.7 m (Source: JICA Study Team, Obs.)			
Design Q	see Summary	m ³ /s		
Estimated P	see Summary	kW (h =)		

SCHEME NAME (ID)	Po Intake		
PROVIDENCE	Pursat	Notes)	
RIVER NAME	STUENG MOUNG	Gate is broken.	
CATCHMENT AREA(km ²)	-	Power house can be installed on right or left banks of the dam (Right bank is preferable because operation building is located in left bank)..	
EFFECTIVE HEAD (m)	2.7	Access road is not paved.	
DRYSEASON DISCHARGE(m ³ /s)	0.03	Some people are bathing.	
DRYSEASON MAXIMUM OUTPUT(kW)	0.7	Ground of both sides is caved.	
Electrification condition of Households (Nos.)		Water flow velocity cannot estimated because it is too small.	
Map No.	5634		

SCHEME NAME (ID)	Po Intake		Photo Date	Year 2011 Mon 11 Date 29
				
From upstream	From downstream	Intake area		
				
To upstream	To downstream	Powerhouse and outlet area		
	Others:			



Result of site survey			
Observation Date	Year 2011 Mon 11 Date 30		
Observer	Mesure	Akira Irie	
name	Wrote	Takayuki Hamada	
Weather	Weather	1:clear, 2:fine, 3:cloudy, 4:rain	
	Wind	blows from	Down/s, Up/s, Left, Right
	Wind power	0:None, 1:light, 2:windy, 3:strong, 4:very strong	
Result	Obs. Discharge (m ³ /s)	-	
	Total area cross section (m ²)	-	
	Average Velocity (m/s)	-	
	Catchment Area (km ²)	-	
	Specific Q (m ³ /s/km ²)	-	
Result			
Measurement Site :			
Site Coordinate (GPS) (Garmin Datum: Indian-Thai)			
X	370423	Elevation (m) :	by GPS 26 m
Y	1380719	(accuracy):	by Alt. m
Gross Head	4 m (Source: JICA Study Team, Obs.)		
Design Q	see Summary	m ³ /s	
Estimated P	see Summary	kW (h =)	










SCHEME NAME (ID)	Damnak Ampil Weir		
PROVIDENCE	Pursat	Notes)	
RIVER NAME	STUENG PORSAT	Irrigation dam completed in 2006 by MOWRAM.	
CATCHMENT AREA(km ²)	4,480	Power house can be installed on right or left banks of the dam (Right bank is preferable because operation building is located in left bank)..	
EFFECTIVE HEAD (m)	4	Weir area seems to become a recreation spot.	
DRYSEASON DISCHARGE(m3/s)		Access road is not paved.	
DRYSEASON MAXIMUM OUTPUT(kW)		Some fishery people is observed.	
Electrification condition of Households (Nos.)		Water flow velocity cannot be estimated because the river width is too large.	
Map No.	5733 5734		

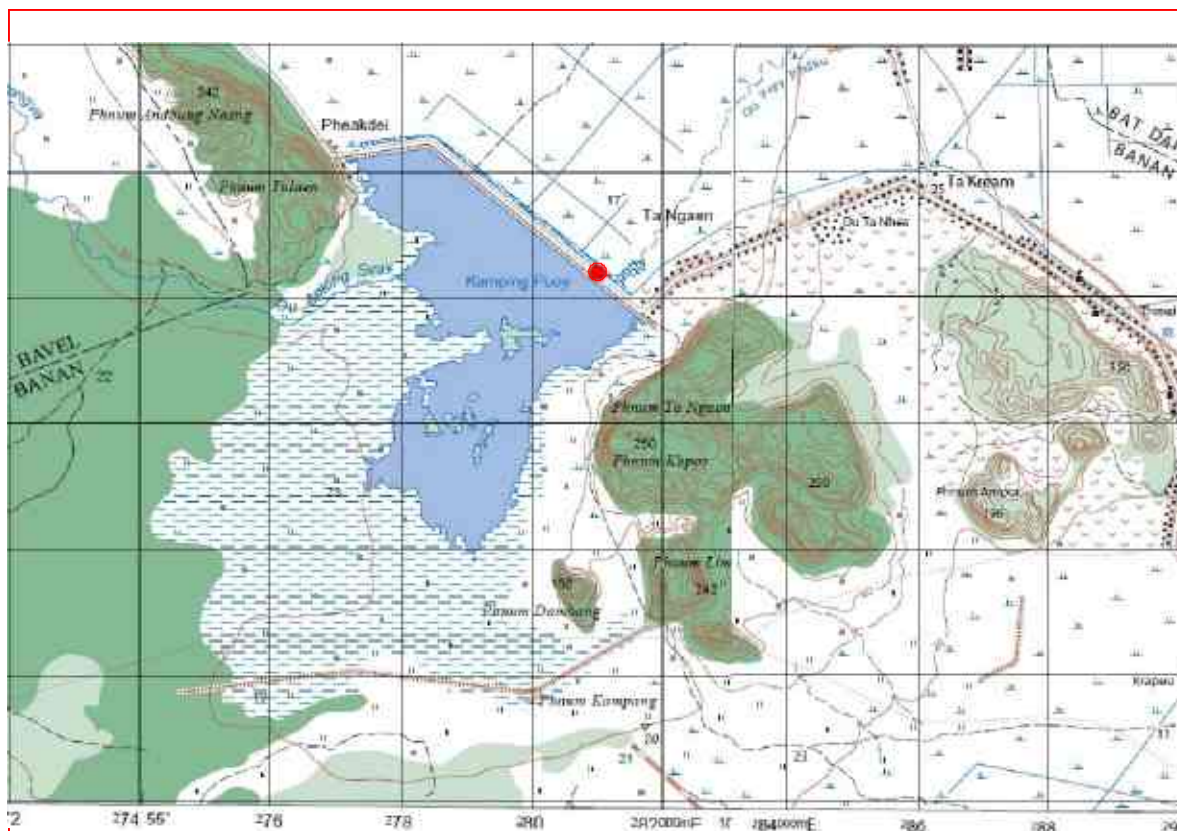
SCHEME NAME (ID)	Damnak Anpil Weir		Photo Date	Year 2011 Mon 11 Date 30	
 <p data-bbox="405 592 546 616">From upstream</p>	 <p data-bbox="1055 592 1218 616">From downstream</p>	 <p data-bbox="1720 592 1827 616">Intake area</p>			
 <p data-bbox="416 1038 535 1062">To upstream</p>	 <p data-bbox="1066 1038 1211 1062">To downstream</p>	 <p data-bbox="1641 1038 1906 1062">Powerhouse and outlet area</p>			
 <p data-bbox="1077 1414 1151 1437">Others:</p>					



Result of site survey			
Observation Date	Year 2011 Mon 11 Date 29		
Observer	Mesure	Akira Irie	
name	Wrote	Takayuki Hamada	
Weather	Weather	1:clear, 2:fine, 3:cloudy, 4:rain	
	Wind	blows from Down/s, Up/s, Left, Right	
	Wind power	0:None, 1:light, 2:windy, 3:strong, 4:very strong	
Result	Obs. Discharge (m ³ /s)	0.33	
	Total area cross section (m ²)	63.4(B) * 0.02(h) = 1.268	
	Average Velocity (m/s)	-	
	Catchment Area (km ²)	-	
	Specific Q (m ³ /s/km ²)	-	
Measurement Site :			
Site Coordinate (GPS) (Garmin Datum: Indian-Thai)			
X	239846	Elevation (m) :	by GPS 101 m
Y	1434394	(accuracy):	by Alt. m
Gross Head	2.5 m (Source: JICA Study Team, Obs.)		
Design Q	see Summary	m ³ /s	
Estimated P	see Summary	kW (h =)	

SCHEME NAME (ID)	Bos S'am Irrigation Weir	
PROVIDENCE	Pailin	<p>Notes)</p> <p>Irrigation dam completed in 2006.</p> <p>Power house can be installed on right or left banks of the dam (Left bank is preferable because waterway is shorter)..</p> <p>Weir area seems to become a recreation spot.</p> <p>Access road is almost paved.</p> <p>Water flow rate was estimated with the depth and length of overflow section.</p>
RIVER NAME	STUENG PAILIN	
CATCHMENT AREA(km ²)	-	
EFFECTIVE HEAD (m)	2.5	
DRYSEASON DISCHARGE(m ³ /s)	1.1	
DRYSEASON MAXIMUM OUTPUT(kW)	24.3	
Electrification condition of Households (Nos.)		
Map No.	5534	

SCHEME NAME (ID)	Bos S'am Irrigation Weir		Photo Date	Year 2011 Mon 11 Date 29
				
From upstream	From downstream	Intake area		
				
To upstream	To downstream	Powerhouse and outlet area		
				
	Others:			






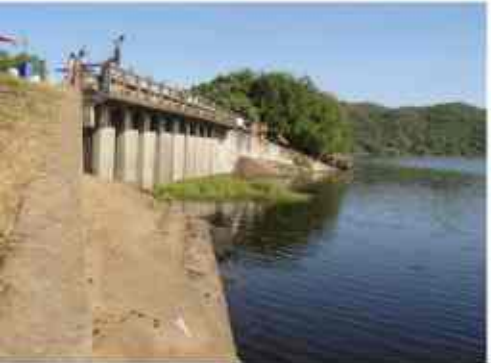





Result of site survey	
Observation Date	Year 2011 Mon 11 Date 29
Observer	Mesure Akira Irie
name	Wrote Takayuki Hamada
Weather	Weather 1:clear, 2:fine, 3:cloudy, 4:rain
	Wind blows from Down/s, Up/s, Left, Right
	Wind power 0:None, 1:light, 2:windy, 3:strong, 4:very strong
Result	Obs. Discharge (m ³ /s) 0.13
	Total area cross section (m ²) 21.8(B) * 0.01(h) = 0.022
	Average Velocity (m/s) -
	Catchment Area (km ²) -
	Specific Q (m ³ /s/km ²) -

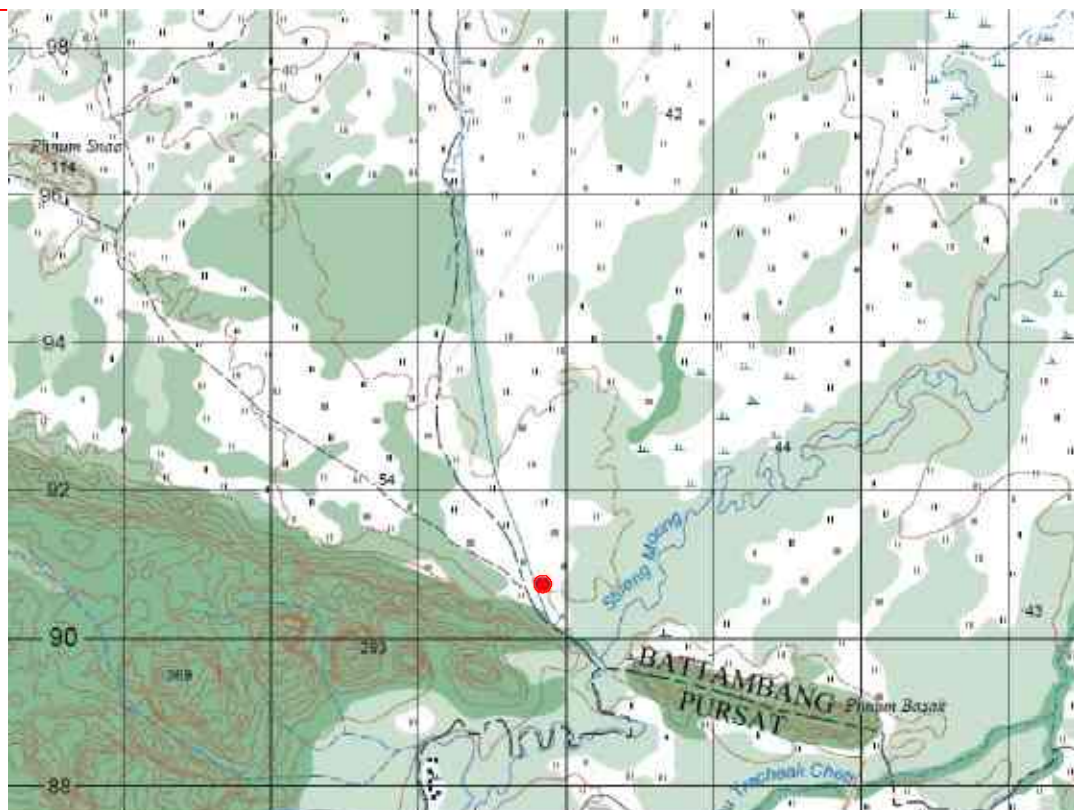
Measurement Site :

Site Coordinate (GPS) (Garmin Datum: Indian-Thai)

X	281093	Elevation (m) :	by GPS	39 m
Y	1446241	(accuracy):	by Alt.	m
Gross Head	4.5 m (Source: JICA Study Team, Obs.)			
Design Q	see Summary	m ³ /s		
Estimated P	see Summary	kW (h =)		










SCHEME NAME (ID)	Kamping Puoy Dam	
PROVIDENCE	Battambang	Notes
RIVER NAME	Ou prey Phdau	Irrigation dam completed in 2006.
CATCHMENT AREA(km ²)	345	Power house can be installed on right or left banks of the dam.
EFFECTIVE HEAD (m)	4.5	Both ends gates of 8 gates were closed. The hydropower plan using these gates may be possible.
DRYSEASON DISCHARGE(m3/s)	0.13	Weir area seems to be a recreation spot.
DRYSEASON MAXIMUM OUTPUT(kW)	5.2	Access road is paved.
Electrification condition of Households (Nos.)		Water flow rate was estimated with the depth and length of overflow section.
Map No.	5535 5635	

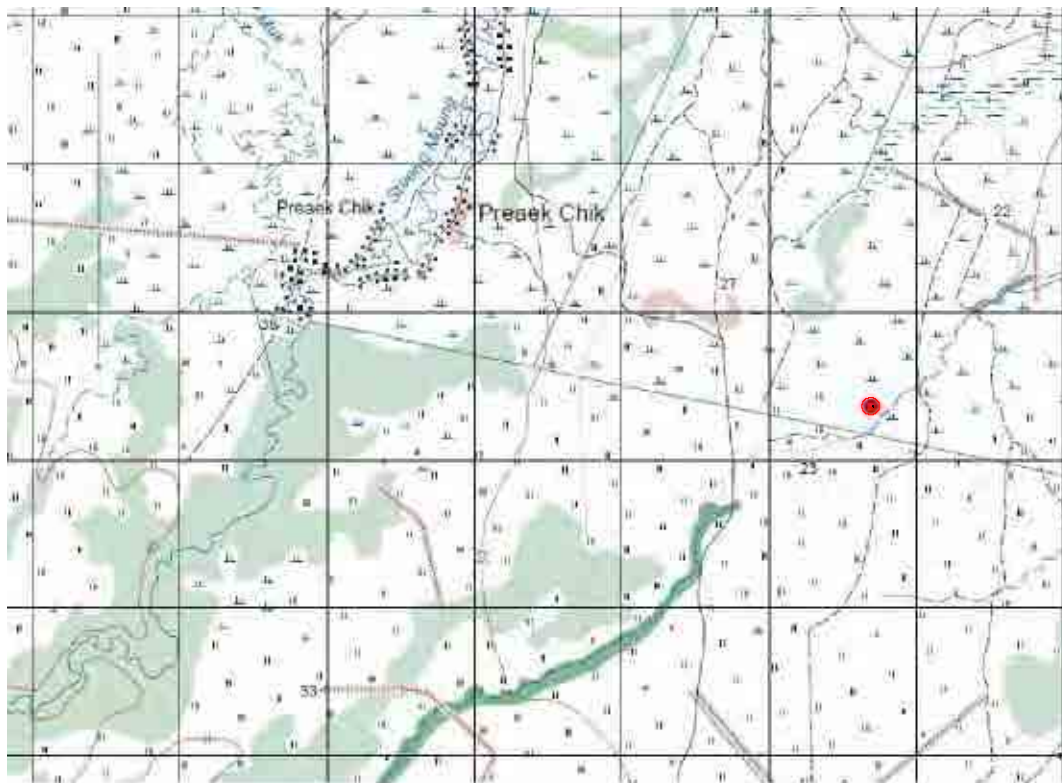
SCHEME NAME (ID)	Kamping Puoy Dam		Photo Date	Year 2011 Mon 11 Date 29
 <p data-bbox="405 592 544 616">From upstream</p>	 <p data-bbox="1055 592 1220 616">From downstream</p>	 <p data-bbox="1720 592 1827 616">Intake area</p>		
 <p data-bbox="416 1038 533 1062">To upstream</p>	 <p data-bbox="1066 1038 1205 1062">To downstream</p>	 <p data-bbox="1641 1038 1901 1062">Powerhouse and outlet area</p>		
	 <p data-bbox="1077 1414 1149 1437">Others:</p>			



Result of site survey				
Observation Date	Year 2011 Mon 11 Date 30			
Observer	Mesure	Akira Irie		
name	Wrote	Takayuki Hamada		
Weather	Weather	1:clear, 2:fine, 3:cloudy, 4:rain		
	Wind	blows from	Down/s,	Up/s, Left, Right
	Wind power	0:None, 1:light, 2:windy, 3:strong, 4:very strong		
Result	Obs. Discharge (m ³ /s)	-		
	Total area cross section (m ²)	-		
	Average Velocity (m/s)	-		
	Catchment Area (km ²)	-		
	Specific Q (m ³ /s/km ²)	-		
Measurement Site :				
Site Coordinate (GPS) (Garmin Datum: Indian-Thai)				
X	318080	Elevation (m) :	by GPS	51 m
Y	1389957	(accuracy):	by Alt.	m
Gross Head	5.9 m (Source: JICA Study Team, Obs.)			
Design Q	see Summary	m ³ /s		
Estimated P	see Summary	kW (h =)		

SCHEME NAME (ID)	Basak reservir 27-1	
PROVIDENCE	Battambang	(Notes) Irrigation dam completed in 2010 supported by Japan. Power house can be installed on both banks of the dam. Access road is not paved. Water flow rate was estimated with the depth and length of overflow section.
RIVER NAME	STUENG MOUNG	
CATCHMENT AREA(km ²)	598	
EFFECTIVE HEAD (m)	5.9	
DRYSEASON DISCHARGE(m3/s)	0.23	
DRYSEASON MAXIMUM OUTPUT(kW)	12	
Electrification condition of Households (Nos.)		
Map No.	5634	

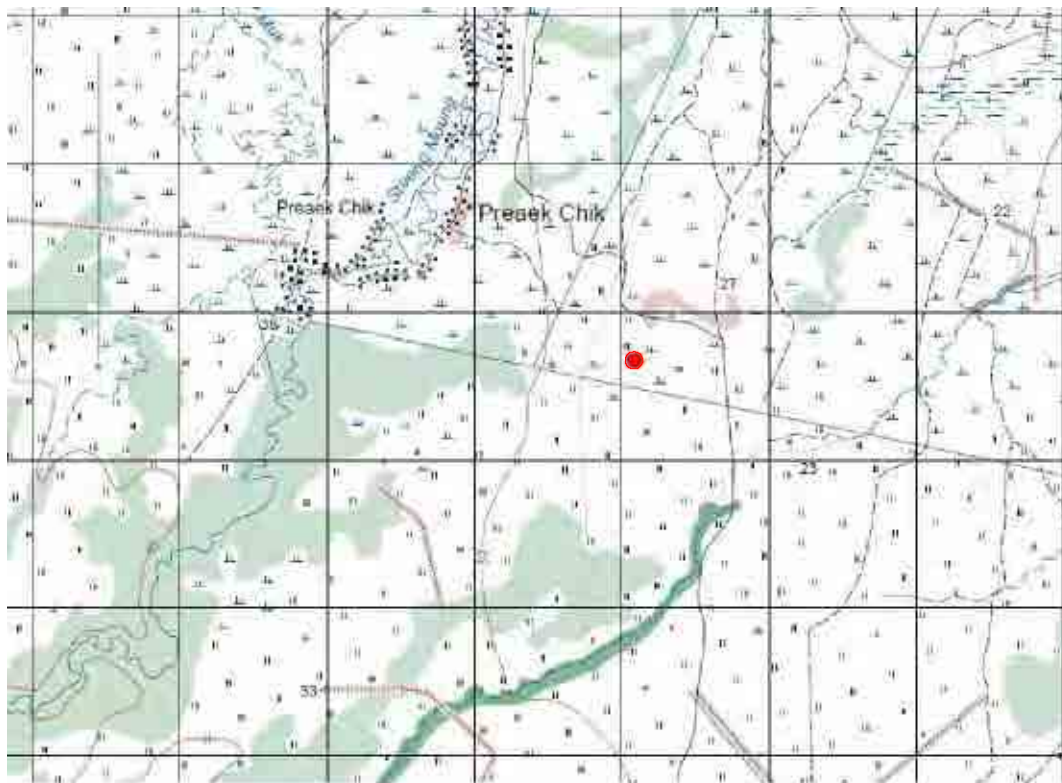
SCHEME NAME (ID)	Basak reservir 27-1		Photo Date	Year 2011 Mon 11 Date 30	
 <p data-bbox="405 592 546 616">From upstream</p>	 <p data-bbox="1055 592 1218 616">From downstream</p>	 <p data-bbox="1720 592 1827 616">Intake area</p>			
 <p data-bbox="416 1038 533 1062">To upstream</p>	 <p data-bbox="1066 1038 1205 1062">To downstream</p>	 <p data-bbox="1644 1038 1899 1062">Powerhouse and outlet area</p>			
	 <p data-bbox="1077 1414 1151 1437">Others:</p>				



Result of site survey			
Observation Date	Year 2011 Mon 11 Date 30		
Observer	Mesure	Akira Irie	
name	Wrote	Takayuki Hamada	
Weather	Weather	①:clear, 2:fine, 3:cloudy, 4:rain	
	Wind	blows from	Down/s, Up/s, Left, Right
	Wind power	①:None, 1:light, 2:windy, 3:strong, 4:very strong	
Result	Obs. Discharge (m ³ /s)	-	
	Total area cross section (m ²)	-	
	Average Velocity (m/s)	-	
	Catchment Area (km ²)	-	
	Specific Q (m ³ /s/km ²)	-	
Measurement Site :			
Site Coordinate (GPS) (Garmin Datum: Indian-Thai)			
X	334558	Elevation (m) :	by GPS 31 m
Y	1396349	(accuracy):	by Alt. m
Gross Head	0.8 m (Source: JICA Study Team, Obs.)		
Design Q	see Summary	m ³ /s	
Estimated P	see Summary	kW (h =)	

SCHEME NAME (ID)	Moug Russei irrigation gate 1	
PROVIDENCE	Battambang	(Notes) One of the gates on the irrigation canal. Space for the power house is paddy field or road. Access road is not paved. Water flow velocity cannot be estimated because it is too small.
RIVER NAME	STUENG MOUNG	
CATCHMENT AREA(km ²)	-	
EFFECTIVE HEAD (m)	0.8	
DRYSEASON DISCHARGE(m ³ /s)	0.03	
DRYSEASON MAXIMUM OUTPUT(kW)	0.2	
Electrification condition of Households (Nos.)		
Map No.	5634	

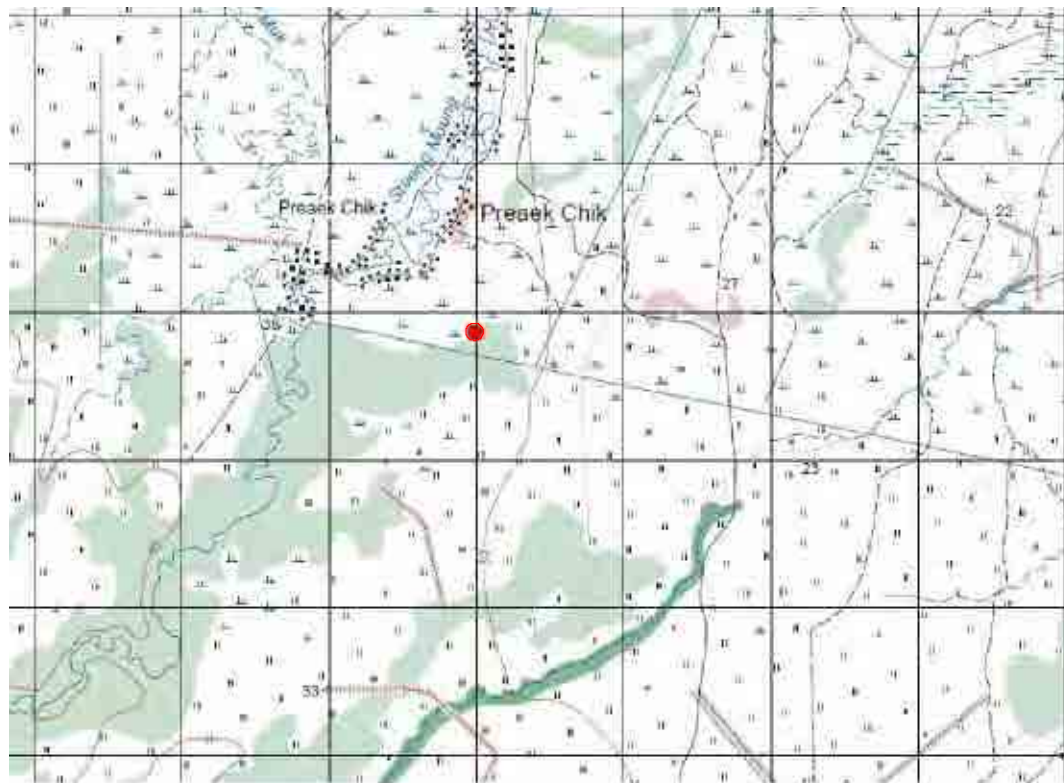
SCHEME NAME (ID)	Moung Russei irrigation gate 1	Photo Date	Year 2011 Mon 11 Date 30
 <p data-bbox="405 592 544 616">From upstream</p>	 <p data-bbox="1055 592 1216 616">From downstream</p>	<p data-bbox="1720 592 1827 616">Intake area</p>	
 <p data-bbox="416 1038 537 1062">To upstream</p>	 <p data-bbox="1066 1038 1209 1062">To downstream</p>	<p data-bbox="1641 1038 1901 1062">Powerhouse and outlet area</p>	
<p data-bbox="1072 1414 1151 1437">Others:</p>			



Result of site survey			
Observation Date	Year 2011 Mon 11 Date 30		
Observer	Mesure	Akira Irie	
name	Wrote	Takayuki Hamada	
Weather	Weather	①:clear, 2:fine, 3:cloudy, 4:rain	
	Wind	blows from	Down/s, Up/s, Left, Right
	Wind power	①:None, 1:light, 2:windy, 3:strong, 4:very strong	
Result	Obs. Discharge (m ³ /s)	-	
	Total area cross section (m ²)	-	
	Average Velocity (m/s)	-	
	Catchment Area (km ²)	-	
	Specific Q (m ³ /s/km ²)	-	
Measurement Site :			
Site Coordinate (GPS) (Garmin Datum: Indian-Thai)			
X	331379	Elevation (m) :	by GPS 33 m
Y	1396984	(accuracy):	by Alt. m
Gross Head	0.9 m (Source: JICA Study Team, Obs.)		
Design Q	see Summary	m ³ /s	
Estimated P	see Summary	kW (h =)	


SCHEME NAME (ID)	Moug Russei irrigation gate 2	
PROVIDENCE	Battambang	Notes) One of the gates on the irrigation canal. Space for the power house is paddy field or road. Access road is not paved. Water flow velocity cannot be estimated because it is too small.
RIVER NAME	STUENG MOUNG	
CATCHMENT AREA(km ²)	-	
EFFECTIVE HEAD (m)	0.9	
DRYSEASON DISCHARGE(m ³ /s)	0.03	
DRYSEASON MAXIMUM OUTPUT(kW)	0.2	
Electrification condition of Households (Nos.)		
Map No.	5634	

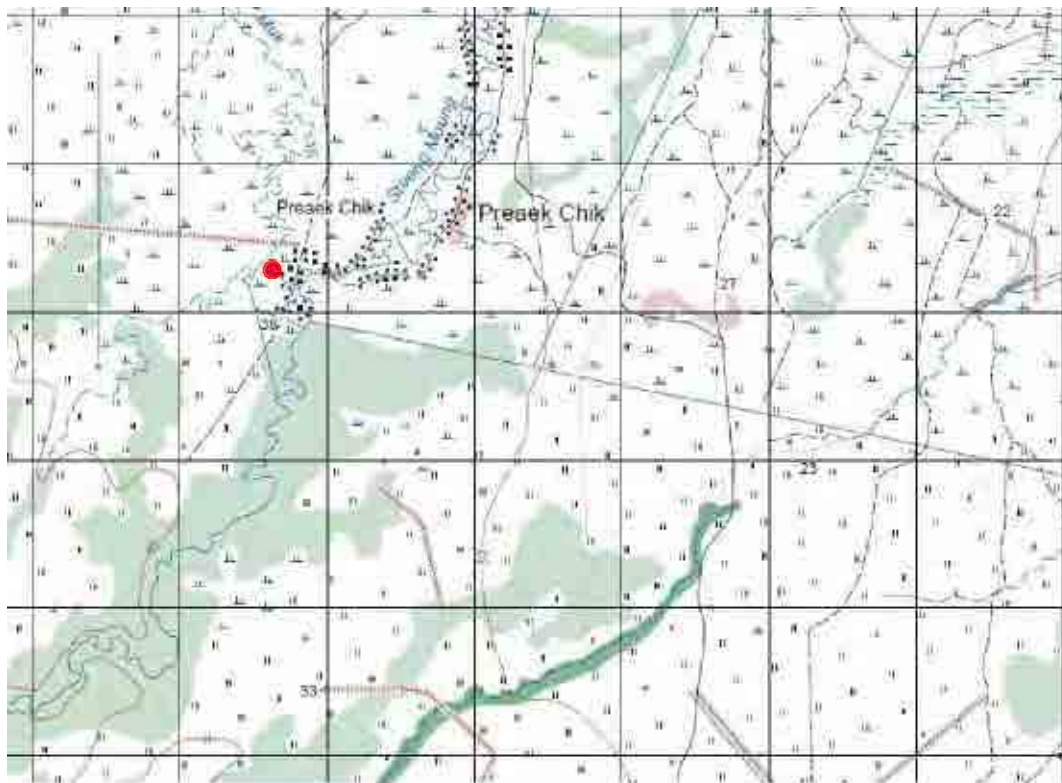
SCHEME NAME (ID)	Moung Russei irrigation gate 2	Photo Date	Year 2011 Mon 11 Date 30
 <p data-bbox="405 592 551 616">From upstream</p>	 <p data-bbox="1055 592 1223 616">From downstream</p>	<p data-bbox="1720 592 1827 616">Intake area</p>	
 <p data-bbox="416 1038 539 1062">To upstream</p>	 <p data-bbox="1066 1038 1211 1062">To downstream</p>	<p data-bbox="1641 1038 1906 1062">Powerhouse and outlet area</p>	
<p data-bbox="1072 1414 1151 1437">Others:</p>			



Result of site survey			
Observation Date	Year 2011 Mon 11 Date 30		
Observer	Mesure	Akira Irie	
name	Wrote	Takayuki Hamada	
Weather	Weather	①:clear, 2:fine, 3:cloudy, 4:rain	
	Wind	blows from	Down/s, Up/s, Left, Right
	Wind power	①:None, 1:light, 2:windy, 3:strong, 4:very strong	
Result	Obs. Discharge (m ³ /s)	-	
	Total area cross section (m ²)	-	
	Average Velocity (m/s)	-	
	Catchment Area (km ²)	-	
	Specific Q (m ³ /s/km ²)	-	
Measurement Site :			
Site Coordinate (GPS) (Garmin Datum: Indian-Thai)			
X	328453	Elevation (m) :	by GPS 35 m
Y	1397589	(accuracy):	by Alt. m
Gross Head	1.8 m (Source: JICA Study Team, Obs.)		
Design Q	see Summary	m ³ /s	
Estimated P	see Summary	kW (h =)	





SCHEME NAME (ID)	Moug Russei irrigation gate 3	
PROVIDENCE	Battambang	(Notes) One of the gates on the irrigation canal. Space for the power house is paddy field or road. Access road is not paved. Water flow velocity cannot be estimated because it is too small.
RIVER NAME	STUENG MOUNG	
CATCHMENT AREA(km ²)	-	
EFFECTIVE HEAD (m)	1.8	
DRYSEASON DISCHARGE(m ³ /s)	0.03	
DRYSEASON MAXIMUM OUTPUT(kW)	0.5	
Electrification condition of Households (Nos.)		
Map No.	5634	

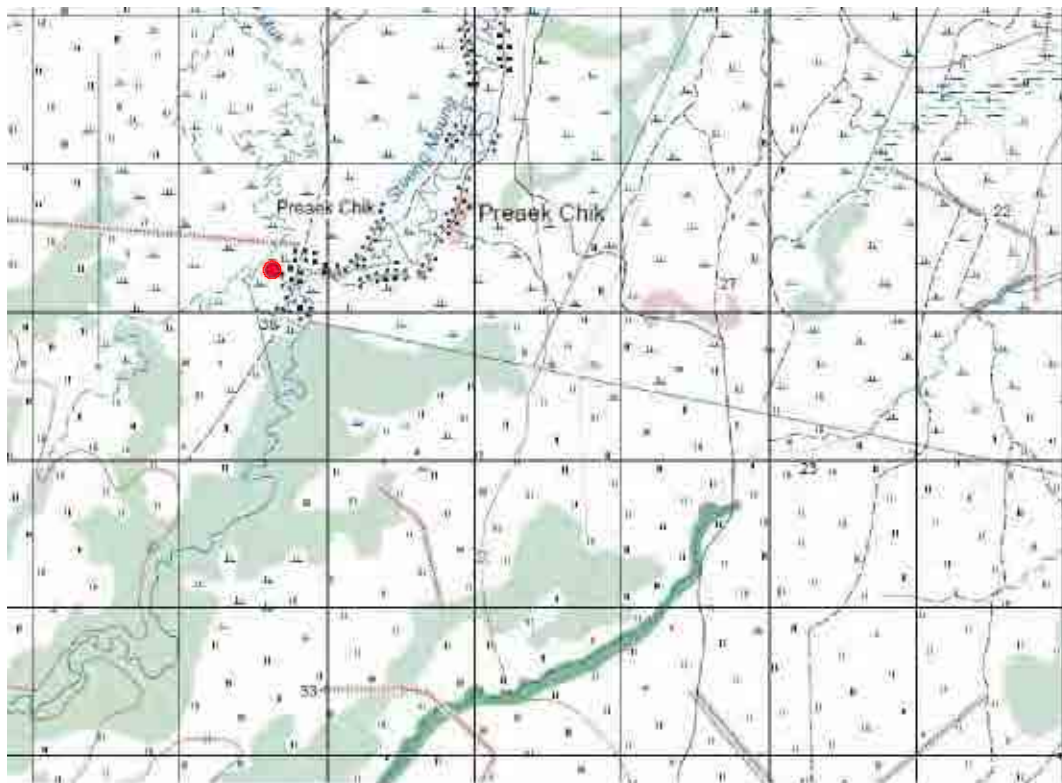
SCHEME NAME (ID)	Moung Russei irrigation gate 3		Photo Date	Year 2011 Mon 11 Date 30
 <p data-bbox="405 592 548 616">From upstream</p>	 <p data-bbox="1055 592 1220 616">From downstream</p>	<p data-bbox="1720 592 1827 616">Intake area</p>		
 <p data-bbox="416 1038 537 1062">To upstream</p>	 <p data-bbox="1066 1038 1207 1062">To downstream</p>	<p data-bbox="1641 1038 1904 1062">Powerhouse and outlet area</p>		
<p data-bbox="1072 1414 1151 1437">Others:</p>				



Result of site survey			
Observation Date	Year 2011 Mon 11 Date 30		
Observer	Mesure	Akira Irie	
name	Wrote	Takayuki Hamada	
Weather	Weather	①:clear, 2:fine, 3:cloudy, 4:rain	
	Wind	blows from	Down/s, Up/s, Left, Right
	Wind power	①:None, 1:light, 2:windy, 3:strong, 4:very strong	
Result	Obs. Discharge (m ³ /s)	-	
	Total area cross section (m ²)	-	
	Average Velocity (m/s)	-	
	Catchment Area (km ²)	-	
	Specific Q (m ³ /s/km ²)	-	
Measurement Site :			
Site Coordinate (GPS) (Garmin Datum: Indian-Thai)			
X	325383	Elevation (m) :	by GPS 37 m
Y	1398377	(accuracy):	by Alt. m
Gross Head	1.8 m (Source: JICA Study Team, Obs.)		
Design Q	see Summary	m ³ /s	
Estimated P	see Summary	kW (h =)	

SCHEME NAME (ID)	Moug Russei irrigation gate 4-1		
PROVIDENCE	Battambang	Notes) Spillway for the irrigation canal. Water does not flow ordinary. Access road is not paved.	
RIVER NAME	STUENG MOUNG		
CATCHMENT AREA(km ²)	550		
EFFECTIVE HEAD (m)	1.8		
DRYSEASON DISCHARGE(m ³ /s)	0.03		
DRYSEASON MAXIMUM OUTPUT(kW)	0.5		
Electrification condition of Households (Nos.)			
Map No.	5634		

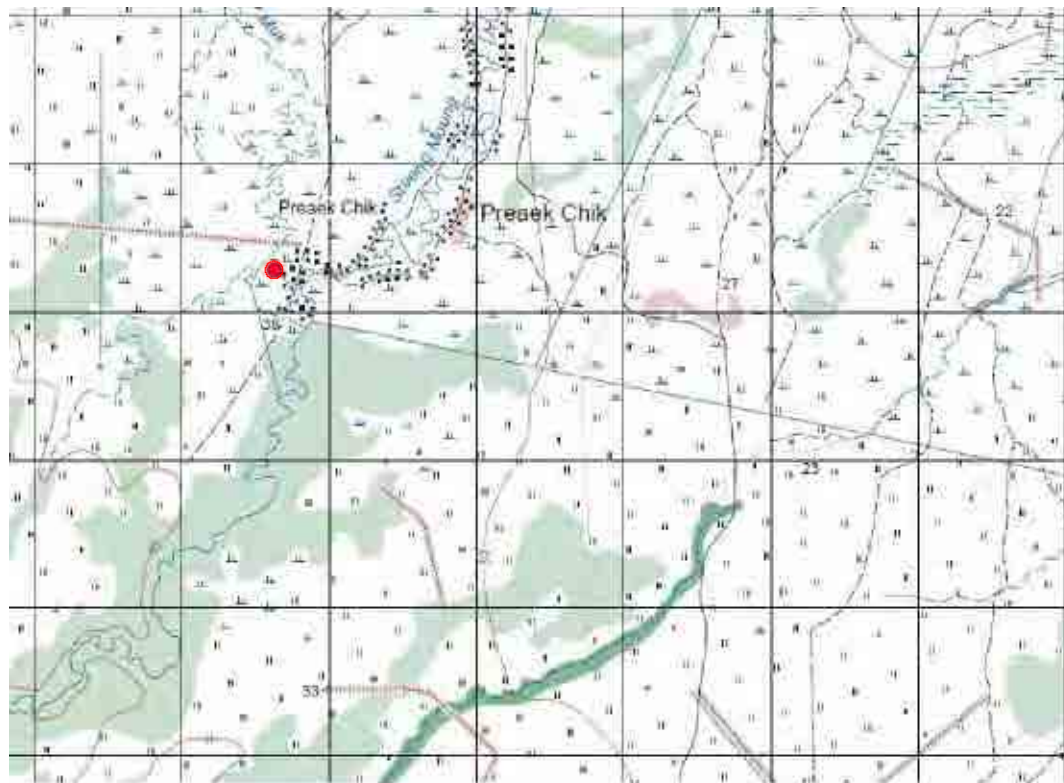
SCHEME NAME (ID)	Moung Russei irrigation gate 4-1		Photo Date	Year 2011 Mon 11 Date 30
 <p data-bbox="405 592 551 616">From upstream</p>	 <p data-bbox="1055 592 1223 616">From downstream</p>	<p data-bbox="1720 592 1827 616">Intake area</p>		
 <p data-bbox="416 1038 539 1062">To upstream</p>	 <p data-bbox="1066 1038 1211 1062">To downstream</p>	<p data-bbox="1644 1038 1906 1062">Powerhouse and outlet area</p>		
<p data-bbox="1077 1414 1155 1437">Others:</p>				



Result of site survey				
Observation Date	Year 2011 Mon 11 Date 30			
Observer	Mesure	Akira Irie		
name	Wrote	Takayuki Hamada		
Weather	Weather	①:clear, 2:fine, 3:cloudy, 4:rain		
	Wind	blows from	Down/s,	Up/s, Left, Right
	Wind power	①:None, 1:light, 2:windy, 3:strong, 4:very strong		
Result	Obs. Discharge (m ³ /s)	-		
	Total area cross section (m ²)	-		
	Average Velocity (m/s)	-		
	Catchment Area (km ²)	-		
	Specific Q (m ³ /s/km ²)	-		
Measurement Site :				
Site Coordinate (GPS) (Garmin Datum: Indian-Thai)				
X	325458	Elevation (m) :	by GPS	36 m
Y	1398375	(accuracy):	by Alt.	m
Gross Head	2.9 m (Source: JICA Study Team, Obs.)			
Design Q	see Summary	m ³ /s		
Estimated P	see Summary	kW (h =)		






SCHEME NAME (ID)	Moung Russei irrigation gate 4-2	
PROVIDENCE	Battambang	(Notes) One of the gates on the irrigation canal. Power house is possible to be installed (right bank is preferable). Access road is not paved. Water flow velocity cannot be estimated because it is too small.
RIVER NAME	STUENG MOUNG	
CATCHMENT AREA(km ²)	550	
EFFECTIVE HEAD (m)	2.9	
DRYSEASON DISCHARGE(m ³ /s)	0.22	
DRYSEASON MAXIMUM OUTPUT(kW)	5.6	
Electrification condition of Households (Nos.)		
Map No.	5634	

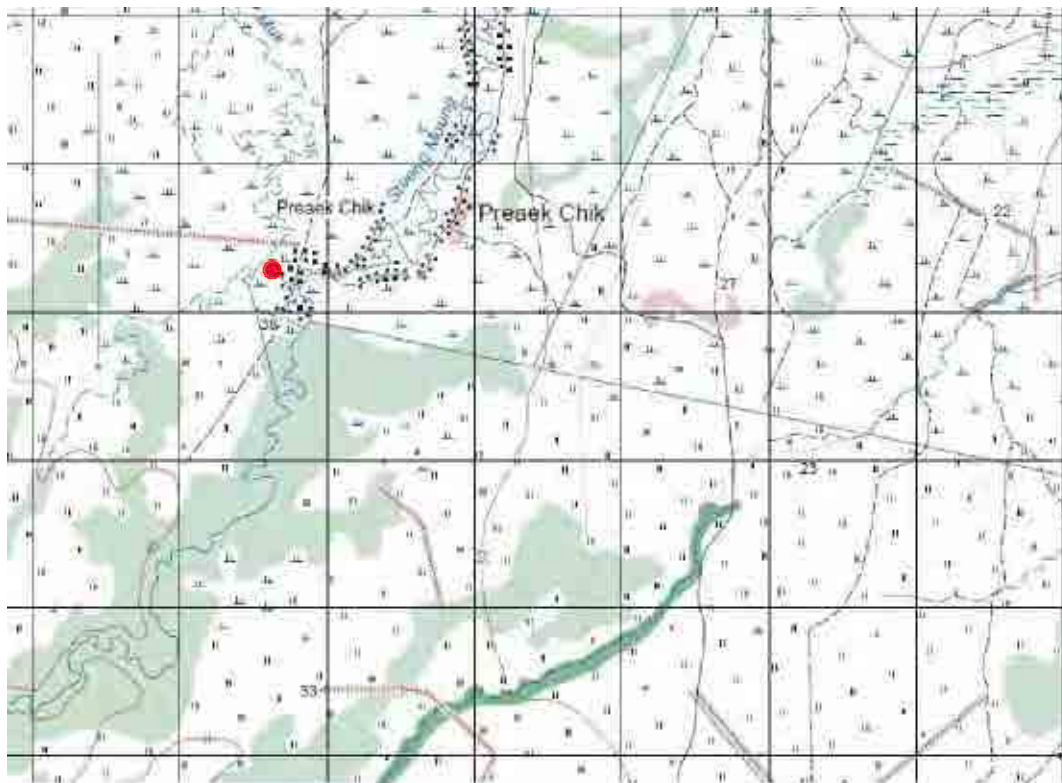
SCHEME NAME (ID)	Moung Russei irrigation gate 4-2		Photo Date	Year 2011 Mon 11 Date 30
 <p data-bbox="405 592 546 616">From upstream</p>	 <p data-bbox="1055 592 1218 616">From downstream</p>	<p data-bbox="1720 592 1827 616">Intake area</p>		
 <p data-bbox="416 1038 535 1062">To upstream</p>	 <p data-bbox="1066 1038 1211 1062">To downstream</p>	 <p data-bbox="1641 1038 1906 1062">Powerhouse and outlet area</p>		
<p data-bbox="1070 1414 1151 1437">Others:</p>				



Result of site survey			
Observation Date	Year 2011 Mon 11 Date 30		
Observer	Mesure	Akira Irie	
name	Wrote	Takayuki Hamada	
Weather	Weather	①:clear, 2:fine, 3:cloudy, 4:rain	
	Wind	blows from	Down/s, Up/s, Left, Right
	Wind power	①:None, 1:light, 2:windy, 3:strong, 4:very strong	
Result	Obs. Discharge (m ³ /s)	-	
	Total area cross section (m ²)	-	
	Average Velocity (m/s)	-	
	Catchment Area (km ²)	-	
	Specific Q (m ³ /s/km ²)	-	
Measurement Site :			
Site Coordinate (GPS) (Garmin Datum: Indian-Thai)			
X	325475	Elevation (m) :	by GPS 35 m
Y	1398181	(accuracy):	by Alt. m
Gross Head	0.9 m (Source: JICA Study Team, Obs.)		
Design Q	see Summary	m ³ /s	
Estimated P	see Summary	kW (h =)	







SCHEME NAME (ID)	Moung Russei irrigation gate 4-3	
PROVIDENCE	Battambang	(Notes) One of the gates on the irrigation canal. Space for the power house is paddy field or road. Access road is not paved. Water flow velocity cannot be estimated because it is too small.
RIVER NAME	STUENG MOUNG	
CATCHMENT AREA(km ²)	550	
EFFECTIVE HEAD (m)	0.9	
DRYSEASON DISCHARGE(m ³ /s)	0.03	
DRYSEASON MAXIMUM OUTPUT(kW)	0.2	
Electrification condition of Households (Nos.)		
Map No.	5634	

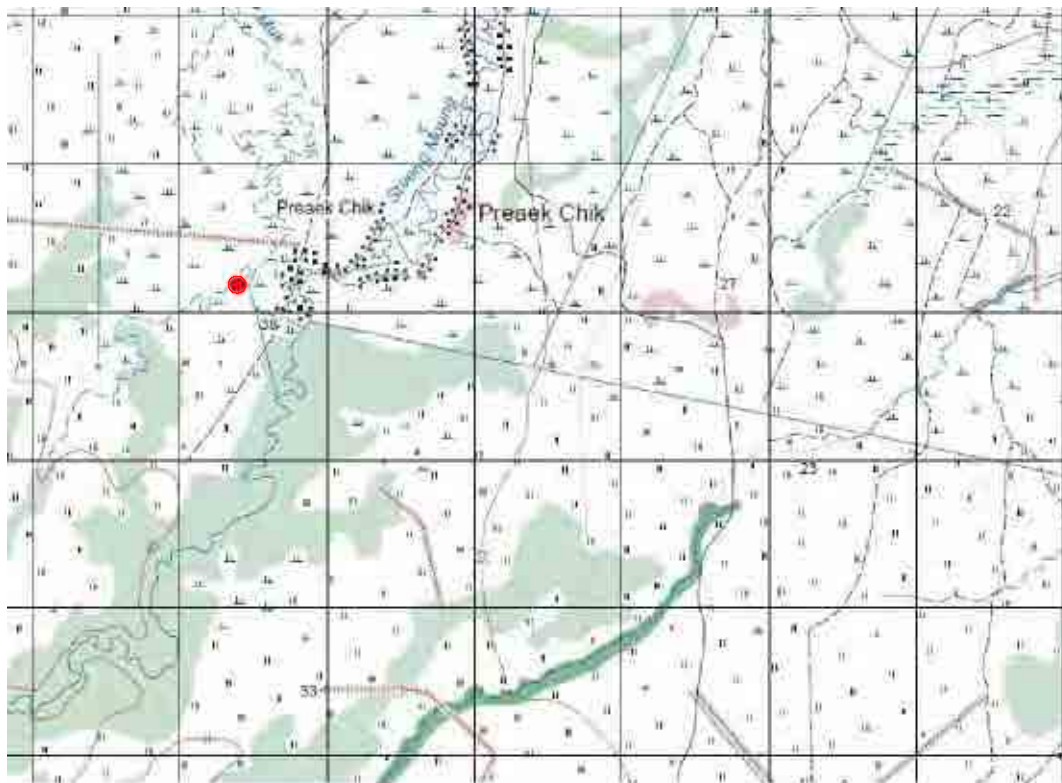
SCHEME NAME (ID)	Moung Russei irrigation gate 4-3	Photo Date	Year 2011 Mon 11 Date 30
 <p data-bbox="405 592 546 616">From upstream</p>	 <p data-bbox="1055 592 1218 616">From downstream</p>	<p data-bbox="1720 592 1827 616">Intake area</p>	
 <p data-bbox="416 1038 533 1062">To upstream</p>	 <p data-bbox="1066 1038 1205 1062">To downstream</p>	<p data-bbox="1644 1038 1906 1062">Powerhouse and outlet area</p>	
		<p data-bbox="1077 1414 1151 1437">Others:</p>	



Result of site survey				
Observation Date	Year 2011 Mon 11 Date 30			
Observer	Mesure	Akira Irie		
name	Wrote	Takayuki Hamada		
Weather	Weather	①:clear, 2:fine, 3:cloudy, 4:rain		
	Wind	blows from	Down/s,	Up/s, Left, Right
	Wind power	①:None, 1:light, 2:windy, 3:strong, 4:very strong		
Result	Obs. Discharge (m ³ /s)	-		
	Total area cross section (m ²)	-		
	Average Velocity (m/s)	-		
	Catchment Area (km ²)	-		
	Specific Q (m ³ /s/km ²)	-		
Measurement Site :				
Site Coordinate (GPS) (Garmin Datum: Indian-Thai)				
X	325399	Elevation (m) :	by GPS	36 m
Y	1398222	(accuracy):	by Alt.	m
Gross Head	0.1 m (Source: JICA Study Team, Obs.)			
Design Q	see Summary	m ³ /s		
Estimated P	see Summary	kW (h =)		





SCHEME NAME (ID)	Moung Russei irrigation gate 4-4		
PROVIDENCE	Battambang	Notes) Gate is broken. Unexploited head is too small. Access road is not paved.	
RIVER NAME	STUENG MOUNG		
CATCHMENT AREA(km ²)	550		
EFFECTIVE HEAD (m)	0.1		
DRYSEASON DISCHARGE(m ³ /s)	0.03		
DRYSEASON MAXIMUM OUTPUT(kW)	0		
Electrification condition of Households (Nos.)			
Map No.	5634		

SCHEME NAME (ID)	Moung Russei irrigation gate 4-4		Photo Date	Year 2011 Mon 11 Date 30
 <p data-bbox="405 592 551 616">From upstream</p>	 <p data-bbox="1055 592 1223 616">From downstream</p>	 <p data-bbox="1715 592 1827 616">Intake area</p>		
 <p data-bbox="416 1038 539 1062">To upstream</p>	 <p data-bbox="1066 1038 1211 1062">To downstream</p>	 <p data-bbox="1637 1038 1906 1062">Powerhouse and outlet area</p>		
<p data-bbox="1070 1414 1151 1437">Others:</p>				



Result of site survey			
Observation Date	Year 2011 Mon 11 Date 30		
Observer	Mesure	Akira Irie	
name	Wrote	Takayuki Hamada	
Weather	Weather	①:clear, 2:fine, 3:cloudy, 4:rain	
	Wind	blows from	Down/s, Up/s, Left, Right
	Wind power	①:None, 1:light, 2:windy, 3:strong, 4:very strong	
Result	Obs. Discharge (m ³ /s)	1.2	
	Total area cross section (m ²)	1.5(B) * 2(H) * 2=6.0	
	Average Velocity (m/s)	0.2	
	Catchment Area (km ²)	-	
	Specific Q (m ³ /s/km ²)	-	
Measurement Site :			
Site Coordinate (GPS) (Garmin Datum: Indian-Thai)			
X	324988	Elevation (m) :	by GPS 38 m
Y	1398218	(accuracy):	by Alt. m
Gross Head	0.5 m (Source: JICA Study Team, Obs.)		
Design Q	see Summary	m ³ /s	
Estimated P	see Summary	kW (h =)	

SCHEME NAME (ID)	Moung Russei irrigation gate 5	
PROVIDENCE	Battambang	(Notes) One of the gates on the irrigation canal. Space for the power house is paddy field or road. Gate was being opened during site survey. Access road is not paved. Water flow rate was estimated with water flow velocity and cross section area.
RIVER NAME	STUENG MOUNG	
CATCHMENT AREA(km ²)	-	
EFFECTIVE HEAD (m)	0.5	
DRYSEASON DISCHARGE(m ³ /s)	4	
DRYSEASON MAXIMUM OUTPUT(kW)	17.6	
Electrification condition of Households (Nos.)		
Map No.	5634	

SCHEME NAME (ID)	Moung Russei irrigation gate 5		Photo Date	Year 2011 Mon 11 Date 30
 <p data-bbox="405 592 548 616">From upstream</p>	 <p data-bbox="1055 592 1220 616">From downstream</p>	<p data-bbox="1720 592 1827 616">Intake area</p>		
 <p data-bbox="416 1038 537 1062">To upstream</p>	 <p data-bbox="1066 1038 1209 1062">To downstream</p>	<p data-bbox="1641 1038 1904 1062">Powerhouse and outlet area</p>		
<p data-bbox="1072 1414 1151 1437">Others:</p>				

Appendix 3

Pictures

Interview



Nov. 22, 2011
MIME Dr. Bun Narith
Deputy General Director, in charge of Hydro Electricity
Department



Nov. 21, 2011
EAC Dr. Ty Norin
Chairman-Secretary of State



Nov. 22, 2011
REF Mr. Loeung Keosela
Executive Director



Nov. 22, 2011
MIME Dr. Ith Praing
Secretary of State



Nov. 28, 2011
ADB Mr. Nida Ouk
Senior Project Officer



Nov. 29, 2011
KOICA
Mr. Yoon Chun Geun, Deputy Representative
Mr. In Sovanpol, Program Coordinator



Dec. 9, 2011
EDC Mr. Keo Rottanak
RGC Delegate in charge of Managing EDC
Advisor to Prime Minister



Jan. 13, 2012
WB Mr. Bun Veasna
Senior Infrastructure Specialist

EDC GS1,2,3 Site Visit
Dec. 1, 2011



Control Room of GS1



Transformer in GS1 (115/22kV, 50MVA)



Equipment of Grid Substation 2



22kV Switch Gear in GS2



Equipment of Grid Substation 3



Control Room of GS3

EDC (National Control Center, Training Center)



Nov. 23, 2011
Building of NCC



Nov. 23, 2011
Control Room of NCC



Nov. 23, 2011
Transmission Line Training Tower at EDC Training Center



Nov. 23, 2011
Transmission Line Training Tower at EDC Training Center



Nov. 23, 2011
Substation Training Equipment at EDC Training Center

GS Takeo Site Visit
Nov. 26, 2011



GS Takeo from entrance



Circuit Breaker and Disconnecting Switch



Transformer (230/22kV, 16MVA)



Control Equipment



Voltage Detector



Monitor



Phase Sign



Phase Sign of Transformer

GS Kampot Site Visit
26-Nov-11



GS Kampot (Under Construction)



Transformer (230/22kV, 50MVA)



Control Equipment



22kV Switch Gear



Control Building

Kamchay Hydropower Station Site Visit
Nov. 26, 2011



Main Dam and PH2 (Powerhouse No.2), Kamchay Hydropower Project



Crest of Main Dam, Kamchay Hydropower Project



Downstream of Main Dam, Kamchay Hydropower Project



Relagulating Dam, Kamchay Hydropower Project



PH3(Powerhouse No.3), Kamchay Hydropower Project



Control Room of PH3(Powerhouse No.3), Kamchay Hydropower Project

Battambang GS, Pursat GS and Battambang – Phnom Penh 230kV Transmission Line, Site Visit
Nov. 29-30, 2011



230kV Transmission Line between Battambang and Pursat



115kV Transmission Line and 230kV Transmission Line near Battambang GS



230kV Transmission line (Left: Blue colored, Right: Yellow colored)
Insulators made of glass



115kV GIS Switchgear at Battambang GS



Pursat GS



Pursat GS (Left tower: to Kampong Chhunang GS, Middle: to O'soam GS, Right: to Battambang GS)

Irrigation around Tonle Sap Lake Site Visit
Nov. 29-30, 2011



Powerhouse and Dam Spillway, Anlog Chrey Hydropower Project, Krang Ponley Irrigation Project



Water Turbine, Anlog Chrey Hydropower Project, Krang Ponley Irrigation Project



Earth Dam & Transmission Line Powerhouse and Dam Spillway, Anlog Chrey Hydropower Project, Krang Ponley Irrigation Project



Distribution Line, Anlog Chrey Hydropower Project, Krang Ponley Irrigation Project



Powerhouse and Dam Spillway, Krapeu Truom Hydropower Project, Krang Ponley Irrigation Project



Waterturbine, Krapeu Truom Hydropower Project, Krang Ponley Irrigation Project

The Rehabilitation of the Ikandal Stung Irrigation System (JICA, Grant Aid) Site Visit
Jan. 19, 2012



7th January Weir, Kandul Stung Irrigation Project



Tuk Tula Regulating Gate , Kandul Stung Irrigation Project



Draems Regulating Gate, , Kandul Stung Irrigation Project

Appendix 4

Minutes

Place	Electricity Authority of Cambodia
Time and Date	From 8:30 to 9:30, November 21, 2011
Participants	EAC: Dr. Ty Norin, Chairman, Secretary of State Mission team: Shinohara, Hirose, Irie, Fukugaichi, Yamamoto
Contents	
<p>Team: Mr. Shinohara explained background and objectives of the mission.</p> <ul style="list-style-type: none"> • We would like to know the reason why electricity tariff is higher than neighboring countries. It is the big issue for Japanese company to invest in Cambodia. • We think that it is necessary for EDC to reinforce Phnom Penh system. There are three Grid Substations here, but the capacity is not enough. In order to reinforce it, indoor substation and underground transmission line are necessary. • We will survey potential sites of micro-hydropower. • In order to stably supply electricity, it is necessary for EDC to develop the capacity of NCC staff. And the capacity building of generation staff is also needed to operate and maintain hydropower plants after BOT term ended. <p>EAC: Regarding electricity tariff, WB wanted to review the tariff and instruct us, but I rejected. It is OK to review the cost such as generation cost, transmission cost, etc. The tariff is political matter, so you should review the cost. Now Dr. Praing Chulasa, Ms. Duong Vannay in EDC and EAC are studying the power purchase cost in five years. Now we are summarizing the study result.</p> <p>Regarding EDC capacity building, I am sure that human resources of generation is poor. However I have doubts about effectiveness of capacity building now. I think that the joint venture of EDC and private company should build the IPP. Through JV, EDC can develop the capacity of staff.</p> <p>In the neighboring countries, the first 2 or 3 IPPs are high price. Because there was no experience. I think that EDC should perform all tasks by itself. Through JV, EDC can get the knowledge and experience of finance as well as generation and maintenance.</p> <p>Team: We will review the cost of tariff and I would like you to support our work.</p> <p>EAC: I will.</p> <p>Team: Regarding rural electrification, there is the official target. However the report of French company shows EAC has new target of rural electrification.</p> <p>EAC: We do not agree with the new target. WB forces the policy that 50% households electrified by 2020 to us even if we have our policy.</p>	
Reference	

Place	Embassy of Japan in Cambodia(EOJ)
Time and Date	From 14:30 to 16:10, November 21, 2011
Participants	EOJ: Mr. Yokoyama Hiroyuki, first secretary JICA: Mr. Shinoda Mission team: Shinohara, Hirose, Irie, Fukugaichi, Yamamoto
Contents	
<p>Team: Mr. Shinohara explained background and objectives of the mission.</p> <p>EOJ: Regarding power development plan, I would like to know the latest information.</p> <p>EOJ: Regarding rural electrification, I would like to know where and why it is good from the viewpoint of macro compared to technical matters.</p> <p>Team: In MP2006, Nippon Koei configured the matrix to evaluate the sites. We would like to follow this method.</p> <p>EOJ: I need the information compared to Japan and neighboring countries.</p> <p>EOJ: I guess electricity tariff will decrease. I would like you to survey the trend of the tariff and how much it will be.</p> <p>Team: I will review the cost of tariff.</p> <p>EOJ: I would like you to the reason of power outage and measures if the power outage is much and long.</p> <p>EOJ: What kind of needs do Japanese companies have for the electricity? Regarding the electric power sector, what kind of product can Japanese companies do business?</p> <p>Team: The product that the Japanese companies have high technologies compared to other countries is one of candidates. For example, Distribution Automation System (DAS) is using Japanese technology and can reduce the power outage time and distribution loss.</p> <p>EOJ: I think that it is necessary for the next project to consider Japanese companies profits as well as EDC profits.</p>	
Reference	

Place	EDC
Time and Date	From 14:30-15:30, November 22, 2011
Participants	EDC: H.E. Chan Sodavath, Deputy Managing Director of Planning and Techniques Mr. Chun Piseth, Deputy Director, Corporate Planning and Projects Dep. Mr. Nou Sokhon, Director, Transmission Dep. Mr. Ros Chenda, Director, Generation Dep. Mr. Eang Chanthy, staff of Generation Dep. Mr. Rann Seihakhiny, staff of Corporate Planning and Projects Dep. Mission team: Shinohara, Hirose, Irie, Fukugaichi, Yamamoto
Contents	
<p>Team: Mr. Shinohara explained background and objectives of the mission by the power point file.</p> <p>EDC:</p> <ul style="list-style-type: none"> • Regarding demand forecast, I tried to do it. But we have never conducted it yet because of lack of human resources. We would like to survey it by the configured team from the view point of micro. • Regarding Phnom Penh system review, Newjec is doing by using WB fund. I think that EDC needs the study from the holoscopic standpoint. We need facility planning based on the demand forecast for each area. • Distribution Automation System (DAS) is one of our needs. • In the future, we will need the backup of NCC. • EDC sent staff members to Thailand for the training of PSS/E by own budget. • EDC sent staff members to Hochiminh Electric Power College in Vietnam for the training of relay and transmission line operation and maintenance by own budget. • EDC is in urgent need of the capacity building of NCC. • In the past, the JICA expert studied electrical power quality such as voltage and frequency and so on. It was great work. We need this kind of support. • We would like to update impedance map. • To support Training Center is also needed. Training Center is already a university. Title is Institute of Electrical Science. It can confer Bachelor degree. To support Training Center is not only capacity building of EDC but whole of Cambodia. Now Training Center has equipment, towers and so on. Training center has received supports from EDF, ADB and the Chugoku Electric Power Co., Inc. so far. • EDC is supporting micro-hydropower. It is better for maintenance of hydropower to connect the grid. • Regarding an example of off-grid, Touk Char case in Kampong Cham constructed by NEDO was not maintained and is out of order now. 	
Reference	

Place	Ministry of Industry, Mines and Energy (MIME)
Time and Date	From 8:50 to 9:10, November 22, 2011
Participants	MIME: Dr. Bun Narith, Deputy Director General, General Department of Energy Mission team: Shinohara, Hirose, Irie, Fukugaichi, Yamamoto
Contents	
<p>Team: Mr. Shinohara explained background and objectives of the mission, especially small and irrigation hydro.</p> <p>Team: What are developers of irrigation hydro?</p> <p>MIME: They are Electricity Development Department of MIME and Ministry of Water Resources and Meteorology (MOWRAM). If main portion is hydro power, it is MIME, but if main portion is irrigation, it is MOWRAM.</p> <p>Team: How about other donors' assistances?</p> <p>MIME: About small hydro, there are no developers.</p> <p>Team: Does MIME have a list of potential sites of small hydro?</p> <p>MIME: We have the list as same as your team's inception report. Although REF is conducting micro hydro project, it is stopped while there is a subsidy of 400\$/kW by MIME. Electricity tariff became expensive because of the construction cost of distribution line.</p> <p>Team: Which projects do you recommend about small hydro?</p> <p>MIME: Prek Dakdeur in Mondul Kiri Province is good.</p> <p>Team: How about Busra?</p> <p>MIME: Busra's capacity is big. It is 20MW, so it is not small hydro.</p> <p>Team: How about Bey Srok in Ratana Kiri Province?</p> <p>MIME: It is very small and access roads are very bad.</p> <p>Team: How about the progress of Kamchay hydropower?</p> <p>MIME: It will be start in this December.</p> <p>Team: About Kamchay hydropower, it can generate up to maximum output. How about the amount of the power generation in dry season?</p> <p>MIME: It is 30% of maximum output based on the study.</p> <p>Team: How about Atay?</p> <p>MIME: It is almost the same as Kamchay so it is 30% in dry season.</p> <p>Team: Does MIME make power supply plan based on the Feasibility Study?</p> <p>MIME: Yes.</p>	
Reference	

Place	Ministry of Industry, Mines and Energy (MIME)
Time and Date	From 16:20 to 17:20, November 22, 2011
Participants	<p>MIME: Dr. Ith Praing, Secretary of State</p> <p>Mr. Tung Sereyvuth, Deputy Director, Energy Development Department</p> <p>Mr. Kong Pagnaritu, Chief, Secretariat Office</p> <p>Mr. Kin Sothea, Energy Development</p> <p>Mission team: Shinohara, Hirose, Irie, Fukugaichi, Yamamoto</p>
Contents	
<p>Team: Mr. Shinohara explained background and objectives of the mission.</p> <p>MIME: Do you propose any new projects in this survey?</p> <p>Team: We do not propose any project this time. We think that the human resource development projects about NCC and transmission and substation engineers, and the extension of Phnom Penh System like construction of underground transmission lines and indoor substations should be considered.</p> <p>MIME: How about the cost? We guess that the underground transmission lines are expensive. Is it 115kV?</p> <p>Team: They should be double circuit and 115kV underground transmission lines due to the central of Phnom Penh.</p> <p>MIME: Is the project expansion? Is it to replace overhead transmission line with underground?</p> <p>Team: It should be an expansion project. We think that expansion of Phnom Penh system is necessary because demand in the center of Phnom Penh is increasing.</p> <p>MIME: We agree with the necessity of capacity building for EDC.</p> <p>MIME: What do you think about electricity tariff?</p> <p>Team: H.E. Ty Norin, EAC, said that he would support us. We would like to investigate the structure of electricity cost and future electricity tariff.</p> <p>MIME: About irrigation hydro, will you implement the survey about all of drainage basin?</p> <p>Team: We will conduct to study to focus on the micro hydropower in Mondul Kiri and Ratana Kiri Province.</p>	
Reference	

Place	Rural Electrification Fund (REF)
Time and Date	From 9:30 to 10:30, November 22, 2011
Participants	REF: Mr. Loeung Keosela, Executive Director of REF Mission team: Shinohara, Hirose, Irie, Fukugaichi, Yamamoto
Contents	
<p>Team: Mr. Shinohara explained background and objectives of the mission.</p> <p>REF: We will give you documents about Solar Home System (SHS). Can Japanese government support REF?</p> <p>Team: Generally, it spends two years to start Japanese ODAs so we think that to support REF is difficult. After finish the WB's fund, what will be REF?</p> <p>REF: Our projects will be conducted by the organization which will merge REF.</p>	
Reference	

Place	EDC Training Center
Time and Date	From 10:00 to 11:30, November 23, 2011
Participants	EDC: Mr. Oum Piseth, Director, Training Center Mr. Meng Sokkheng, Deputy Director, Training Center Mr. Sy Moeung, Chief, Technical Office, Training Center Mr. Hong Neang, Chief, Transmission Line, Training Center JICA: Mr. Shinoda Mission team: Shinohara, Hirose, Fukugaichi, Yamamoto
Contents	
<p>EDC: This Training Center will be institute in next year and its name will be Institute of Electrical Science. We can award Bachelor degree to graduates.</p> <p>Team: Do you prepare training and education curriculum in order to be institute?</p> <p>EDC: Now, we are making effort to prepare.</p> <p>Team: Will The institute start on September?</p> <p>EDC: It will open on August next year but the schedule is up to Ministry of Education. The institute is under Ministry of Education because Ministry of Labor controls Vocational course.</p> <p>Team: How many students will be about the Bachelor Degree's course?</p> <p>EDC: About 200 people. The Bachelor Degree's course is 5 years course. In the first year, students will study basic knowledge.</p> <p>Team: Are the curriculum of Training Center as same as before?</p> <p>EDC: We prepare them to change. We are gathering information from each department.</p> <p>Team: Please let us know the next year's training courses for EDC staff.</p> <p>EDC: Now, we are making them. The number of training course next year will be more than that of this year. We will add the programs based on Capacity Building for HV transmission System. How about the training towers?</p> <p>EDC: Transmission Department made them which are same as the field ones while Training Center said that training towers should be useful, for example, training towers should be low than actual ones. This time, Training Center only lent the place because transmission department got the budget. But three training towers which transmission department made are asset of training center now.</p> <p>Team: Hove you ever conducted training using the training towers?</p> <p>EDC: We did twice.</p> <p>EDC: In order to add curriculum of transmission and substation next year, we dispatched two staff to power junior college in Ho Chi Minh. We would like JICA to support training course like this. Incidentally, the staffs which were trained by Capacity Building Project moved to Transmission Department. We need more staffs in order to operate institute. We think that capacity building for not only engineers but also administrators is necessary.</p> <p>Team: We would like to know the priority of Japan's assistance.</p>	

EDC: First, we would like JICA to make training towers. Second, Equipment of Transformers, Circuit Breakers and Disconnecting Switches for training of maintenance. We dispatched two staffs of Power Plant Section to TNB college for two weeks because we got a scholarship from the government of Malaysia. From next week, one person will be dispatched to Japan for the training of human resource development by JEPIC. There are a lot of things which we have to do to award Bachelor Degree. So far, France, ADB and JICA supported us a lot. We would like to be dispatched experts to be institute. Now, we have got information from TNB and Hanoi Power College. As Hanoi Power College was supported by JICA, we would like to share the fruitful result.

Reference	
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Place	ADB
Time and Date	From 14:30 to 15:20 November 28, 2011
Participants	ADB: Mr. Ouk Nida, Senior Project Officer Mission team: Shinohara, Hirose, Irie, Yamamoto and Hamada
Contents	
<p>Team: Mr. Shinohara explained background and objectives of the mission.</p> <p>Team : We hear that ADB implements the transmission project (Kampot – Sihanouk Ville) being under construction and rural electrification projects. Could you let us know the order of priority of them?</p> <p>ADB : As a support policy, ADB has established “New strategy in Cambodia 2011 to 2013”. Usually, the period of such kind of ADB’s policy is five years. However, because that of RGC is from 2009 to 2013, the end of ADB’s policy was set that of RGC’s policy. Total amount of the rural electrification project is 45MUSD. The schedule of 500kV transmission grid connection project of GMS (Vietnam – Laos – Cambodia – Thailand) was prolonged because of the abeyance of hydropower development in Laos due to the economical recession.</p> <p>Team : Was it “prolonged” or “canceled”?</p> <p>ADB : Judge was “prolonged”, not “canceled”. However, the restart of it is after 2014 at the earliest. This is one of the reasons that ADB focus of rural electrification.</p> <p>Team : After 2013, will ADB support rural electrification etc continuously?</p> <p>ADB : ADB shall support continuously.</p> <p>Team : Capacity building supported by ADB/JBIC was conducted by our company. What does ADB think about a capacity building in Cambodia?</p> <p>ADB : In the present project of rural electrification, ADB shall implement capacity building as a soft component. It will be the same as in the projects in the future.</p> <p>Team : What kind of capacity building does ADB think?</p> <p>ADB : It is not clear as of now. AECOM is research the present situation in the FS. The result will be reported in next February.</p> <p>Team : What type of rural electrification projects (Extension of LV, Mini-Grid with Diesel Power Plant etc.) does ADB set more priority?</p> <p>ADB : Grid Extension has the first priority</p> <p>Team : Does ADB has Mini-Grid projects on going?</p> <p>ADB : No. ADB has experiences of distribution line extension projects in rural grid of EDC and the construction of diesel power plant.</p> <p>Team : Rural electrification project on going consists only of grid extension, doesn’t it?</p> <p>ADB : Yes.</p> <p>Team : Could you provide the name of the project?</p> <p>ADB : Its name is ”Rural Electrification Project”.</p> <p>Team : When will the project start?</p> <p>ADB : At present, FS is on-going now. Probably, the project will start around the beginning of 2013.</p> <p>Team : When will the project end?</p>	

ADB : The period of the project is 5 years. Prior to the start of the project, some procedures should be completed. After FS, ADB by itself will dispatch a mission team for reconfirming the necessity, will make a decision, and will make a discussion with RGC.

ADB : For grid extension, ADB focuses on the areas around Siemreap, Kampong Tom, Kandal and Kampot for grid extension. KfW focuses on the areas around Takeo – Kampot T/L. Areas focused on by ADB in Kampot are other than the parts where KfW focuses on. WB focuses on the western areas such as Battambang, Pursat and Southeastern areas such as Kampong Cham and Svay Rieng. China seems make a strong effort to the large scale hydropower development but not to rural electrification. ADB cannot focus on the rural electrification of northeastern area because of the low population density

Reference	
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Place	UNIDO
Time and Date	From 15:30 to 16:30, November 28, 2011
Participants	UNIDO: Mr. SOK Narin Mission team: Shinohara, Hirose, Fukugaichi, Yamamoto
Contents	
<p>Team : We come here based on the JICA's information related to a disposal project of PCB transformers</p> <p>UNIDO : The objective of the project is to dispose PCB oil (300t) and contaminated facilities and equipment. Draft of the project has been just finished. Co-financing with RGC is considered now. However, RGC will not be responsible for the finance but provide staffs and office. Co-financing in Cambodia is recognized to be difficult.</p> <p>Budget of the project is USD1.9M. Financing agency is Global Environmental Fund (GEF). The draft proposal submitted MIME and EDC is sent to GEF, however, there is no reply as of now. After approved in UNIDO, approved by GEF is necessary.</p> <p>Cement plant in Kampot is said to be suitable for the treatment of oil. If it is not possible there, the oil will be transported to Europe. The information of the treatment experiences in neighboring countries can not be gotten.</p> <p>Simple study as FS was conducted in Phnom Penh, Kampong Thom, Kampong Cham, Sihanouk. Two barrel of oil was stored in a warehouse in Sihanouk Ville. Conservation condition of drum cans was not appropriate. Water is filled and the cans may be corroded. Three years are considered for the project period and the start will be 2012.</p> <p>Team : What is the role of MOE?</p> <p>UNIDO : MOE has a Laboratory. PCB oil is analyzed now. It also has portable PCB analyzers. EDC doesn't have the analyzer. So, provision in the project is now considered.</p> <p>Team : Deadline to dispose the oil is regulated in Japan. Are there any rules or regulations to indicate the deadline to dispose the PCB in Cambodia?</p> <p>UNIDO : Not regulated.</p> <p>Team : Does oil for all transformers in Cambodia contain PCB?</p> <p>UNIDO : No all. Old transformers (6.6kV) of EDC were repaired in Work Shop (repair section) and sold in rural areas. The oil of them were basically contains PCB. PCB oil is also contaminated into other transformers. The area polluted by PCB is expanded by this reason. According to MIME, PCB oil was used for frying bananas or fishes around 1980.</p> <p>Team : Is notification of the risk of PCB necessary?</p> <p>UNIDO : Of course.</p> <p>Team : Where is high concentration contamination transformer made?</p> <p>UNIDO : Russia. They are stored in the Ware House of EDC. Transformers manufactured before 1981 are basically contaminated. UNIDO are waiting the answer from MIME and EDC. The response of EDC is late. Chairman of EDC is interested in Grid Extension but not interested in this kind of projects. If JICA conducts technical support project for EDC, it is appreciated if JICA support through EDC.</p>	

Reference	