SECRETARY OF STATE FOR ENERGY POLICY
THE DEMOCRATIC REPUBLIC OF TIMOR-LESTE

PREPARATOR SURVEY REPORT
ON
THE PROJECT FOR INTRODUCTION OF CLEAN ENERGY
BY SOLAR ELECTRICITY GENERATION SYSTEM
IN
THE DEMOCRATIC REPUBLIC OF TIMOR-LESTE

JULY, 2010

JAPAN INTERNATIONAL COOPERATION AGENCY

INTERNATIONAL TOTAL ENGINEERING CORPORATION
YAMASHITA SEKKEI INC.

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Preface

Japan International Cooperation Agency (JICA) decided to conduct the preparatory survey on the Project for Introduction of Clean Energy by Solar Electricity Generation System in the Democratic Republic of Timor-Leste, and organized a survey team headed by Mr. Shigehito Akagi of International Total Engineering Corporation (and Yamashita Sekkei Inc.) between July, 2009 to July, 2010.

The survey team held a series of discussions with the officials concerned of the Government of the Democratic Republic of Timor-Leste, and conducted field investigations. As a result of further studies in Japan, the present report was finalized.

I hope that this report will contribute to the promotion of the project and to the enhancement of friendly relations between our two countries.

Finally, I wish to express my sincere appreciation to the officials concerned of the Government of the Democratic Republic of Timor-Leste for their close cooperation extended to the survey team.

July, 2010

Nobuko Kayashima
Director General
Human Development Department
Japan International Cooperation Agency

Summary

Summary

1. Outline of the country

The Democratic Republic of Timor-Leste (hereinafter referred to as “Timor-Leste”) occupies approximately half of the island of Timor, the easternmost of the Lesser Sunda Islands and is approximately 14,900 square kilometers in area which is the almost same as Shikoku Island of Japan.

Administratively, “Timor-Leste” is organized into 13 districts (Dili, Baucau, Manatuto, Lautem, Viqueque, Ainaro, Manufahi, Covalima,Oecusse, Bobonaro, Liquica, Ermera, Aileu), 64 sub districts and 442 sucos (villages). Oecusse district is a detached estate located in the west Timor province of Indonesia.

“Timor-Leste” has a dry tropical monsoon climate with two distinct seasons – dry and wet. In the north coast area, wet and relatively warm from November to April and dry and relatively cool from June to September. In the east and south area, there are two wet seasons from November to May and from June to August. The minimum temperature is ranging from 18 - 23℃ and maximum one from 28 - 33℃.

GDP per capita of “Timor-Leste” is US$366 (2004), and one of the poorest countries in Asia Pacific region according to report by UNDP (2006). On the other hand, GNI per capita is US$2,198 (2009), US$2,915 (2008), US$1,728 (2007), it is US$590 (2009), US$499 (2008) US$, US$398 (2007) except oil income, the oil income expands greatly, and the oil fund established in September, 2005 is expected to reach 47 million US dollars in March, 2009. Moreover, the oil income in 2008 is estimated to be 13.58 million US dollars (Ministry of Finance and 2008).

The major industry in “Timor-Leste” is agriculture and 80 percent of the population is engaged. The farm production is 1/4 of GDP, however, it shows low percentage of productivity and the scale is small as compared with its population.

The major product is grain (maze, manioc, rice and potato) and most of them are for the captive use. The cash crop has been limited to coffee. The rice and the fruit as the staple food are imported.

2. Background and overview of the Project

Shift to clean energy including solar power generation is mentioned as one of the mitigation measures in the overall climate change measures, and the Framework Convention on Climate Change, which went into effect in 1994, and the Kyoto Protocol, which was ratified by 170 nations, also seek developing countries for efforts to reduce greenhouse gas emissions, including CO_2. In January 2008, Japan announced "Cool Earth Partnership" in the Davos Forum, as one of the initiatives for the developing countries that are willing to contribute to climate stabilization while keeping balance between reduction of greenhouse gas emissions and economic growth, and introduced "Grant Aid for Environmental Programs" in fiscal 2008 in order to support the developing countries that are not provided with sufficient performance capability or funds to keep balance emissions reduction, such as energy saving, and economic growth.

On the other hand, the electrification rate of the Democratic Republic of Timor-Leste (hereinafter referred to as "Timor-Leste") is as low as 36.6% in national average, and power failure also frequently occurs in Dili. Almost all main power sources in “Timor-Leste” depend on diesel electric power generation, and the fuel used for power generation (crude oil) is all imported. In addition, the country has been seriously affected by global fluctuation in oil price, as known from the shortage of power supply resulting from the recent sharp rise in international oil price. Hence, a departure from dependence on primary energy is recognized as emergency needs in “Timor-Leste”, and expectation for clean energy including solar power generation is growing in the country. The government of “Timor-Leste” is also trying to shift its policy to the introduction of clean energy, such as hydraulic, wind, and solar power generation. However, the most of its national budget for the electric power sector are spent on fuel import and electricity charges, so it is difficult to realize its policy.

Under such circumstances, “Timor-Leste” decided to participate in the Cool Earth Partnership, and announced that its urgent issue is to aim to establish both reduction of greenhouse gas emissions and economic growth by implementing adaptation and mitigation measures in the overall climate change measures.

3. Outline of the Study and Contents of the Project

In response to the above-described request, the Government of Japan decided to conduct a Preparatory Survey (Basic Design), and accordingly Japan International Cooperation Agency (JICA) dispatched a 1st Preparatory Survey Team to “Timor-Leste” for 22 days from July 9, 2009 to July 30, 2009 and a 2nd Preparatory Survey Team for 18 days from December 1, 2009 to December 18, 2009. After coming back to Japan, the Survey Team compiled a Basic Design Report based on analyses of the findings in “Timor-Leste” and dispatched a 3rd Preparatory Survey Team for 8 days from April 25, 2010 to May 2, 2010, to confirm the contents of the Project and have discussion with the counterparts of “Timor-Leste”.

The equipment to be procured under the requested assistance project was designed with consideration given to the necessity and appropriately as the climate change measures in “Timor-Leste”. The major equipment planned for the Project is as follows.

Overview of major equipment to be procured

No.	Name of planned equipment	Q’ty	Application
1	Solar power generation system, grid-connected type 50kw	2	Shifting part of the diesel electric power generation to natural/recyclable energy
2	Solar power generation system, grid-connected type 10kw	2	
3	Solar power generation system, grid-connected type 2kw	16	
4	Solar power generation system, stand-alone type 2kW	4	Supply natural/recyclable energy to non electrified areas
5	Solar power generation system, stand-alone type 6kW (UNTL, Hera Campus)	1	Research and study of Solar power generation system

4. Implementation schedule and cost estimation

Assuming that this project is to be carried out under Japan's grant-aid assistance scheme, the total implementation period will required approx. 17.0 months, consisting of approx. 5.0 months for detailed design and approx. 12.o months for equipment procurement.

Cost to be borne by "Timor-Leste" US$5,450.00 (approx. 0.5 million yen).

5. Project evaluation

The direct effect of introducing the solar power generation system is the reduction in annual consumption (combustion) of fossil fuel (crude oil) for diesel electric power generation, which leads to reduced CO_2 emissions and consequently contributes to the climate warming prevention measures of "Timor-Leste", a member country of the Cool Earth Partnership. Also, installation of the largest solar power generation system in this country (a display board indicating the status of system operation and effect will be installed) is expected to bring the effect of raising the awareness of solar power generation at home and abroad.

As indirect effects, the system introduction is expected to product the economic effect of reducing the import of fossil fuel (crude oil) and lead to the future penetration / promotion of power generation systems using recyclable energy.

Further, stable power supply to educational facilities using solar power generation enables distance learning using audio-visual equipment (television, video, computer, etc.) in schools in "Timor-Leste", which are suffering from the shortage of human resources including teachers, and such new style of learning is expected to improve the content of education and benefit local residents and schoolchildren. With system introduction, the engineering department of the "UNTL" is also expected to advance research on the solar power generation, improve the capability of maintenance, and deepen the knowledge about clean energy, which is expected to promote the clean energy policy of "Timor-Leste".

The requested project is deemed appropriate to be carried out under Japan's grant-aid assistance scheme due to the following reasons.

(1) A departure from dependence on primary energy including fossil fuel is recognized as emergency needs in "Timor-Leste", and the government of "Timor-Leste" is trying to shift its policy to the introduction of clean energy, such as hydraulic, wind, and solar power generation. Shift to clean energy by solar power generation in the requested project is the initiative implemented all over the world to reduce greenhouse gas emissions, including CO2 as one of the mitigation measures in the overall climate change measures.

(2) The requested project targets 24 facilities, and residents receive high publication effect about introduction of clean energy by solar power generation. Especially in basic schools, children

who will forge the future of “Timor-Leste” can have a chance to see solar power generation system closely, and consider about necessity of clean energy and environment.

(3) The engineering department of the “UNTL” will advance research on alternative energy, and improve the technical capability of “Timor-Leste” including maintenance.

In order to maintain the effect of the equipment procurement resulting from the implementation of this Project on a long-term basis, “Timor-Leste” is expected to address the following issues.

(1) For the independent-storage system planned to be installed in basic schools in non-electrified areas and “UNTL”, budget for battery replacement should be secured, and unnecessary batteries should be collected certainly from a viewpoint of environmental protection.
(2) Audio-visual equipment should be systematically procured in order to provide distance learning to basic schools, and distance learning should be started promptly after introduction of the solar power generation system.
(3) “UNTL”, Hera Campus, should promote research of the solar power generation system and improve relevant technical capabilities.

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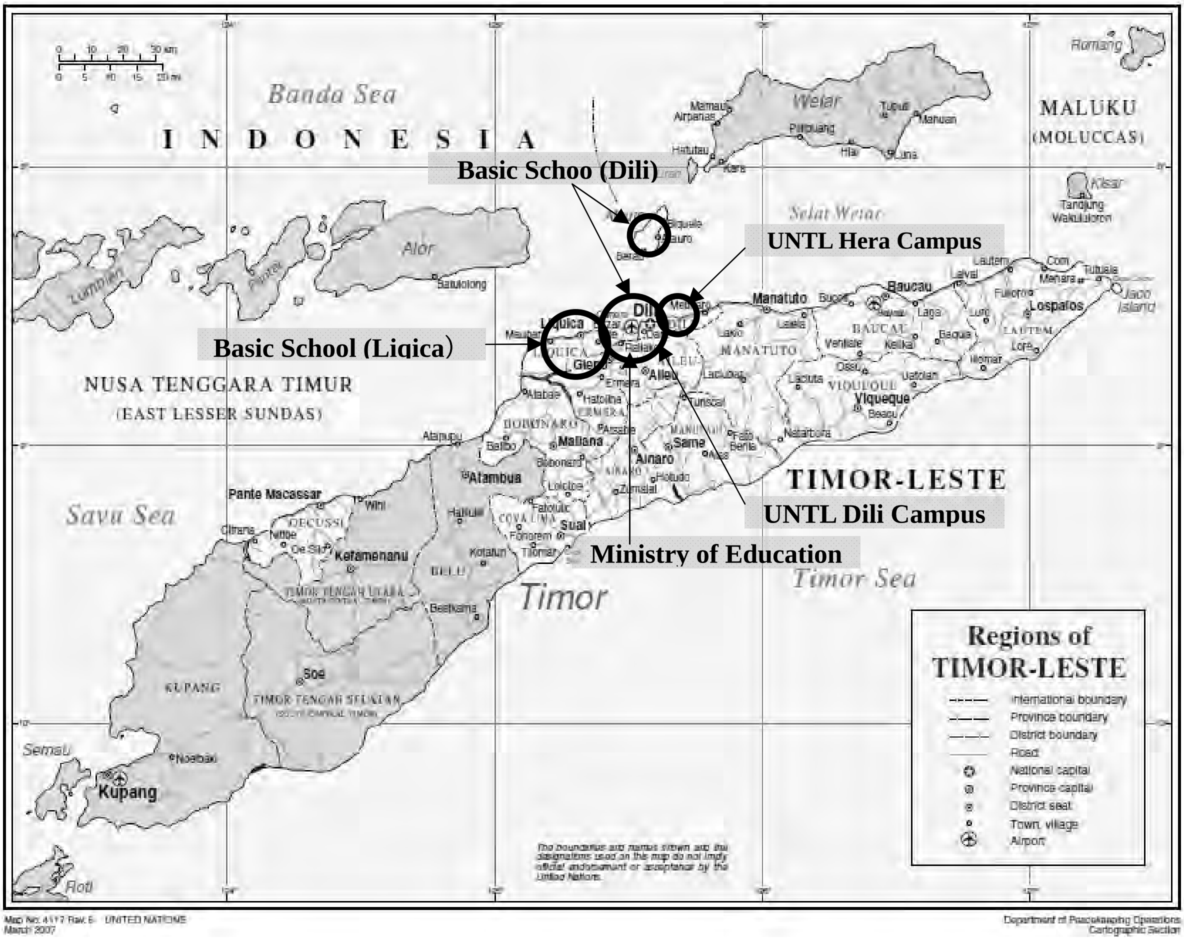
5. Technical Memorandum (Third Site Survey)
6. Equipment List
7. Outline of Major Equipment
8. Operation and Maintenance Cost for the Equipment
9. References

Location Map

Location Map of the Democratic Republic of Timor-Leste



Location Map of the Site

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Abbreviations

Abbreviation	Orginal name
ADB	Asisan Development Bank
AusAID	Australian Government's Overseas Aid Program
CO2	Carbon Dioxide
E/N	Exchange Note
EB	Basic School
EDTL	Electricidade de Timor-Leste
EP	Primary School
EPS	Preriminary Secondary School
ES	Secondary School
EU	European Union
F/S	Feasibility Study
FAO	Food and Agriculture Organization of the United Nations
G/A	Grant Agreement
GDP	Gross Dometic Product
GNI	Gross National Income
GTZ	German Agency for Technical Cooperation
IMF	International Monetary Fund
IOM	International Organization for Migration
JIS	Japan Industrial Standard
NGO	Non-Governmental Organizations
PLN	PT PLN
PSDP	Power Sector Development Plan
REA	Registry of External Assistance
SEPE	Secretary of State for Energy policy
UN	United Nations
UNDP	United Nations Development Programme
UNICEF	United Nations International Children's Emergency Fund
UNMIT	United Nations Integrated Mission in East Timor
UNTL	University of Timor-Leste
USAID	United States Agency for International Development
WB	World Bank
WFP	World Food Programme
WHO	World Health Organization

Chapter 1. Background of the Project

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1-1 Background and Outline of the Project

Shift to clean energy including solar power generation is mentioned as one of the mitigation measures in the overall climate change measures, and the Framework Convention on Climate Change, which went into effect in 1994, and the Kyoto Protocol, which was ratified by 170 nations, also seek developing countries for efforts to reduce greenhouse gas emissions, including CO_2. In January 2008, Japan announced "Cool Earth Partnership" in the Davos Forum, as one of the initiatives for the developing countries that are willing to contribute to climate stabilization while keeping balance between reduction of greenhouse gas emissions and economic growth, and introduced "Grant Aid for Environmental Programs" in fiscal 2008 in order to support the developing countries that are not provided with sufficient performance capability or funds to keep balance emissions reduction, such as energy saving, and economic growth.

On the other hand, the electrification rate of the Democratic Republic of Timor-Leste (hereinafter referred to as "Timor-Leste") is as low as 36.6% in national average, and power failure also frequently occurs in Dili. Almost all main power sources in “Timor-Leste” depend on diesel electric power generation, and the fuel used for power generation (crude oil) is all imported. In addition, the country has been seriously affected by global fluctuation in oil price, as known from the shortage of power supply resulting from the recent sharp rise in international oil price. Hence, a departure from dependence on primary energy is recognized as emergency needs in “Timor-Leste”, and expectation for clean energy including solar power generation is growing in the country. The government of “Timor-Leste” is also trying to shift its policy to the introduction of clean energy, such as hydraulic, wind, and solar power generation. However, the most of its national budget for the electric power sector are spent on fuel import and electricity charges, so it is difficult to realize its policy.

Under such circumstances, “Timor-Leste” decided to participate in the Cool Earth Partnership, and announced that its urgent issue is to aim to establish both reduction of greenhouse gas emissions and economic growth by implementing adaptation and mitigation measures in the overall climate change measures.

In view of the foregoing situation, Japan conducted a field survey in proposed sites including Hospitals, University of Timor Leste (hereinafter referred to as “UNTL”), and Basic Schools about the possibility of power supply by solar power generation in “Timor-Leste”. As the result of this survey, it was finally decided upon request of the “Timor-Leste” Government to formulate a cooperation plan for the following 24 proposed sites.

- UNTL, Dili Campus (Head Office, Faculty of Agriculture and Law)	1 site
- UNTL, Dili Campus (Faculty of Economy, Education and Health Science)	1 site
- UNTL, Hera Campus (Faculty of Engineering)	1 site
- Main building of the Ministry of Education	1 site
- Basic school	20 sites

Power generation requested for each proposed site is as follows.

Table 1-1 Requested Sites and Amount of Power Generation

Proposed Sites		Power generation (approx.)
1. UNTL		
1)	Dili: Head Office, Faculty of Agriculture and Law	10-30kW
2)	Dili: Faculty of Social Economics, Education, Health Science	10-30kW
3)	Hera: Faculty of Engineering	30-70kW
		2-6kW
2. Ministry of Education		
1)	Main Building	50kW
3. Public Basic Schools		
1)	Atauro	2kW
2)	Bikeli	2kW
3)	August 30	2kW
4)	Fatometa	2kW
5)	Manleuana	2kW
6)	Farol	2kW
7)	Bidau Acadiruhun	2kW
8)	Hera	2kW
9)	Metinaro	2kW
10)	Liquica	2kW
11)	Darulete	2kW
12)	Bazartete	2kW
13)	Leorema	2kW
14)	Kasai	2kW
15)	Maubara	2kW
16)	Lois	2kW
4. Private Basic Schools		
17)	Sao Pedro	2kW
18)	Paulo VI	2kW
19)	Crystal	2kW
20)	Sao Francisco Xavier	2kW

1-2 Natural Conditions

(1) Temperature

"Timor-Leste" belongs to the tropical savanna climate, the temperature of Dili ranges from 19.8 °C (Jul. to Aug.) to 31.6 °C (Nov. to Dec.), and its annual average temperature is 26.5 °C. Temperature difference between the dry season (Apr. to Sept.) and the rainy season (Oct. to Mar.) is also small.

(2) Rainfall

The rainfall of "Timor-Leste" varies according to monsoons, which separate the seasons into the dry season when the southeast trading wind blows and the rainy season when the northwest monsoon blows. In the rainy season, roads in municipalities are often made impassable by flood. Expect for the mountainous regions with high rainfall, annual rainfall is 1,000-2,000 mm in general. Average rainfall is small in Dili and Liquica Districts, the proposed sites of the project, since their altitudes are rather low.

Table 1-2 Annual Rainfall in Dili and Liquica Districts Unit: mm

Districts	Altitude	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Full year
Dili	4m	139	135	149	90	83	60	32	27	23	35	70	149	992
Liquica	25m	214	180	160	138	165	112	62	44	35	39	95	201	1,445

Source: "Timor-Leste" Agriculture, Forestry, and Fishery Industries Development Program Survey (JICA)
* Measurement period: Dili: 1953-1999, Liquica: 1956-1974

(3) Solar radiation

The annual average solar radiation in "Timor-Leste" is 1.73 times that in Japan, as shown in the following table. The annual number of days without solar radiation is 47.03 days (about 12% per year), which is appropriate in introducing solar system.

Table 1-3 Monthly Standard Solar Radiation in "Timor-Leste" and Japan (kWh/m^2/day) * 22-year average

	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Annual average
"Timor-Leste" (Dili)	5.75	5.59	6.17	6.12	5.85	5.54	5.76	6.45	7.09	7.34	6.96	5.99	6.22
Japan (Kanto Region)	2.42	3.20	40.1	4.87	4.95	4.34	4.41	4.41	3.29	3.00	2.50	2.23	3.63

Source: Website of Atmospheric Science Data Center

Table 1-4 Monthly Number of Consecutive Days without Solar Radiation in "Timor-Leste" (days)

	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
1 day	0.75	0.84	0.91	0.88	0.68	0.58	0.45	0.53	0.44	0.56	0.84	0.83
3 days	1.81	1.97	1.95	1.77	1.29	1.23	0.75	0.69	0.66	1.29	1.48	2.09
7 days	3.07	3.12	3.05	3.14	2.03	1.92	0.98	1.09	1.16	1.50	2.57	3.30
14 days	4.19	4.80	3.88	5.13	3.68	2.46	1.35	1.70	1.43	1.91	4.12	4.65
21 days	5.28	5.20	4.63	4.23	4.51	2.01	1.63	1.76	1.50	2.44	4.54	6.84
1 month	4.85	4.90	4.32	4.85	5.29	1.46	1.66	1.58	1.35	3.29	3.92	5.64

Source: NASA: Website of Atmospheric Science Data Center

The following table shows the data of solar radiation measurement conducted by the engineering department of the "UNTL" in Hera Campus in 2009 (July - November). The data of each month is almost the same as the average of 22 years shown in Table 2-8, which verifies that the country's solar radiation is suitable for solar system introduction.

Table 1-5 2009 (July-Nov.) Solar Radiation in Hera Campus

Jul.	5.63 kWh/m^2/day
Aug.	6.24 kWh/m^2/day
Sep.	6.31 kWh/m^2/day
Oct.	6.49 kWh/m^2/day
Nov.	6.23 kWh/m^2/day

Table 1-6 Solar Radiation in Hera Campus by Week in 2009 (July - November)

Month / Time	July 2009					Aug. 2009				Sep. 2009			
	6/29-7/5	7/6-7/12	7/13-7/19	7/20-7/26	7/27-8/2	8/3-8/9	8/10-8/16	8/17-8/23	8/17-8/23	8/31-9/6	9/7-9/13	9/14-9/20	9/21-9/27
5:30													
6:00	0.00146	0.00144	0.00137	0.00120	0.00100								
6:30	0.00159	0.00158	0.00156	0.00138	0.00121								
7:00	0.01278	0.01026	0.01005	0.01039	0.01460						0.02569	0.03359	0.03655
7:30	0.04645	0.04582	0.04698	0.05208	0.06001	0.05236	0.04347	0.03161	0.01284	0.01778	0.05137	0.06224	0.06125
8:00	0.12138	0.12515	0.12014	0.14630	0.13716	0.18969	0.18277	0.15610	0.04051	0.03655	0.20747	0.27070	0.28453
8:30	0.24141	0.24735	0.22014	0.23442	0.25777	0.29836	0.31812	0.33195	0.19166	0.21142	0.39715	0.42284	0.42482
9:00	0.37680	0.36184	0.33463	0.34959	0.40174	0.45544	0.44260	0.45248	0.35764	0.38332	0.51571	0.52756	0.54535
9:30	0.48041	0.49401	0.48086	0.48063	0.52348	0.55918	0.54337	0.55819	0.47619	0.52262	0.62636	0.64315	0.64809
10:00	0.57563	0.58787	0.44647	0.57585	0.63140	0.65797	0.64414	0.64809	0.58388	0.57202	0.69551	0.68761	0.72910
10:30	0.66575	0.68105	0.53981	0.65090	0.72889	0.73701	0.72318	0.72318	0.68366	0.70638	0.78641	0.79530	0.80320
11:00	0.72707	0.67810	0.58674	0.81254	0.72684	0.78641	0.79826	0.82197	0.76368	0.75479	0.85161	0.87335	0.88322
11:30	0.80212	0.73478	0.62981	0.86560	0.78693	0.83185	0.85951	0.88125	0.84173	0.80221	0.88520	0.72713	0.87927
12:00	0.89257	0.77604	0.71528	0.83435	0.91366	0.86544	0.81209	0.89903	0.91879	0.84766	0.93460	0.97609	0.98400
12:30	0.62913	0.79554	0.78103	0.85131	0.82343	0.87532	0.89903	0.82790	0.97016	0.88026	0.88322	0.87038	1.00672
13:00	0.86356	0.89620	0.85426	0.80665	0.87990	0.87532	0.90101	0.90496	0.97807	0.96127	0.95436	0.97016	0.98202
13:30	0.74272	0.87861	0.84292	0.93905	0.75995	0.85556	0.87927	0.88718	0.94250	0.93954	0.91286	0.82592	0.89212
14:00	0.76766	0.84519	0.80166	0.88713	0.87582	0.82000	0.83976	0.84370	0.91286	0.92077	0.87730	0.77060	0.74886
14:30	0.64455	0.68876	0.71052	0.84000	0.71755	0.78048	0.78838	0.78245	0.88125	0.87137	0.81012	0.77850	0.53349
15:00	0.61712	0.63367	0.52348	0.76312	0.72594	0.73503	0.69552	0.68959	0.81012	0.81012	0.70737	0.75084	0.44655
15:30	0.57291	0.58787	0.34810	0.65838	0.65248	0.60660	0.61650	0.62833	0.74294	0.73503	0.51966	0.65007	0.40111
16:00	0.44452	0.47383	0.32261	0.52643	0.47068	0.48805	0.53744	0.52756	0.60660	0.64612	0.45050	0.52065	0.20747
16:30	0.27956	0.38020	0.24050	0.37204	0.42305	0.39913	0.36159	0.39123	0.48409	0.52164	0.31911	0.31614	0.15511
17:00	0.12102	0.23649	0.16351	0.24165	0.22225	0.23118	0.21932	0.24304	0.33985	0.33096	0.22328	0.24699	0.14128
17:30	0.15383	0.28394	0.17076	0.15544	0.11032	0.12745	0.09287	0.14424	0.29243	0.22624	0.12942	0.14029	0.06422
18:00	0.03177	0.08530	0.03480	0.04323	0.05253	0.03853	0.03260	0.04940	0.16005	0.13634	0.04051	0.03952	0.02964
18:30	0.00555	0.00453	0.00476	0.00692	0.01203				0.04742	0.04051			
19:00													
Total	10.81930	11.53541	9.93275	12.10659	11.91062	12.26635	12.23080	12.42343	13.03892	12.87492	12.80479	12.89962	11.88797
×0.5	**5.40965**	**5.76770**	**4.96638**	**6.05329**	**5.95531**	**6.13318**	**6.11540**	**6.21171**	**6.51946**	**6.43746**	**6.40240**	**6.44981**	**5.94399**
Monthly average	5.63047					6.24494				6.30841			

Month / Time	Oct. 2009					Nov. 2009			
	9/30-10/4	10/5-10-11	10/12-10/18	10/19-10/25	10/26-11/1	11/2-11/8	11/9-11/15	11/16-11-22	11/23-11/29
5:30									
6:00									
6:30		0.00988	0.01383	0.01581	0.01581	0.01778	0.02569	0.02865	0.02371
7:00	0.04347	0.04545	0.04643	0.05434	0.05335	0.05928	0.62520	0.08299	0.09682
7:30	0.08299	0.87930	0.08892	0.10472	0.14424	0.20747	0.21932	0.16400	0.17585
8:00	0.29441	0.28552	0.31417	0.33393	0.33590	0.39320	0.36949	0.29441	0.30626
8:30	0.41494	0.36752	0.42284	0.42482	0.46236	0.51176	0.46038	0.41296	0.40901
9:00	0.52954	0.49200	0.49397	0.55720	0.57894	0.62241	0.59079	0.52361	0.54337
9:30	0.63624	0.61253	0.64019	0.67773	0.68168	0.72713	0.70935	0.60265	0.65600
10:00	0.73306	0.73306	0.71527	0.77455	0.75677	0.81012	0.77060	0.65995	0.73898
10:30	0.81407	0.84074	0.71132	0.81802	0.82197	0.89310	0.82197	0.70144	0.79826
11:00	0.87532	0.87137	0.69749	0.86742	0.89310	0.96226	0.90891	0.80419	0.87137
11:30	0.93262	0.86050	0.85359	0.97214	0.92867	0.88718	0.86149	0.73108	0.68959
12:00	0.95436	0.83778	0.92867	0.96226	0.95633	1.01067	0.97807	0.91089	0.72318
12:30	0.93065	0.97807	0.93855	1.00771	0.96028	1.00375	0.91484	0.92472	0.67180
13:00	0.94448	0.95436	0.87730	0.94645	0.93855	0.99387	0.96028	0.78838	0.80814
13:30	0.89508	0.73898	0.81802	0.94547	0.90101	0.95041	0.83975	0.77455	0.69947
14:00	0.80419	0.64019	0.84371	0.84568	0.84963	0.82197	0.87730	0.58882	0.56313
14:30	0.78245	0.68662	0.75677	0.64217	0.77580	0.83580	0.75874	0.45446	0.54732
15:00	0.69749	0.63031	0.63821	0.54732	0.68959	0.74491	0.61648	0.38135	0.31911
15:30	0.54732	0.52460	0.58091	0.47619	0.58882	0.63426	0.45841	0.37383	0.33393
16:00	0.45248	0.38629	0.45841	0.39320	0.49793	0.44062	0.40703	0.27465	0.23019
16:30	0.28058	0.23118	0.32602	0.28848	0.34183	0.35369	0.35566	0.21340	0.20747
17:00	0.20549	0.17585	0.22130	0.17882	0.24896	0.24896	0.25687	0.15214	0.10867
17:30	0.09781	0.06817	0.09682	0.08101	0.11757	0.11658	0.13041	0.08496	0.06224
18:00	0.02964	0.02173	0.02766	0.02075	0.03359	0.04051	0.04742	0.03063	0.03557
18:30					0.00593				
19:00									
Total	12.97868	12.87200	12.51037	12.93619	13.57861	14.28769	13.96445	10.95871	10.61944
×0.5	**6.48934**	**6.43600**	**6.25519**	**6.46810**	**6.78931**	**7.14385**	**6.98223**	**5.47936**	**5.30972**
Monthly average	6.48759					6.22879			

* Since each data is received every 30 minutes, it is multiplied by 0.5 for conversion to a kWh basis.
Weekly average data is adopted.

1-3 Social and Environmental Issues

Batteries included in the equipment to be procured under this project need to be replaced 7 to 10 years after the procurement and old ones must be disposed of at each replacement.

Environmental standards and regulations are in the process of organization in “Timor-Leste”, and it is sought to ensure the collection of used batteries.

Chapter 2. Contents of the Project

Chapter 2 Contents of the Project

2-1 Basic Concept of the Project

2-1-1 Objectives of the Project and its Overall Goals

In January 2008, Japan announced "Cool Earth Partnership" in the Davos Forum, as one of the initiatives for the developing countries that are willing to contribute to climate stabilization while keeping balance between reduction of greenhouse gas emissions and economic growth, and introduced "Grant Aid for Environmental Programs" in fiscal 2008 in order to support the developing countries that are not provided with sufficient performance capability or funds to keep balance emissions reduction, such as energy saving, and economic growth.

For its energy field, “Timor-Leste”, as stated in its "Development Strategies by Sector" under the National Development Policy, aims to develop its economic energy sources, such as natural gas, solar power, and hydraulic power, and thereby enhance the capability of power generation/self-supply. In such situation, “Timor-Leste” decided to participate in the Cool Earth Partnership.

Through the implementation of climate change measures and mitigation measures in “Timor-Leste”, this Project aims to establish both reduction of greenhouse gas emissions and economic growth in the country.

2-1-2 Outline of the Project

This Project is expected to reduce the country's dependence on import fuel by shifting part of the diesel electric power generation to natural/recyclable energy through introduction of a solar energy power generation system, and thereby strengthen the nation's independence. In addition, establishment of both reduction of greenhouse gas emissions and economic growth is expected from this Project. This Project is the development of solar power generation system.

2-2 Basic Design of the Requested Japanese Assistance

2-2-1 Design Policy

(1) Basic Policy

The Project is in principle for the grid connected system with the power supplied by power companies since it is aimed to replace part of the diesel electric power generated by existing power companies with natural/recyclable energy. However, in consideration the priority of needs in the Ministry of Education, a stand alone with battery type of solar power generation system is planned in some non-electrified areas.

1) Target facilities

This Project covers educational facilities in Dili (including Atauro Island) and Liquica Districts, which are under jurisdiction and operation of the Ministry of Education, and the main building of the Ministry of

Education, and also covers the equipment plan for the sites where space necessary for installation of solar power generation system is secured.

2) Planned equipment

The grid connected system covers the supply of electric power in the target facilities and prevents the adverse flow to the power supply line from power companies. In addition, since the solar power generation system to be introduced provides part of the total electric power necessary for the target facilities, if power supply from the power company stops, the supply of electric power from the solar power generation will also be suspended.

The portion of foundation work, for which safe installation of equipment is required, is also included in the Project.

(2) Policy on Natural Environment Conditions

In the Project, influence of natural environment is expected to little, but attention should be paid to installation area and contents of foundation work so that the solar power generation system may not be affected by local heavy rain or similar natural phenomenon, which occurs on rare occasion.

(3) Policy on Social Economy Conditions

Since the Project covers educational facilities and the main building of Ministry of Education currently in service, safety measures should be taken for students, school personnel and staff when installing the solar power generation system. In addition, consideration should be made for installation work and training operation so that they may not affect school classes or work of school personnel.

(4) Procurement Policy

1) Eligible source country

In this Project, Japanese products shall be adopted and products of Japanese enterprises shall also be procured for system components.

2) Means of transportation

When transporting equipment from Japan, a container shall be shipped from Yokohama Port and unloaded at Dili Port, the main port of “Timor-Leste”. About 40 days is required for transportation from Yokohama Port to Dili Port.

For transportation to target sites in Atauro Island, after customs clearance in Dili Port, the container cargo is reloaded into trucks in Dili and then transported by ferry. The cargo packed in wood boxes is transported to target sites. It takes about 3 hours from Dili Port to Atauro Island.

For transportation to other target sites, after customs clearance in Dili Port, the container cargo is reloaded into trucks in Dili and then transported by truck to each facility. The distance from the Port to each site is about 10-40 km, and two days are required for transportation including the day of reloading.

(5) Policy on Operation and Maintenance

This project is based on a grid connected system that excludes batteries in order to reduce maintenance cost. In non-electrified areas, however, the minimum-required numbers of batteries are included in the system for stable power supply without applying load to the equipment (audio-visual equipment) that uses solar power.

(6) Policy on Grade, Specifications, Quantity, etc. of Equipment

1) Specifications / grade of equipment

Since installation space in proposed sites is limited, specifications that enable larger power generation per panel area should be adopted.

2) Quantity of equipment

The quantity of solar panels should be adjusted in the solar power generation system according to the electric energy required. However, since the planned system capacity is the product of the nominal maximum power of the solar power module and the number of panels installed, it should be recognized as pre-condition that electric energy to be generated from the actual use of the solar system may greatly change according to conditions, such as actual solar radiation and environment surrounding the installation sites.

(7) Policy on Whole Process

In terms of the work period of the Project, installation work and implementation supervision should be conducted by two or more teams so that the work may be completed in a short period of time.

2-2-2 Basic Plan

(1) Overall Plan

Equipment to be procured in the Project is planned to be used for the following existing facilities.

• "UNTL", Dili Campus (Head Office, Faculty of agriculture and law)	1 site
• "UNTL", Dili Campus (Faculty of economics, education and health science)	1 site
• "UNTL", Hera Campus (Faculty of engineering)	1 site
• Main building of the Ministry of Education	1 site
• Basic school	20 sites

(2) Examination of requested equipment

The amount of power generation and system structure under the plan were examined for each site by confirming whether the space for panels and components of the solar power generation system is secured in each site and whether a power company supplies electricity to the site.

The amount of power generation from the solar power generation system was designed to be within 70%

of the assumed maximum demand of each facility except for Basic Schools in the non-electrified areas.

Note that Hera Campus of "UNTL" receives power supply from the power company but a Stand Alone with battery system is also planned for the engineering department to study the solar power generation system.

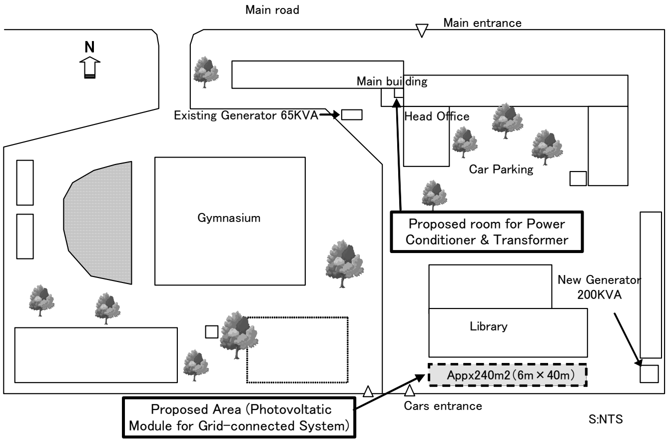
The project sites and planned power generation for each site are as follows.

Table 2-1 Project sites and planned power generation

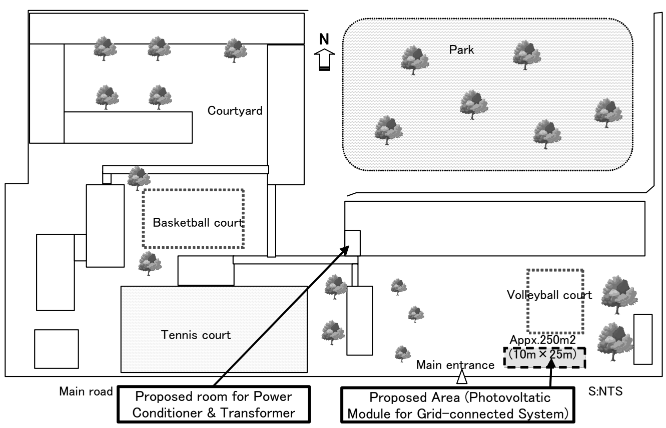
<table>
<tr><th colspan="2">Project Sites</th><th>Power supply</th><th>Planned kW</th><th>System Contents</th></tr>
<tr><td colspan="5">1. University of "Timor-Leste"</td></tr>
<tr><td>1)</td><td>Dili: Head Office, Faculty of Agriculture and Law</td><td>○</td><td>10kW</td><td>Grid-connection</td></tr>
<tr><td>2)</td><td>Dili: Faculty of Economics, Education, and Health Science</td><td>○</td><td>10kW</td><td>Grid-connection</td></tr>
<tr><td rowspan="2">3)</td><td rowspan="2">Hera: Engineering Dept.</td><td>○</td><td>50kW</td><td>Grid-connection</td></tr>
<tr><td>-</td><td>6kW</td><td>Stand Alone</td></tr>
<tr><td colspan="5">2. Ministry of Education</td></tr>
<tr><td>1)</td><td>Main Building</td><td>○</td><td>50kW</td><td>Grid-connection</td></tr>
<tr><td colspan="5">3. Basic schools</td></tr>
<tr><td colspan="5">(1) Dili District</td></tr>
<tr><td>1)</td><td>Atauro</td><td>x</td><td>2kW</td><td>Stand Alone</td></tr>
<tr><td>2)</td><td>Bikeli</td><td>x</td><td>2kW</td><td>Stand Alone</td></tr>
<tr><td>3)</td><td>August 30</td><td>○</td><td>2kW</td><td>Grid-connection</td></tr>
<tr><td>4)</td><td>Fatometa</td><td>○</td><td>2kW</td><td>Grid-connection</td></tr>
<tr><td>5)</td><td>Manleuana</td><td>○</td><td>2kW</td><td>Grid-connection</td></tr>
<tr><td>6)</td><td>Farol</td><td>○</td><td>2kW</td><td>Grid-connection</td></tr>
<tr><td>7)</td><td>Bidau Acaduruhun</td><td>○</td><td>2kW</td><td>Grid-connection</td></tr>
<tr><td>8)</td><td>Hera</td><td>○</td><td>2kW</td><td>Grid-connection</td></tr>
<tr><td>9)</td><td>Metinaro</td><td>○</td><td>2kW</td><td>Grid-connection</td></tr>
<tr><td>10)</td><td>Sao Pedro</td><td>○</td><td>2kW</td><td>Grid-connection</td></tr>
<tr><td>11)</td><td>Paulo VI</td><td>○</td><td>2kW</td><td>Grid-connection</td></tr>
<tr><td>12)</td><td>Crystal</td><td>○</td><td>2kW</td><td>Grid-connection</td></tr>
<tr><td>13)</td><td>Sao Francisco Xavier</td><td>○</td><td>2kW</td><td>Grid-connection</td></tr>
<tr><td colspan="5">(2) Liquica District</td></tr>
<tr><td>14)</td><td>Liquica</td><td>○</td><td>2kW</td><td>Grid-connection</td></tr>
<tr><td>15)</td><td>Darulete</td><td>x</td><td>2kW</td><td>Stand Alone</td></tr>
<tr><td>16)</td><td>Bazartete</td><td>○</td><td>2kW</td><td>Grid-connection</td></tr>
<tr><td>17)</td><td>Leorema</td><td>x</td><td>2kW</td><td>Stand Alone</td></tr>
<tr><td>18)</td><td>Kasai</td><td>○</td><td>2kW</td><td>Grid-connection</td></tr>
<tr><td>19)</td><td>Maubara</td><td>○</td><td>2kW</td><td>Grid-connection</td></tr>
<tr><td>20)</td><td>Lois</td><td>○</td><td>2kW</td><td>Grid-connection</td></tr>
<tr><td colspan="3" rowspan="2">Subtotal</td><td>152kW</td><td>Interconnection</td></tr>
<tr><td>14kW</td><td>Stand Alone</td></tr>
<tr><td colspan="3">Total</td><td>166kW</td><td>-</td></tr>
</table>

Site drawings and planned installation place of solar system of each site are as shown below:

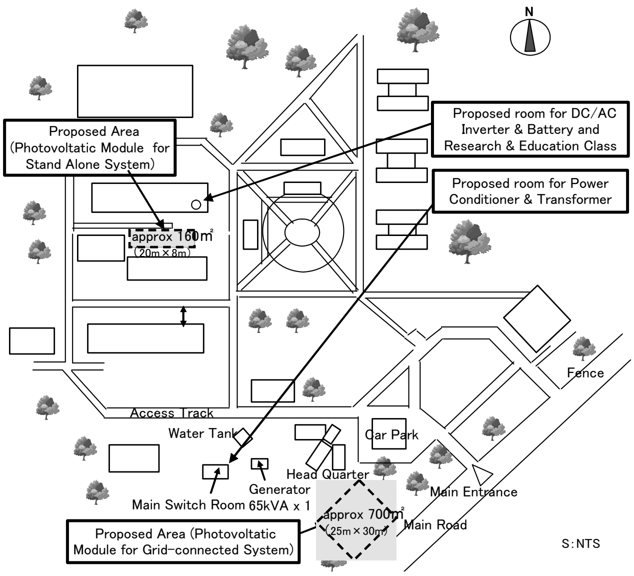
1) UNTL DILI Campus
Head Office, Faculty of Agriculture
Faculty of Law



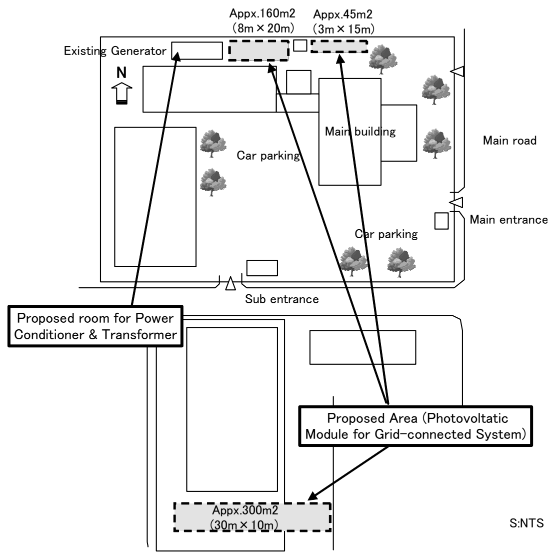
2) UNTL DILI Campus
Faculty of Economy, Faculty of Education,
Faculty of Health Science



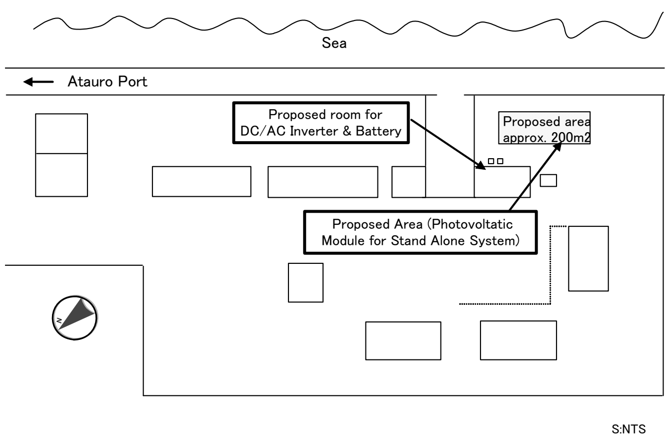
3) UNTL HERA Campus
Faculty of Engineering



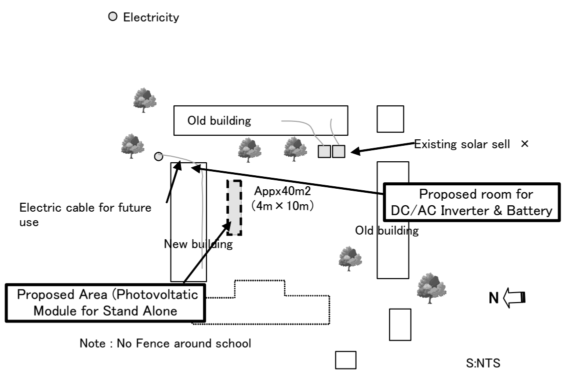
4) Ministry of Education
Main Building



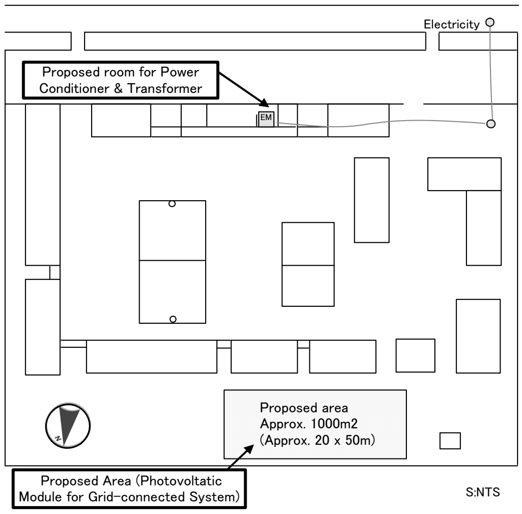
5) Basic School (Atauro)



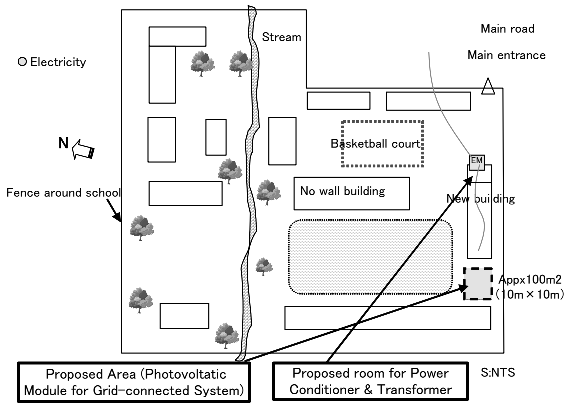
6) Basic School (Biqueli)



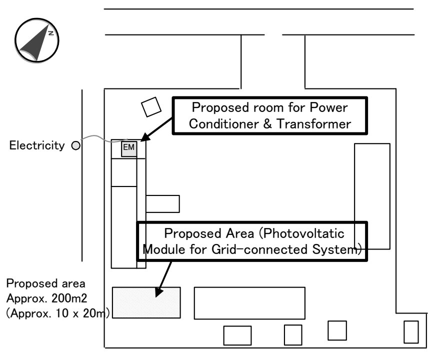
7) Basic School (30th August)



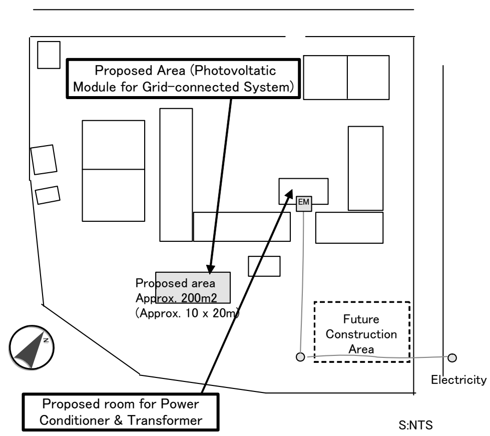
8) Basic School (Fatumeta)



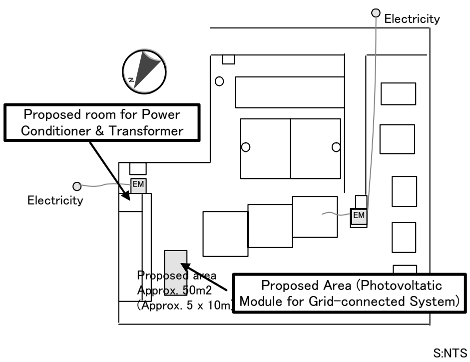
9) Basic School (Manleuana)



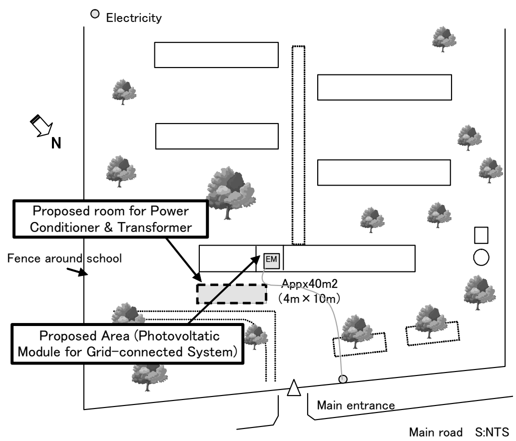
10) Basic School (Farol)



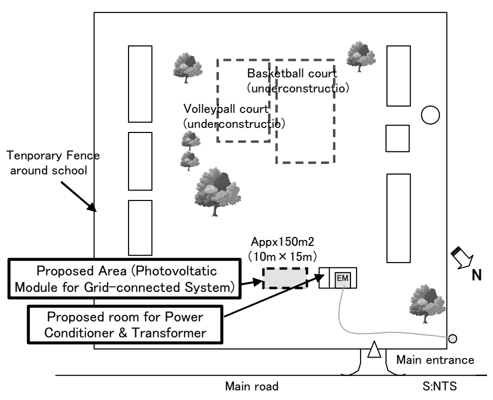
11) Basic School (Bidau Acadiruhun)



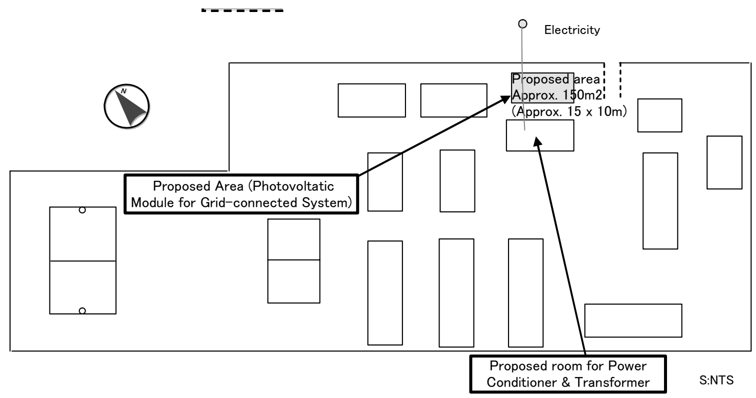
12) Basic School (Hera)



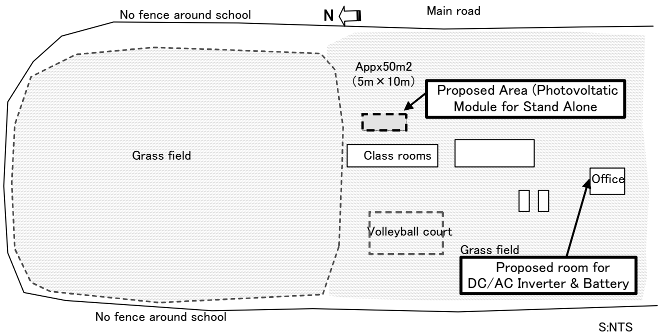
13) Basic School (Metinaro)



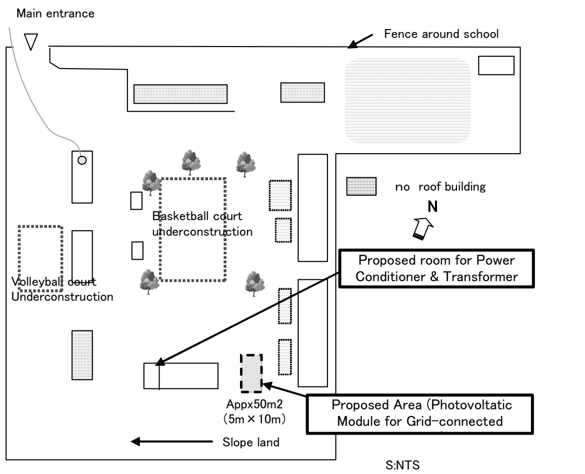
14) Basic School (Liquica)



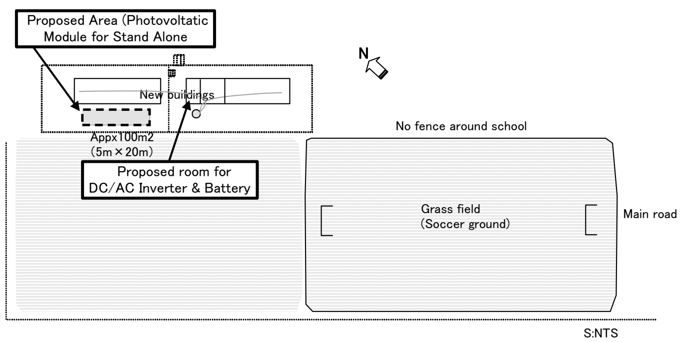
15) Basic School (Darulete)



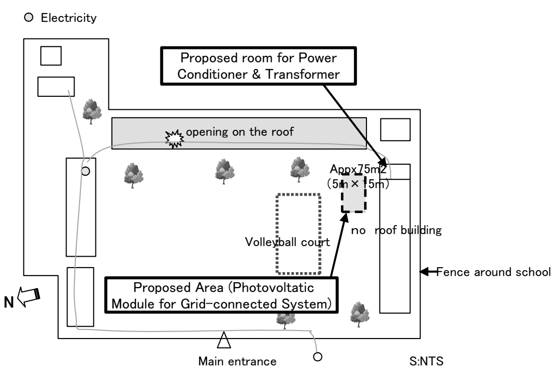
16) Basic School (Bazartete)



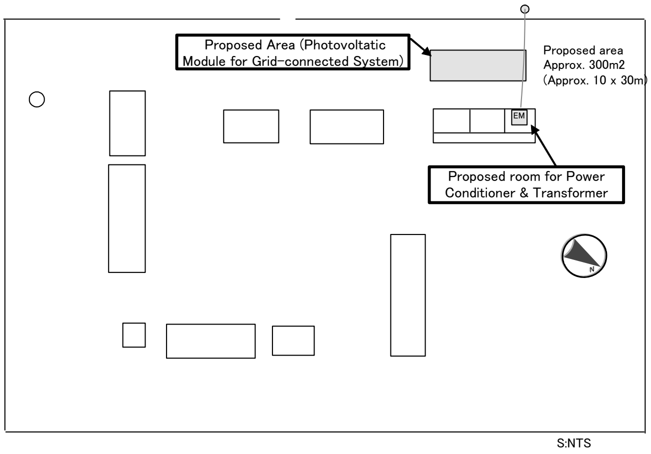
17) Basic School (Leorema)



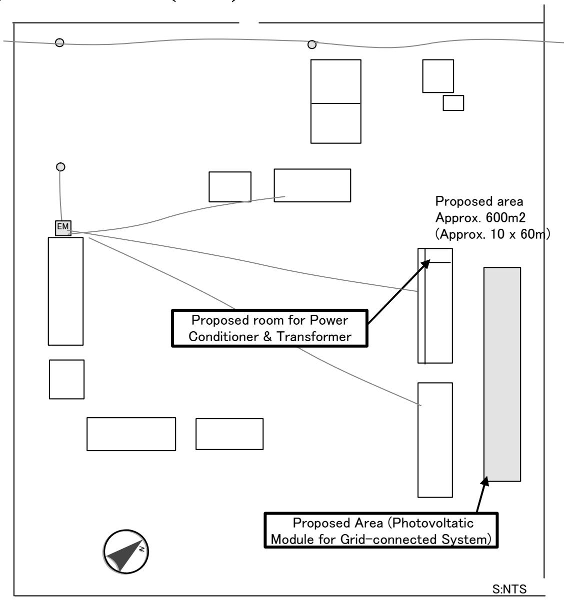
18) Basic School (Casait)



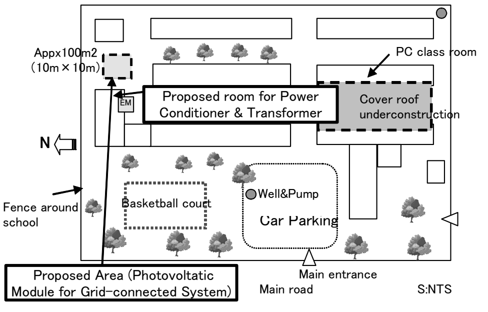
19) Basic School (Maubara)



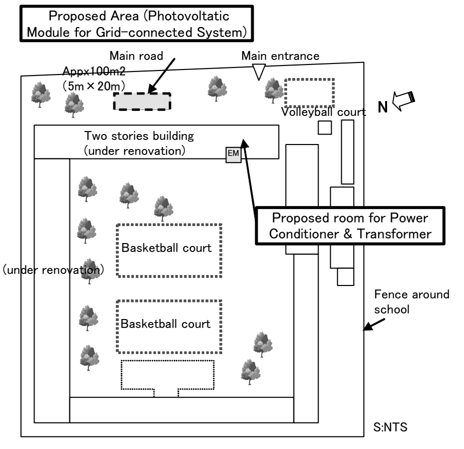
20) Basic School (Loes)



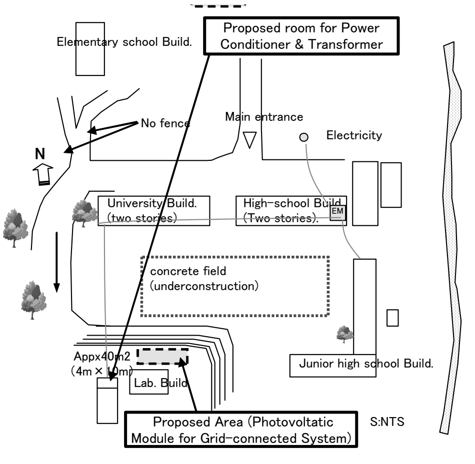
21) Basic School (Sao Pedro)



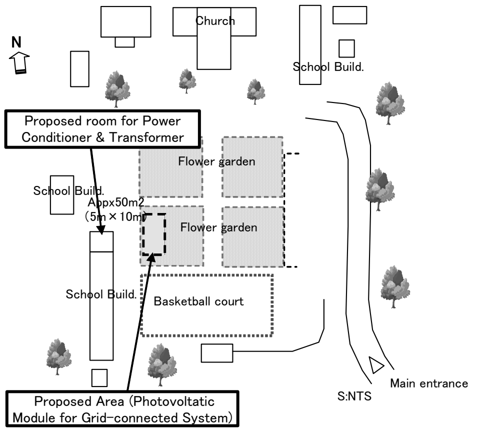
22) Basic School (Paulo VI)



23) Basic School (Cristal)



24) Basic School (Sao Francisco Xavier)



(3) Equipment Plan

In the Project, a grid connected type and stand alone with battery type of solar power generation systems are planned.

The outline of each system is as follows.

1) Grid-connected type

1-1) 2kW system (Basic schools in electrified areas)

Refer to Attachment for system structure and components list.

2kW ≒ Nominal maximum power of the module 210W x 12 panels = 2.52kW

If a commercial power supply fails, the supply from the solar power generation system will also stop.

- This is because the control power source of the power conditioner is supplied from the power company.
- This is also for preventing, as a safety measure, an electric shock resulting from the reverse power flow that may occur when working on troubleshooting (in a school or power company) or other occasions.

1-2) 10kW system (UNTL Dili Campus: two places)

Refer to Attachment for system structure and components list.

10kW ≒ Nominal maximum power of the module 210W x 48 panels = 10.08kW

If a commercial power supply fails, the supply from the solar power generation system will also stop.

- This is because the control power source of the power conditioner is supplied from the power company.
- This is also for preventing, as a safety measure, an electric shock resulting from the reverse power flow that may occur when working on troubleshooting (in a school or power company) or other occasions.

  If an existing emergency generator starts, interconnection is made possible, but if supply load is too small as compared with the capacity of the generator, power supply from the solar power generation system is suspended.
- This is because reverse power flow from the solar power generation system to the generator may arise and cause breakdown in the generator.

1-3) 50kW system (Ministry of Education, UNTL Hera Campus)

Refer to Attachment for system structure and components list.

50kW ≒ Nominal maximum power of the module 210W x 240 panels = 50.40kW

If a commercial power supply fails, the supply from the solar power generation system will also stop.

- This is because the control power source of the power conditioner is supplied from the power company.
- This is also for preventing, as a safety measure, an electric shock resulting from the reverse power

flow that may occur when working on troubleshooting (in a school or power company) or other occasions.

If an existing emergency generator starts, interconnection is made possible, but if supply load is too small as compared with the capacity of the generator, power supply from the solar power generation system is suspended.

- This is because reverse power flow from the solar power generation system to the generator may arise and cause breakdown in the generator.

2) Stand-alone with Battery type

2-1) 2kW system (Basic schools in non-electrified areas)

Refer to Attachment for system structure and components list.

2kW ≒ Nominal maximum power of the module 135W x 16 panels = 2.16kW

Power use at night time is not taken into account for the battery capacity

Electricity is constantly charged by the solar power generation system but a battery that enables the system use about 3 hours is provided in consideration of the instability in solar power generation. However, power use at night time is not assumed.

If there is no storage of electricity due to over discharge or any other reason, a period of about 3 days is necessary for charge.

2-2) 6kW system (UNTL, Hera Campus)

Same as above.

2-2-3 Basic Design Drawings

(1) Grid-connected type 2kW system (Basic schools, UNTL Hera Campus)

1) System overview

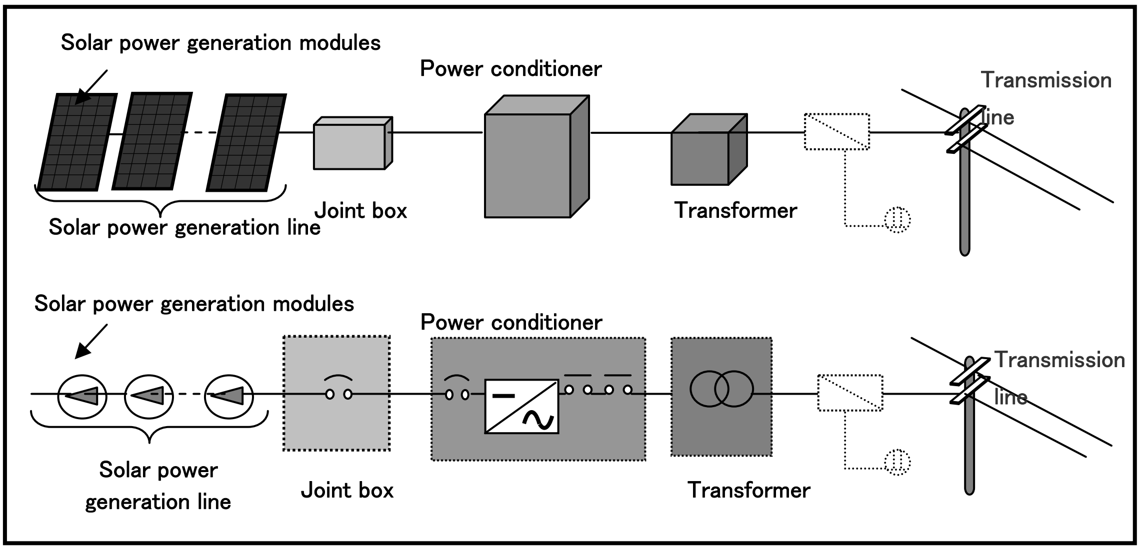


Figure 2-1 Overview of Grid-connected type 2kW System

2) Components list

Number	Equipment composition
1	Solar power generation modules
2	Frame of the solar power generation modules
3	Joint box
4	Power conditioner
5	Transformer
6	Cables, etc.

(2) Grid-connected type 10 and 50kW system (UNTL/Hera Campus and Dili Campus, Ministry of Education/ main building)

1) System overview

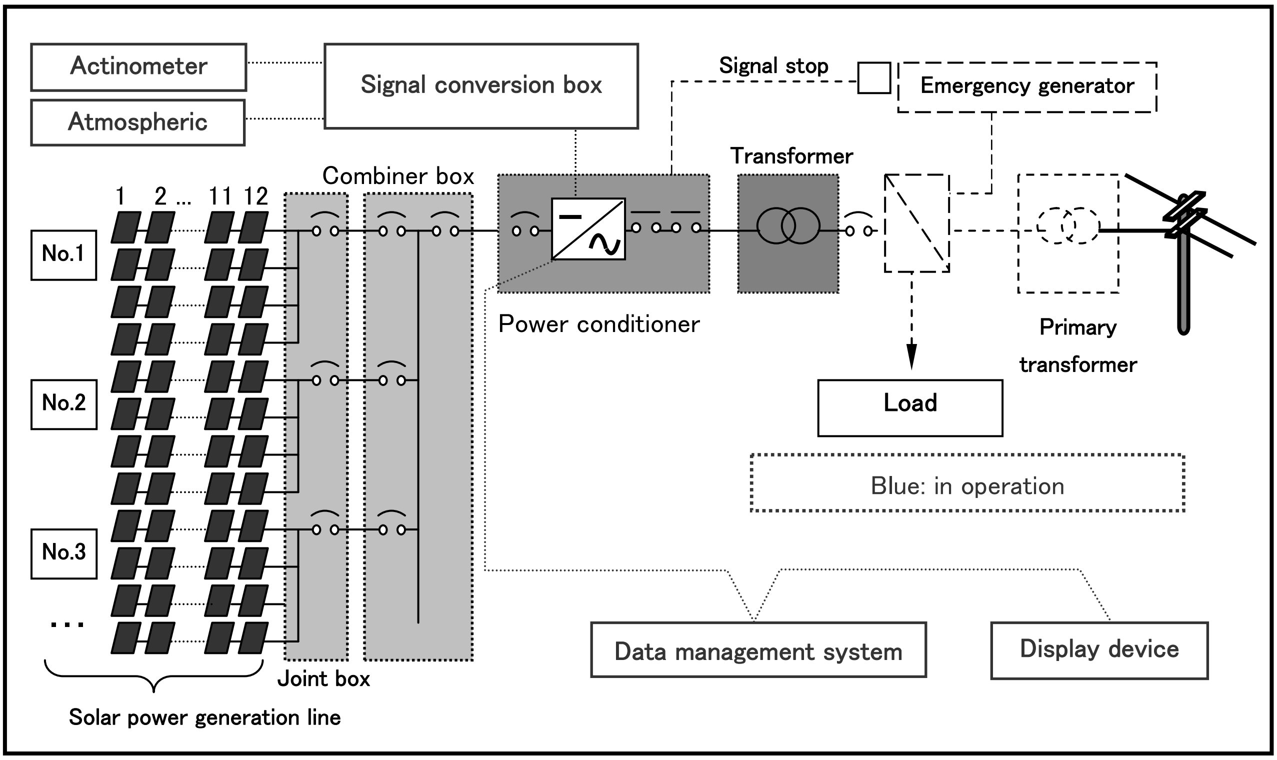


Figure 2-2 Overview of Grid-connected type 10 & 50kW System

2) Components list

Number	Equipment composition
1	Solar power generation modules
2	Frame of the solar power generation modules
3	Extension cables for the solar power generation modules
4	Combiner box
5	Joint box
6	Power conditioner
7	Transformer
8	Display device, data management system
9	Measuring device
10	Cables, etc.

(3) Stand alone with Battery type 2kW system

1) System overview

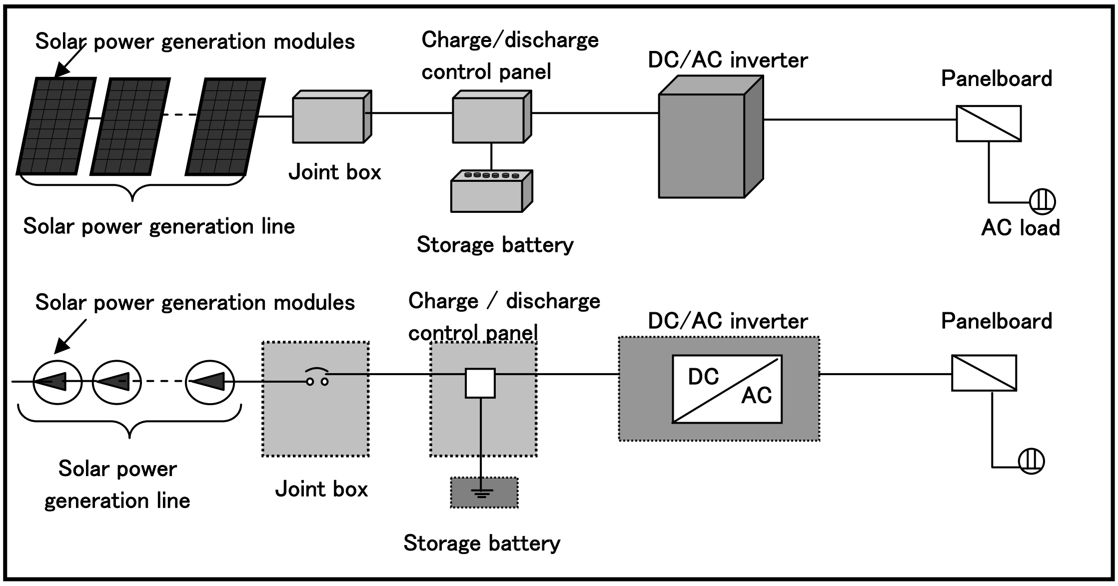


Figure 2-3: Overview of Stand alone with Battery type 2kW System

2) Components list

Number	Equipment composition
1	Solar power generation modules
2	Frame of the solar power generation modules
4	Joint box
5	DC/AC inverter
6	Charge / discharge control panel
7	Battery
8	External storage battery panel
9	Panel board
10	Cables, etc.

2-2-4 Implementation Plan

2-2-4-1 Implementation Policy

The Project is implemented in accordance with the framework of grant aid from the Japanese Government. To be specific, the project is officially started after both Japanese and "Timor-Leste" Governments approve it and execute Exchange of Notes (E/N) and Grant Agreement (G/A). Then, the procurement agent of Japan implements detailed design work (preparation of detailed design documents) in accordance with the agreement exchanged with "Timor-Leste". Equipment suppliers, who are Japanese corporations and determined through the tender system, conduct delivery / installation of equipment.

Examination concerning the implementation plan is conducted during the period of detailed design between the procurement agent and the persons concerned in the executive agency of the "Timor-Leste" Government. They also consult with each other so that works to be borne by Japan and "Timor-Leste" may be smoothly carried out in accordance with the implementation schedule specified in this report.

(1) Implementation System

The competent authority of this Project is the Secretary of State for Energy Policy of "Timor-Leste", and the executive agency is the Ministry of Education. Note that the Ministry of Finance takes charge of actions for tax exemption etc. in cooperation with the Secretary of State for Energy Policy.

(2) Procurement Agent

After both Japanese and "Timor-Leste" Governments execute E/N and G/A, the procurement agent of Japanese corporations executes a procurement agent agreement with the executive agency of "Timor-Leste" in accordance with the grant aid procedure of Japan. The procurement agent conducts the following operations in accordance with this agreement.

- Detailed design: Preparation of detailed design documents (specifications and other technical materials)
- Tender: Selection of equipment suppliers and procurement agreement
- Procurement supervision: Supervision of equipment procurement, installation, and operation / maintenance guidance

Detailed design means to decide the details of the procurement plan in accordance with the feasibility study specified herein and to prepare tender documents consisting of specifications, tender instruction, and draft of supply agreement, which are necessary for selecting Japanese corporations who supply equipment for the Project.

In offering the tender, the procurement agent carries out tender procedures including tender notice, acceptance of tender applications, eligibility examination, distribution of tender documents, acceptance of bid documents, and assessment of bids, executes a procurement agreement with equipment suppliers. The procurement agent also conducts operational cooperation concerning reporting to the executive agency of "Timor-Leste" and the Japanese Government.

Procurement supervision means the duties to verify whether operations of equipment supplier are implemented as set forth in the agreement, and to confirm the proper performance of the content of the agreement. The procurement agent performs the following operations in fairness in order to promote the performance of the assistance operation.

1) Guidance, advice, and adjustment concerning equipment procurement

Examine the equipment procurement process, plan, etc. and provide guidance, advice, and adjustment to equipment suppliers.

2) Inspection and approval of installation drawing etc.

Inspect erection drawings, documents, etc. submitted by equipment suppliers, and give instructions and approval for them.

3) Confirmation and approval of equipment

Confirm consistency between the equipment to be supplied by the supplier and contract documents, and give approval for adoption of the equipment.

4) Inspection

Stand by as needed during the inspection in the manufacturing process of equipment to ensure the quality and performance.

5) Reporting the progress in installation work

Grasp the status of implementation schedule and site and report the progress in installation work to both countries.

6) Training for equipment operation

Some equipment to be provided for grant aid requires knowledge on maintenance. For such equipment, it is necessary for the suppliers to provide on-site training to local persons concerned in "Timor-Leste" through the period of installation / adjustment/ test operation so that they master how to operate the equipment and techniques for troubleshooting and repair. The procurement agent provides guidance and advice for this training plan.

(3) Equipment Supplier

The equipment supplier selected through the tender executes an agreement the "Timor-Leste" side (procurement agent). In accordance with this agreement, the supplier conducts procurement, carry-in, and installation of materials and equipment and provides guidance concerning the operation and maintenance of supplied equipment to the "Timor-Leste" side. Also, the supplier establishes a system that enables continual supply of spare parts and consumables for value and guidance after delivery of the equipment.

2-2-4-2 Implementation Conditions

(1) Management of Installation Schedule

Installation work, operation guidance, etc. for the procured equipment will be implemented while target educational facilities are in operation. It is therefore necessary in installation work for the agent of "Timor-Leste" and the procurement agent of Japan to perform detailed and elaborate process management keeping close communication with each other so that educational activities of each target educational facility may not be disturbed.

(2) Necessity for Engineers

For long-term and effective operation of the procured equipment, it is necessary to dispatch engineers who instruct education personnel on the correct way of equipment operation and maintenance after installation / trial run. In the Project, engineers of the equipment manufacturer or the local agent are dispatched for providing guidance concerning equipment installation, adjustment, operation, and maintenance.

2-2-4-3 Scope of Works

(1) Japan

- Procurement of the equipment provided as grant aid and air and marine transportation to the port of unloading.
- Inland transportation from the port of unloading to the place of delivery.
- Installation, trial run, and adjustment of the equipment provided as grant aid.
- Explanation / guidance about the operation and maintenance of the equipment provided as grant aid

(2) "Timor-Leste"

- Leveling / development of the installation sites of the equipment to be procured.
- Securing of the route for carrying in the equipment.
- Provision of space in the site for temporary storage of the equipment.
- Power supply (outlet, breaker) necessary for installing the equipment, etc.
- Security measures for the equipment to be installed (fence, arrangement of security guards), etc.

2-2-4-4 Agent Supervision

(1) Procurement Supervision Policy

According to the measure set for grant aid assistance by the Japanese government, the procurement agent is required to organize a consistent project team which for detailed design based on the purpose of outline design, and perform operations smoothly. The policy concerning procurement supervision is as follows.

- Aim to complete equipment procurement without delay keeping close communication with the representatives of the relevant agencies of both Governments.

- Provide prompt and appropriate guidance / advice in fairness to equipment suppliers and other persons concerned.
- Provide appropriate guidance / advice about equipment management after delivery.
- After confirming that the equipment delivery was completed and conditions of the agreement were performed, the procurement agent stands by during the delivery of the equipment and completes the operations after obtaining acceptance approval from “Timor-Leste”.

(2) Procurement Supervision Plan

In performing the aforementioned operations, the procurement agent implements supervision by procurement supervision engineer and inspection engineer. In addition, the procurement agent dispatches engineers from time to time according to the progress in the work to engage them in necessary inspection / guidance / adjustment, and assigns responsible engineers in Japan so as to establish a system for communication with the local site and backup operation. The agent also reports various necessary matters concerning the progress, payment procedure, etc. for the assistance operation.

2-2-4-5 Quality Control Plan

All the materials and equipment planned to be procured in this Project are ready-made products. Moreover, in terms of the manufacturing standards of each equipment, equipment that satisfies JIS or other standards needs to be selected.

2-2-4-6 Procurement Plan

(1) Equipment Procurement Plan

Equipment to be procured shall be Japanese products.

(2) Transportation Plan

- Marine transportation

For the route of transporting Japanese products, a container shall be shipped from Yokohama Port and unloaded at Dili Port, the main port of “Timor-Leste”. About 40 days are required for transportation from Yokohama Port to Dili Port.

- Inland transportation

For inland transportation after customs clearance from Dili Port to the destination site, truck transportation through national highways is used. About 0.3 month is required for inland transportation including the customs clearance procedure.

2-2-4-7 Operational Guidance Plan

For proper use and maintenance of the equipment to be procured, the following training is provided by the supplier upon delivery, and technical materials necessary for maintenance, operation / maintenance manual, contact list of agents, manufactures, etc., if possible, etc. are prepared.

- Operating procedure (equipment outline, procedure, check points, etc.)
- Regular maintenance method (cleaning / adjustment, repair of minor faults, etc.)

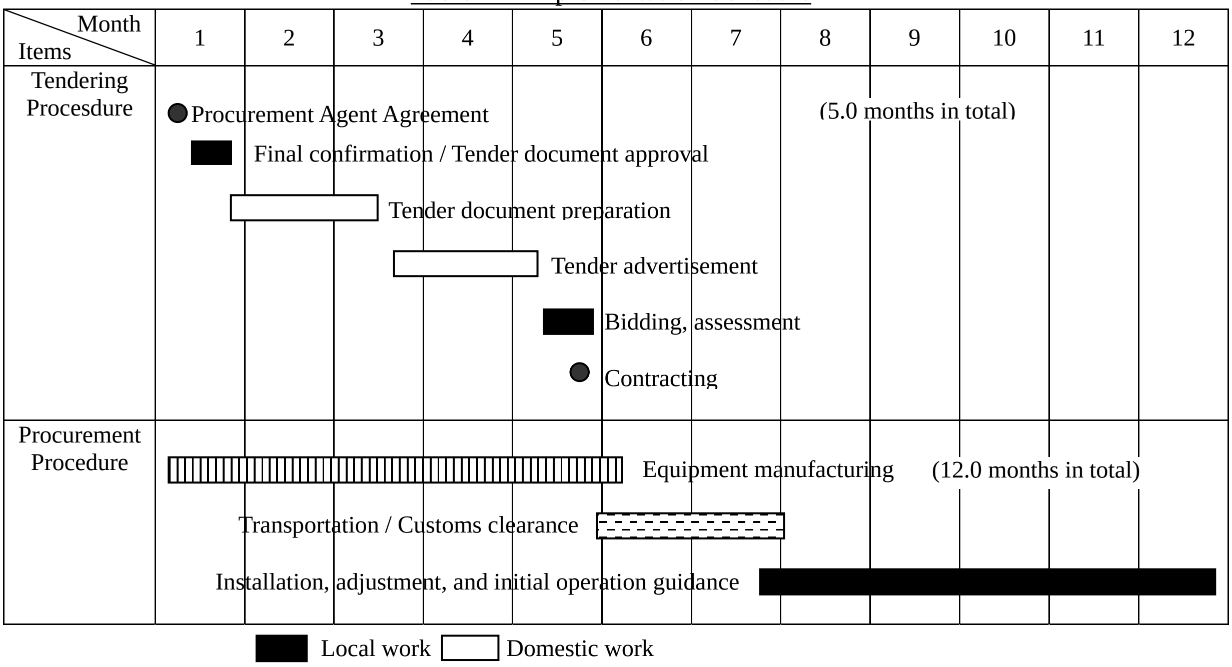
2-2-4-8 Soft Component (Technical Assistance) Plan

No soft component (technical assistance) is planned in this project.

2-2-4-9 Implementation Schedule

When E/N and G/A concerning the implementation of the Project are executed between Japan and "Timor-Leste", the procurement of equipment is implemented through each stage below.

Table 2-2 Implementation Schedule



2-3 Obligations of Recipient Country

In this Project, the items to be performed by implementing agency of "Timor-Leste" at its own cost are as follows.

(1) Equipment Transportation / Installation

- Leveling / development of the installation sites of the equipment to be procured.
- Securing of the route for carrying in the equipment.
- Provision of space in the site for temporary storage of the equipment.
- Power supply (outlet, breaker) necessary for installing the equipment, etc.
- Security measures for the equipment to be installed (fence, assessment of security guards), etc.

(2) Facilities and Operation

- Appropriate arrangement of equipment users in target facilities
- Securing of budget for the maintenance of delivered equipment
- Audio-visual equipment necessary for distant education (television, video, computer, etc.)

(3) Other

- Payment of A/P fee etc. under the banking arrangement (B/A).
- Prompt unloading and customs clearance procedure for the product to be purchased in relation to the grant.
- Of the products and services to be procured under the certified agreement, exemption of customs, value-added tax, and other surcharges imposed on Japanese citizens.
- Regarding the service of Japanese citizens to be provided under the certified agreement, provision of facilities necessary for entry into and staying in the country for the purpose of performing the relevant service.
- Permit, license, and other necessary actions necessary for implementation of this Project.
- Payment of all other expenses that are not included in the grant aid but are necessary for carrying out the Project.

2-4 Project Operation / Maintenance Plan

2-4-1 Operation Plan

The competent authority of this Project is the Secretary of State for Energy Policy of "Timor-Leste", and the executive agency of the Project is the Ministry of Education. The planned solar power generation systems are to be arranged in the "UNTL", basic schools, which are both under the jurisdiction of the Ministry of Education, and the main building of the Ministry of Education, and are operated by the personnel working in each facility. "UNTL" has about 320 personnel members and each basic school has 10-30 personnel members.

Since all the facilities are active facilities and operation of the solar power generation system planned under the Project is rather simple, it is possible to respond to the system with the current personnel and there is no need for employing new personnel.

2-4-2 Maintenance Plan

The department responsible for the maintenance of the Project is the logistics department of the Administration / Finance Bureau in the Ministry of Education. The Project will not require advanced maintenance techniques, but simple system check, etc. are needed. "UNTL" and the Ministry of Education have in-house power generation systems and have already arranged power system maintenance personnel, so they don't need arrangement of new maintenance staff. In basic schools, the current staff can conduct simple system check, but it is difficult for them to troubleshoot failures. While it may be difficult to arrange new maintenance staff to each school, it is possible to dispatch engineers through the logistics department of the Ministry of Education since the coverage area is rather near Dili, including Liquica District. Also, since the engineering department of the “UNTL” is conducting technical research of solar power generation systems, it is possible for them to support in the system maintenance, so there will be no problem.

2-5 Project Cost Estimation

2-5-1 Initial Cost Estimation

The total project cost of “Timor-Leste” that is necessary for implementing the Project is 0.5 million yen.

(1) Cost to be borne by “Timor-Leste”: 5,450.00 U.S. dollars (about 0.5 million yen)

Table 2-3 Cost to be borne by “Timor-Leste”

Item	Estimated cost
B/A fee	US$5,450 (about ¥0.5 million)
Total	US$5,450 (about ¥0.5 million)

US$1=¥91.73

2-5-2 Operation / Maintenance Cost

(1) Budget of the Ministry of Education

The budget of the Ministry of Education as the executive agency is as follows.

Table 2-4 Budget of the Ministry of Education

Items	2008	2009	2010	2011	2012
Government's general budget	42,508	49,775	50,919	52,206	53,545
Salaries etc.	21,008	32,313	33,028	33,849	34,693
Goods / service	14,870	10,683	10,942	11,233	11,552
(Maintenance cost of equipment/facilities)		(108)	(110)	(114)	(115)
Small capital	2,630	2,779	2,849	2,921	2,992
Carry-over	4,000	4,000	4,100	4,203	4,308
Investment	8,861	12,795	19,488	4,397	-
Grand total	51,369	62,570	70,407	56,603	53,545

Unit: thousand US$

In the budget of the Ministry of Education, maintenance cost for school equipment/facilities is included. Although the amount of the budget is about 0.2% of the government's general budget, the significance of securing the budget necessary for maintenance is recognized.

(2) Maintenance Cost Estimation

The solar power generation system to be procured in the Project includes the stand alone with battery type to be installed in 4 schools in non-electrified areas and in the engineering department of the "UNTL" for research purpose. In the stand alone with battery system, it is necessary to renew the battery periodically (every 7-10 years), and each renewal requires the cost of about 186,000 US dollars. "Timor-Leste" has another solar system that was introduced in the past project, and has allocated the budget to the renewal of batteries of the system. Little maintenance cost is required for the grid connected system. Solar panels are expensive but rarely break down, and other associated equipment is rather inexpensive, so replacement of such equipment, if necessary, is not so costly and therefore will not cause any serious problem with the budget of "Timor-Leste".

2-6 Other Relevant Issues

There is also strong sunlight in "Timor-Leste", and greening is progressing in each proposed site. Solar power panels are affected by the shadows of buildings and trees. It is therefore necessary to pay attention to trees standing in the environment of installation sites since they are expected to grow high in several years.

Chapter 3. Project Evaluation and Recommendations

Chapter 3 Project Evaluation and Recommendations

3-1 Project Effect

The direct effect of introducing the solar power generation system is the reduction in annual consumption (combustion) of fossil fuel (crude oil) for diesel electric power generation, which leads to reduced CO_2 emissions and consequently contributes to the climate warming prevention measures of “Timor-Leste”, a member country of the Cool Earth Partnership. Also, installation of the largest solar power generation system in this country (a display board indicating the status of system operation and effect will be installed) is expected to bring the effect of raising the awareness of solar power generation at home and abroad.

As indirect effects, the system introduction is expected to product the economic effect of reducing the import of fossil fuel (crude oil) and lead to the future penetration / promotion of power generation systems using recyclable energy.

Further, stable power supply to educational facilities using solar power generation enables distance learning using audio-visual equipment (television, video, computer, etc.) in schools in “Timor-Leste”, which are suffering from the shortage of human resources including teachers, and such new style of learning is expected to improve the content of education and benefit local residents and schoolchildren. With system introduction, the engineering department of the “UNTL” is also expected to advance research on the solar power generation, improve the capability of maintenance, and deepen the knowledge about clean energy, which is expected to promote the clean energy policy of “Timor-Leste”.

Table 3-1 Effects of Implementation and Improvement Level

Current status and issues	Measures in this Project (Requested Project)	Direct effects / Improvement level	Indirect effects / Improvement level
Almost all main power sources depend on diesel electric power generation, and reduction of greenhouse gases, such as CO_2, is required.	Introduction of solar power generation system (24 sites, 166kW in total)	CO_2 reduction About 132t /year (*1) Electric charge reduction About ¥2,500,000 /year (*2)	Effect of raising the awareness of solar power generation Decrease in fossil fuel usage Distance education is implemented in elementary schools. Research on solar power generation progresses.

(*1) Annual CO_2 reductions are calculated with the following formula.
Capacity of a solar power panel (kW) x Solar radiation (kWh/m2 * day) x System efficiency = Annual power generation (kWh/year) x Emission factor (kg-CO_2/kWh) x 365 days

(*2) Annual saving of electric charges is calculated with the following formula.
Annual power generation (kWh/year) x Unit electricity rate (yen/kWh)

Table 3-2 CO_2 Reduction / Electric Charge Reduction

Capacity of a solar power panel (kW)	Solar radiation (kWh/m^2 per day)	System efficiency	Power generation (kWh/year)	Unit electricity rate (yen/kWh)	Electric charge reduction (yen/year)	Emission factor (kg-CO_2/kWh)	CO_2 reduction (kg/day)	CO_2 reduction (t/year)
150	6.22	0.7	238,382	10.8	2,574,520	0.555	362.47	132.30

3-2 Recommendations

3-2-1 Issues / Proposals To Be Addressed by Recipient Country

In order to maintain the effect of the equipment procurement resulting from the implementation of this Project on a long-term basis, "Timor-Leste" is expected to address the following issues.

(1) For the independent-storage system planned to be installed in basic schools in non-electrified areas and "UNTL", budget for battery replacement should be secured, and unnecessary batteries should be collected certainly from a viewpoint of environmental protection.

(2) Audio-visual equipment should be systematically procured in order to provide distance learning to basic schools, and distance learning should be started promptly after introduction of the solar power generation system.

(3) "UNTL", Hera Campus, should promote research of the solar power generation system and improve relevant technical capabilities.

3-2-2 Technical Cooperation / Cooperation with Other Donors

Technical training for "Timor-Leste" is planned for improvement of technologies concerning solar power generation, and long-term utilization of the solar power generation system to be procured through the Project is expected.