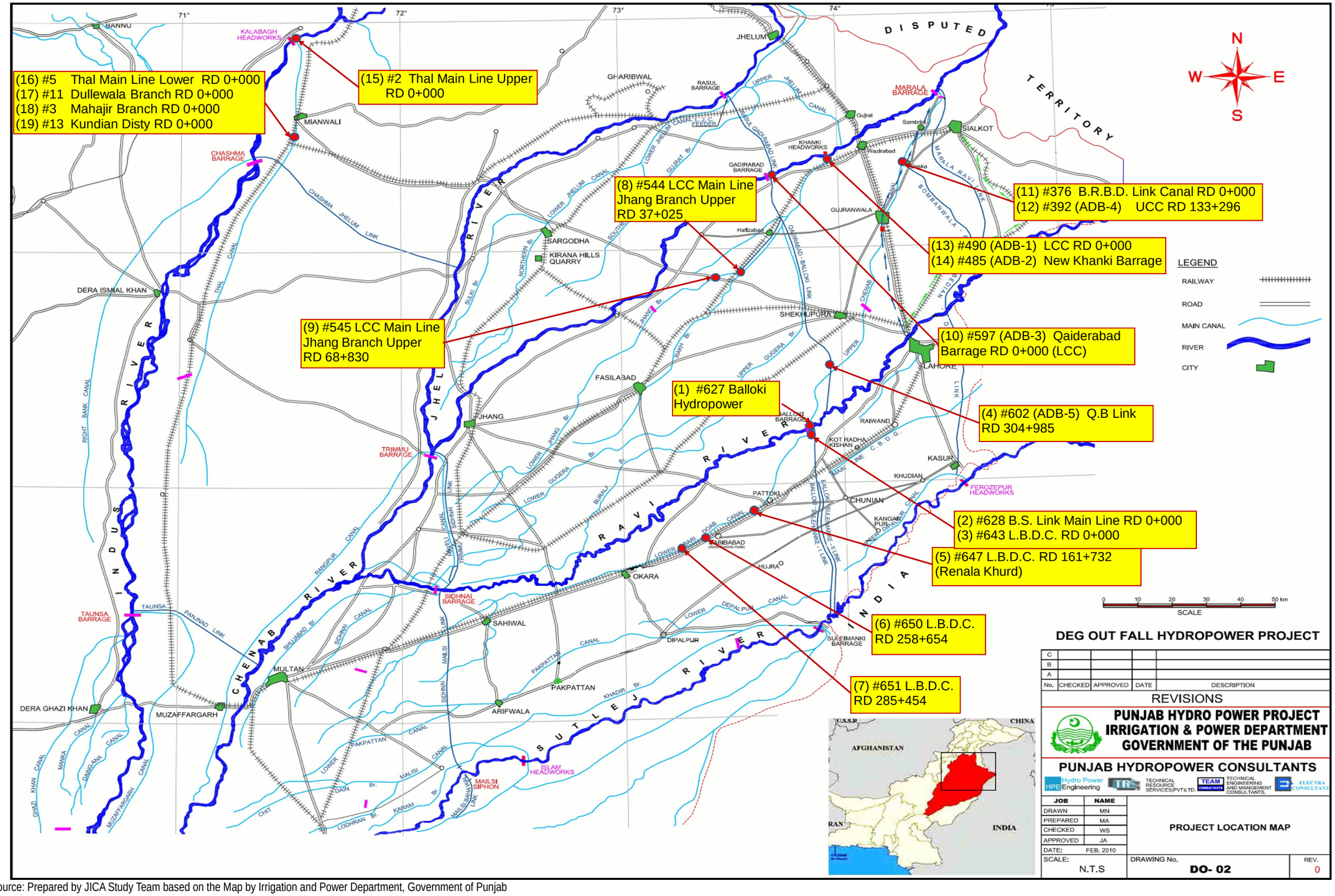


Source: Prepared by JICA Study Team based on the Map by Irrigation and Power Department, Government of Punjab

Figure 8.3.1-2 Location Map of Field Survey on Small Hydro Power Potential Sites

Table 8.3.1-1 Summary of Field Survey of Small Hydro Power in Northern Punjab

Day	Date		Field Survey Sites																							
			Site No.	Natural River / Canal	Type of P/NP *3)	Sr. # of PPDB List	Source of River	Barrage	Canal System	Canal	R.D.1000 FT.	Latitude (N) Longitude (E) Measured by GPS	Province	District	Name of City / Town	Distance from City	List Data / Field Data	Head (m)	Discharge (m^3/s)	Power (Insalled Capacity) (MW)	Average Annual Energy (GWh)	Plat Factor (%)	Cost per MW (Million US$/MW)	Stage of Study	Notes	Judge	Rank by PPDB List
1	10-Nov-2012	Sat.	**1**	Natural River	NP	627	*RAVI*	Balloki	Balloki Hydropower	Ravi River	at Balloki Barrage 0+000	31° 13.208' 73° 51.709'	Punjab	Nankana Sahib	Pjoolnaar (Radha Kishan)	83 km from Lahore	PPDB List	4.00	129.00	4.128				Identified			X (Not Perennial)
																	Field Data	4.00	0.00	0.000					Not Perennial Flow to D/S	X	
			2	Canal	P	628	*RAVI*	Balloki	B. S. Link Main Line	B. S. Link Main Line	0+000	31° 13.208' 73° 51.709'	Punjab	Kasur	Pjoolnaar (Radha Kishan)	83 km from Lahore	PPDB List	0.74	523.86	3.101				Identified			-
																	Field Data	2.52	240.00	4.838					New B.S. Link Barrage will be constructed	O	
			3	Canal	P	643	*RAVI*	Balloki	Lower Bari Doab Canal (L.B.D.C.)	L.B.D.C	0+000	31° 13.208' 73° 51.709'	Punjab	Kasur	Pjoolnaar (Radha Kishan)	83 km from Lahore	PPDB List	0.67	278.00	1.490				Identified			-
																	Field Data	0.95	193.00	1.467					Good condition, P/H will be in canal.	O	
			4	Canal	P	602 ADB-5	*RAVI*	Balloki	Qaiderabad Balloki Link Canal (304+985)	Qaiderabad Balloki Link Canal	304+985	31° 32.007' 73° 56.483'	Punjab	Nankana Sahib	Miranpur	144 km from Lahore	PPDB List	2.08	450.00	7.488				F/S *1)			6
																	ADB F/S	2.04	450.00	7.684	52.59	78.17	4.42		Proposed P/H will be in canal	O	
																	Field Data	1.92	320.00	4.915					Good site condition and design	O	
2	11-Nov-2012	Sun.	**5**	Canal	P	647	*RAVI*	Balloki	Lower Bari Doab Canal	L.B.D.C (Renala Khurd)	161+732	30° 53.002' 73° 35.621'	Punjab	Okara	Renala Khurd	123 km from Lahore	PPDB List	2.03	220.00	3.573				Identified	Existing off-grid HPP 1.1 MW was operated by WAPDA.		7
																	Field Data	-	-	-					F/S for Upgradeing HPP (Total 4MW) will be finished in Dec.2012 by WAPDA.	O	
			6	Canal	P	650	*RAVI*	Balloki	Lower Bari Doab Canal	L.B.D.C	258+654	30° 45.556' 73° 19.742'	Punjab	Okara	Okara	145 km from Lahore	PPDB List	1.98	195.00	3.089				Identified			9
																	Field Data	2.09	116.35	1.945					Good site condition in Right Bank	O	
			7	Canal	P	651	*RAVI*	Balloki	Lower Bari Doab Canal	L.B.D.C	285+454	30° 42.981' 73° 15.634'	Punjab	Shahiwal	Shahiwal	155 km from Lahore	PPDB List	1.66	193.00	2.563				Identified			14
																	Field Data	1.87	*111.00*	1.661					Good condition, P/H will be in canal.	O	
3	12-Nov-2012	Mon.	**8**	Canal	P	544	*CHENAB*	Khanki	Lower Chenab Cnal (L.C.C) MAIN LINE	Jhang Branch Upper	37+025 (37/38))	31° 53.593' 73° 31.802'	Punjab	Hafizabad	Kaleke	124 km from Lahore	PPDB List	2.11	83.93	1.417				Identified			11
																	Field Data	0.36	98.10	0.283					Low head (small potential)	X	
			9	Canal	P	545	*CHENAB*	Khanki	Lower Chenab Cnal (L.C.C) MAIN LINE	Jhang Branch Upper	68+830	31° 52.823' 73° 25.966'	Punjab	Hafizabad	Sukheke	270 km from Lahore	PPDB List	2.15	82.00	1.410				Identified	F/S by Alka Power (PVT) Limited		10
																	Field Data	1.82	87.75	1.278					F/S by Alka Power (PVT) Limited	O	
			10	Natural River	NP	597 ADB-3	*CHENAB*	Khanki	Qaiderabad Barrage	Lower Chenab Canal (LCC)	at Qaiderabad Barrage 0+000	32° 19.785' 73° 40.925'	Punjab	Mandi Bahaddin	Phalia	198 km from Lahore	PPDB List	3.83	700.00	21.448				F/S *1)			1
																	ADB F/S	3.68	700.00	23.000	54.53	27.06	3.20		Proposed P/H will be at right bank	△	
																	Field Data	5.04	0.00	0.000					Not Perennial Flow to D/S	△	
4	13-Nov-2012	Tue.	**11**	Canal	P	376	*CHENAB*	Marala	Bombanwala Ravi Bedian Diapur (B. R. B. D.) Link Canal	B. R. B. D. Link Canal	0+000	32° 21.689' 74° 17.627'	Punjab	Sialkot	Daska	152 km from Lahore	PPDB List	1.76	203.76	2.869				F/S *2)			13
																	Tarakai F/S	1.93	156.00	1.916	12.39	50.60	4.94				
																	Field Data	0.61	83.50	0.407					Low head (small potential)	△	
			12	Canal	NP	392 ADB-4	*CHENAB*	Khanki	Upper Chenab Canal (UCC) (RD 133+296)	Upper Chenab Canal (UCC)	133+296	32° 21.446' 74° 17.484'	Punjab	Sialkot	Daska	139 km from Lahore	PPDB List	2.45	476.86	9.346				F/S *1)			4
																	ADB F/S	2.39	170.00	3.580	17.19	54.76	4.26		Proposed P/H will be in canal	△	
																	Field Data	3.23	*10.00*	0.258					Not Perennial Flow to D/S	△	
5	14-Nov-2012	Wed.	**13**	Canal	P	490 ADB-1	*CHENAB*	Khanki	Lower Chenab Canal (LCC) (RD 0+000)	Lower Chenab Canal (LCC)	0+000	32° 24.150' 73° 58.230'	Punjab	Gujranwala	Mansurwali	128 km from Lahore	PPDB List	3.60	240.00	6.912				F/S *1)			2
																	ADB F/S	3.57	240.00	7.550	43.61	65.94	4.04		Proposed P/H will be in New Lower Chenab Canal	△	
																	Field Data	2.42	159.42	3.086					(after construction of New Khanki Barrage)	△	
			14	Natural River	NP	485 ADB-2	*CHENAB*	Khanki	New Khanki Barrage	Lower Chenab Canal (LCC)	at Proposed New Khanki Barrage	32° 24.901' 73° 58.135'	Punjab	Gujrat	Maggowal	128 km from Lahore	PPDB List	2.47	600.00	11.856				F/S *1)			3
																	ADB F/S	2.62	600.00	14.090	38.34	31.06	3.56		Proposed P/H will be at right bank of proposed New Khanki Barrage	△	
																	Field Data	2.29	0.00	0.000					Not Perennial Flow to D/S	△	
6	15-Nov-2012	Thu.	**15**	Canal	P	2	*INDUS*	Jinnah	Thal Main Line Upper	Thal Main.Line upper	0+000	32° 54.940' 71° 31.650'	Punjab	Mianwali	Mari Indus	278 km from Islamabad	PPDB List	1.97	283.45	4.467				Identified			8
																	Field Data	0.64	147.67	0.756					Low head (small potential)	X	
7	16-Nov-2012	Fri.	**16**	Canal	P	5	*INDUS*	Jinnah	Thal Main Line Upper	Main Line Lower	0+000	32° 30.615' 71° 33.248'	Punjab	Mianwali	Mianwalli	265 km from Islamabad	PPDB List	1.52	144.13	1.753				Identified			18
																	Field Data	1.21	127.96	1.239					Good condition, P/H will be in canal.	O	
			17	Canal	P	11				Dullewala Branch	0+000	32° 30.615' 71° 33.248'	Punjab	Mianwali	Mianwalli	265 km from Islamabad	PPDB List	1.92	24.60	0.378				Identified			-
																	Field Data	2.05	19.20	0.315					Small discharge (Low Potential)	X	
			18	Canal	P	3				Mahajir Branch	0+000	32° 30.615' 71° 33.248'	Punjab	Mianwali	Mianwalli	265 km from Islamabad	PPDB List	2.11	41.42	0.699				Identified			20
																	Field Data	2.42	29.90	0.579					Small discharge (Low Potential)	△	
			19	Canal	P	13				Kundian Disty	0+000	32° 30.615' 71° 33.248'	Punjab	Mianwali	Mianwalli	265 km from Islamabad	PPDB List	1.65	1.84	0.024				Identified			-
																	Field Data	1.15	1.70	0.016					Small discharge (Low Potential)	X	
			20	Canal	NP	-				Escape Channel	0+000	32° 30.615' 71° 33.248'	Punjab	Mianwali	Mianwalli	265 km from Islamabad	PPDB List	-	-	-				Identified			-
																	Field Data	3.41	0.00	0.000					Not Perennial Flow to D/S	X	

Source : Prepared by JICA Study Team based on PPDB Hydro Power Potential List.

*1) : Feasibility Studies of Hydel Power Stations in Punjab (Task 2), Asian Development Bank (ADB) for the Renewable Energy Development Sector Investment Program, Government of Punjab (GOP), National Engineering Service Pakistan (NESPAK), 2011.

*2) : 2MW Hydropower Project on BRBD Canal RD0+000, Feasibility Report, Government of the Punjab Department of Energy, PPDB, Taraki Energy (PVT) Limited, July 2011.

Note: *3) : **P** = Perennial, means the canal operates for 11 months a year., **NP** = Not Perennial.

8.3.2 Potential Project

(1) ADB-F/S Sites

In December 2009, the National Engineering Services Pakistan (NESPAK) was appointed as consultant by the Government of Punjab, Irrigation and Power Department (IPD) (now Energy Department) and entrusted with the task of completing a two stage study of ten potential hydro power sites. The first stage (Task 1), comprising of a ranking study of the sites on the basis of EIRR and unit generation cost of energy, was completed. The top five ranked schemes have been identified (Task 2) and detailed feasibility studies have been carried out. The details of the top five ranked small HPPs are shown in **Table 8.3.2-1**.

Table 8.3.2-1 Summary of ADB-F/S Sites

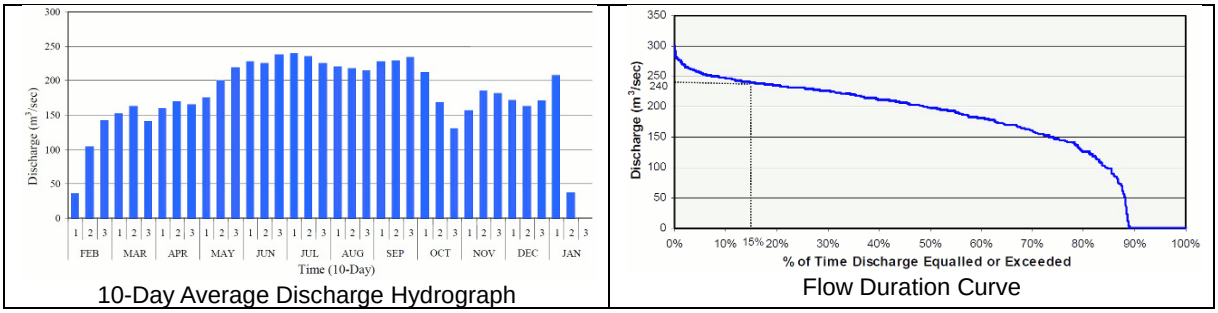
Sr. No.	Sr. No.	Hydropower site	Installed Capacity	Average Annual Energy	Plant Factor	Base Cost		Cost per MW	Type of P/NP
			(MW)	(GWh)		Million Rs.	Million US$	Million US$	(*1)
1	490	Lower Chenab Canal (RD 0+000)	7.55	43.61	65.94%	2,625	30.52	4.04	P
2	485	New Khanki Barrage	14.09	38.34	31.06%	4,316	50.19	3.56	NP
3	597	Qaiderabad Barrage	23.00	54.53	27.06%	6,331	73.62	3.20	NP
4	392	Upper Chenab Canal (RD 133+296)	3.58	17.19	54.76%	1,311	15.24	4.26	NP
5	602	Qaiderabad Balloki Link Canal (304+985)	7.68	52.59	78.17%	2,921	33.97	4.42	P

Note (*1) : P = Perennial, means the canal operates for 11 months a year., NP = Not Perennial
Source: Feasibility Studies of Hydel Power Stations in Punjab (Task 2), ADB, GOP, NESPAK, 2011

Among the five sites, ADB-F/S site Nos. 2, 3, and 4 were identified as “not perennial” river or canal whose flow is available one to four months a year. Also, ADB-F/S site Nos. 1 and 2 are planned at the proposed New Khanki Barrage. These sites are available for implementation after the construction of the proposed New Khanki Barrage. The New Khanki Barrage is planned for construction in October 2013 and the construction period is planned for three years.

Based on the above reasons, implementation of ADF-F/S site Nos. 1 and 2 are not sure at this moment and site Nos. 2, 3 and 4 are “not perennial”. No. 5 (#602) of the ADB F/S sites is the most viable.

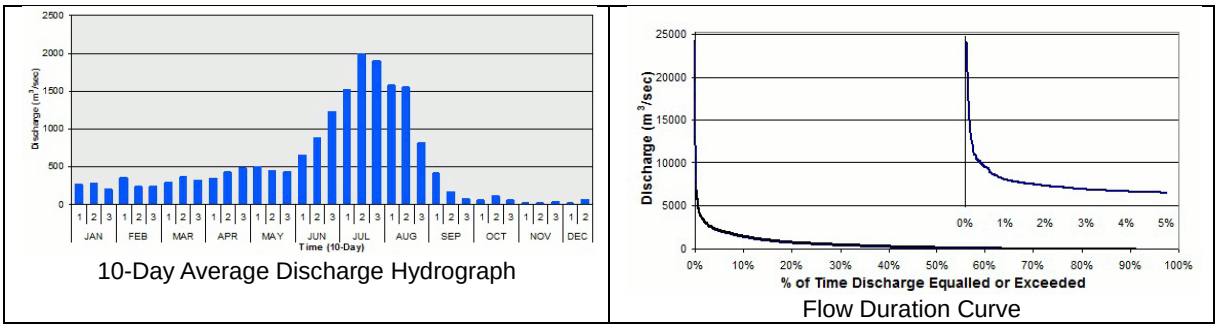
The 10-day average flow hydrograph and flow duration curves at each site are shown in **Figures 8.3.2-1** to **8.3.2-5**, and the project summary sheets are attached as **Appendix D-4**.



10-Day Average Discharge Hydrograph　　Flow Duration Curve

Source: Feasibility Studies of Hydel Power Stations in Punjab (Task 2), ADB, GOP, NESPAK, 2011

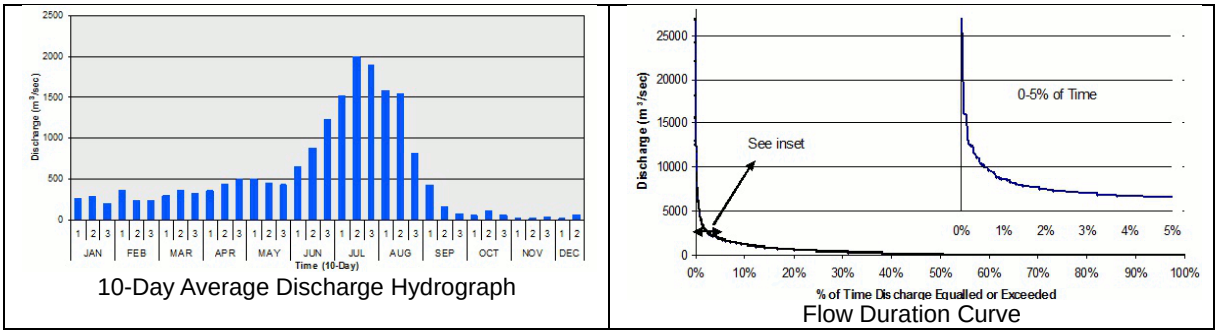
Figure 8.3.2-1 10-Day Average Hydrograph and Flow Duration Curve at Lower Chenab Canal (RD 0+000) [ADB-1]



10-Day Average Discharge Hydrograph　　Flow Duration Curve

Source: Feasibility Studies of Hydel Power Stations in Punjab (Task 2), ADB, GOP, NESPAK, 2011

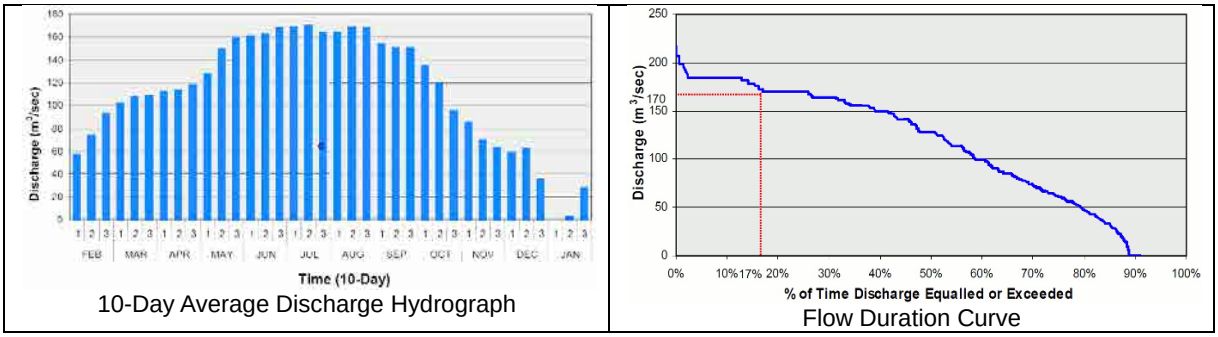
Figure 8.3.2-2 10-Day Average Hydrograph and Flow Duration Curve at New Khanki Barrage [ADB-2]



10-Day Average Discharge Hydrograph　　Flow Duration Curve

Source: Feasibility Studies of Hydel Power Stations in Punjab (Task 2), ADB, GOP, NESPAK, 2011

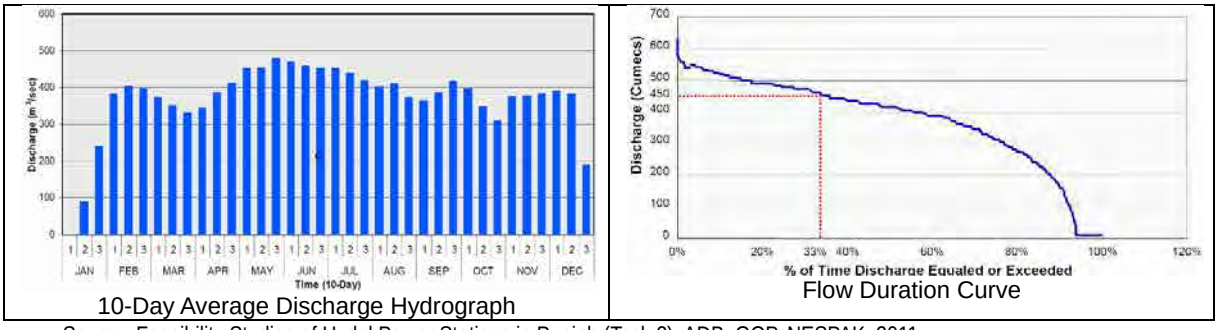
Figure 8.3.2-3 10-Day Average Hydrograph and Flow Duration Curve at Qaiderabad Barrage [ADB-3]



10-Day Average Discharge Hydrograph　　Flow Duration Curve

Source: Feasibility Studies of Hydel Power Stations in Punjab (Task 2), ADB, GOP, NESPAK, 2011

Figure 8.3.2-4 10-Day Average Hydrograph and Flow Duration Curve at Upper Chenab Canal (RD 133+296) [ADB-4]



10-Day Average Discharge Hydrograph　　Flow Duration Curve

Source: Feasibility Studies of Hydel Power Stations in Punjab (Task 2), ADB, GOP, NESPAK, 2011

Figure 8.3.2-5　10-Day Average Hydrograph and Flow Duration Curve at Qaiderabad Balloki Link Canal (304+985) [ADB-5]

(2) F/S on 2 MW Hydro Power Project on BRBD Canal RD 0+000

The PPDB issued an LOI to Tarakai Energy (PVT) Limited inviting them to undertake the development of a hydro power project at a canal fall located on Bambanwala - Rave - Bedian - Deepalpur (BRBD) Canal. The proposed site for the 2 MW project is located at RD 0+000 of BRBD Canal. The first step in the development process is the preparation of an F/S for the project.

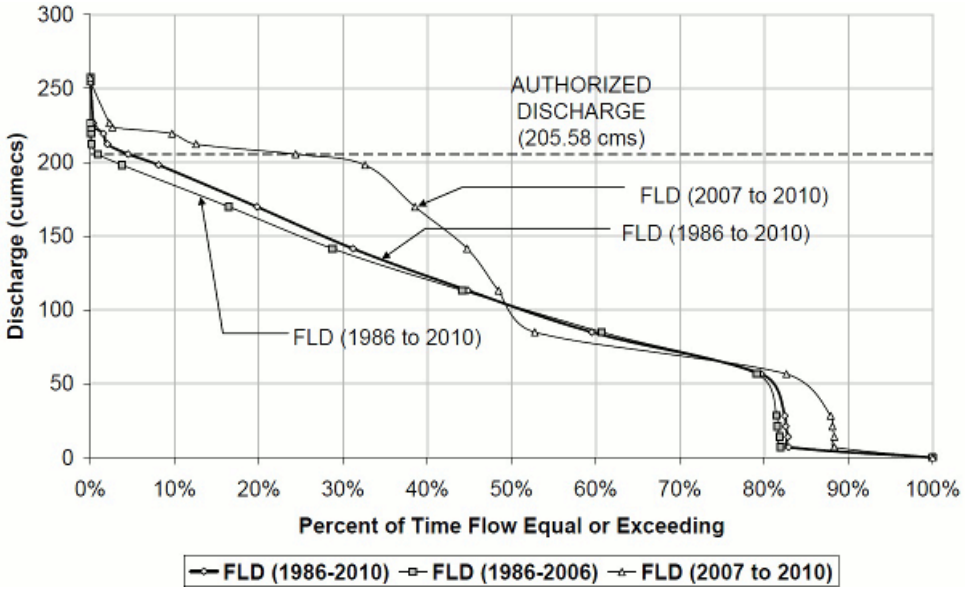
A summary of the F/S on BRBD RD 0+000 is shown in **Table 8.3.2-2**.

Table 8.3.2-2　Summary of the F/S on the 2 MW Hydro Power Project on BRBD Canal RD 0+000

Sr. No.	Hydropower site	Installed Capacity	Average Annual Energy	Plant Factor	Base Cost		Cost per MW
		(MW)	(GWh)		Million Rs.	Million US$	Million US$
376	Lower Chenab Canal (RD 0+000)	1.93	12.65	50.6%	1,205	14.087	4.94

Source: 2MW Hydropower Project on BRBD Canal at RD 0+000, Feasibility Report, Government of the Punjab, Department of Energy, PPDB,, Tarakai Energy (PVT) Limited, July 2011

The flow duration curve for BRBD Canal RD 0+000 is shown in **Figure 8.3.2-6**. The project summary sheet of BRBD Canal RD 0+000 is attached as **Appendix D-4**.



Source: 2 MW Hydropower Project on BRBD Canal at RD 0+000, Feasibility Report, Government of the Punjab, Department of Energy, PPDB,, Tarakai Energy (PVT) Limited, July 2011

Figure 8.3.2-6 Flow Duration Curve at BRBD Canal RD 0+000

(3) Potential Projects

The seven sites given in **Table 8.3.2-3** were evaluated as the potential project sites among the sites visited. These sites were considered based on the available head, stable discharge and site conditions from the information of the field survey and existing F/S information.

Table 8.3.2-3 Potential Project Sites for Small Hydro Power Development in Northern Punjab

No.	Sr. #	Source of River	Barrage	Canal System	Canal	R.D.1000 FT.	Latitude(N) Longitude(E)	District	Name of City / Town	Distance from City	List Data / Field Data	Head (m)	Discharge (m^3/s)	Power (Insalled Capacity) (MW)	Stage of Study
1	628	*RAVI*	Balloki	B. S. Link Main Line	B. S. Link Main Line	0+000	31° 13.208' 73° 51.709'	Kasur	Pjoolnaar (Radha Kishan)	83 km from Lahore	PPDB List	0.74	523.86	3.101	Identified
											Field Data	2.52	240.00	4.838	
2	602 ADB-5	*RAVI*	Balloki	Qaiderabad Balloki Link Canal (304+985)	Qaiderabad Balloki Link Canal	304+985	31° 32.007' 73° 56.483'	Nankana Sahib	Miranpur	144 km from Lahore	PPDB List	2.08	450.00	7.488	F/S *1)
											ADB F/S	2.04	450.00	7.684	
											Field Data	1.92	320.00	4.915	
3	650	*RAVI*	Balloki	Lower Bari Doab Canal	L.B.D.C	258+654	30° 45.556' 73° 19.742'	Okara	Okara	145 km from Lahore	PPDB List	1.98	195.00	3.089	Identified
											Field Data	2.09	116.35	1.945	
4	651	*RAVI*	Balloki	Lower Bari Doab Canal	L.B.D.C	285+454	30° 42.981' 73° 15.634'	Shahiwal	Shahiwal	155 km from Lahore	PPDB List	1.66	193.00	2.563	Identified
											Field Data	1.87	*111.00*	1.661	
5	545	*CHENAB*	Khanki	Lower Chenab Cnal (L.C.C) MAIN LINE	Jhang Branch Upper	68+830	31° 52.823' 73° 25.966'	Hafizabad	Sukheke	270 km from Lahore	PPDB List	2.15	82.00	1.410	Identified
											Field Data	1.82	87.75	1.278	
6	376	*CHENAB*	Marala	Bombanwala Ravi Bedian Diapur (B. R. B. D.) Link Canal	B. R. B. D. Link Canal	0+000	32° 21.689' 74° 17.627'	Sialkot	Daska	152 km from Lahore	PPDB List	1.76	203.76	2.869	F/S *2)
											Tarakai F/S	1.93	156.00	1.916	
											Field Data	0.61	83.50	0.407	
7	5	*INDUS*	Jinnah	Thal Main Line Upper	Main Line Lower	0+000	32° 30.615' 71° 33.248'	Mianwali	Mianwalli	265 km from Islamabad	PPDB List	1.52	144.13	1.753	Identified
											Field Data	1.21	127.96	1.239	

*1) : Feasibility Studies of Hydel Power Stations in Punjab (Task 2), ADB for the Renewable Energy Development Sector Investment Program, Government of Punjab (GOP), NESPAK, 201.
*2) : 2MW Hydropower Project on BRBD Canal RD0+000, Feasibility Report, Government of the Punjab Department of Energy, PPDB, Taraki Energy (PVT) Limited, July 2011.
*3) : **P** = Perennial, means the canal operates for 11 months a year., **NP** = Not Perennial.
Source: Prepared by JICA Study Team based on field survey information, PPDB information and existing feasibility study reports

CHAPTER 9 RECOMMENDATION FOR JAPAN'S OFFICIAL ASSISTANCE

Recommendations of Japanese assistance for RE development in Pakistan are as follows based on the result of the survey:

1. Solar Power Generation Project at Pakistan Institute of Medical Sciences (PIMS)

The project is recommendable for Japanese grant aid. The solar power generation will be a grid-connected system and the PV module of the system will be installed at the premises of PIMS. The project contributes much to the management of PIMS financially by reducing the payment of electricity tariff. The project also helps in disseminating RE in Pakistan in the form of solar power generation.

As mentioned in **Sub-chapter 6.2.3**, solar power generation system was installed through the Japanese grant aid at the Planning Commission (PC) and at Pakistan Engineering Council (PEC), with each site having 178 kW capacities. At first, the system was a grid-connected solar power generation system in Pakistan, which was a technical breakthrough in the country. This project attracted a high level of interest from the private sector and donors. During the study period, the World Bank representative visited the Study team for the detailed information of this Japan's grant aid project. Stimulated by this project, the World Bank is now planning to introduce the same grid-connected solar generation system in the whole country of Pakistan. This project became a good technical model in Pakistan.

The recommended solar power generation system at PIMS will become a role model from the financial and technical points of view, as it is the first large-scale grid-connected solar power generation system in Pakistan. Regarding the scale of the project, referring to the trial cost estimation stated in **Sub-chapter 8.1.1** and the fact that available land space has not yet been finalized, the installation capacity of 2 MW or more is recommendable in order for the project to contribute financially.

In case that the recommended project is going to be implemented through the Japanese grant aid, it is noted that the detailed topographic and geological surveys at PIMS are essential at the time of preparatory survey.

2. Small Hydro Power Generation Project in Punjab Province

Based on the result of the field survey for small hydro power generation, the potential projects are selected in **Sub-chapter 8.3.2**. Each of these projects is recommendable for Japanese grant aid and packaging all the projects is also recommendable for Yen loan. There is a huge potential of small hydro power generation utilizing canals in the Punjab province. This potential is almost not yet developed because of the low head for normal hydro development, but it became possible through the application of recent technical improvement.

As order of development, it is recommended to realize the development of low head hydro power generation through Japanese grant aid. Based on the development results, the Yen loan project will be promoted to support the packaged potential projects.

Besides the development of hydro power, it is recommended to install the PV module over the canal, being a hybrid of hydro and solar power generation. PV module installation over canals at small hydro power development sites solves land acquisition issue, facilitates operation and maintenance of solar power generation with the staff of hydro power generation, and reduces water evaporation from the canal. This technology may lead the project to a Special Terms for Economic Partnership (STEP) project for Yen loan.

3. Technical Assistance to the Provincial Government

Technical assistance to the provincial government for the development of RE is recommendable. As mentioned in **Sub-chapter 2.2.7**, the provinces in Pakistan are allowed to develop power generation projects up to a maximum capacity of 50 MW through public or private sectors using RE sources. In **Sub-chapter 6.8**, the bottlenecks in disseminating renewable energy are mentioned. One of the bottlenecks is "Technical Expertise Barriers". There are needs to develop institutional and human capacities in the provinces. The same kind of needs to AEDB also exists but the necessity of the technical assistance by JICA and the effectiveness of that to the provinces is considered to be high.

Regarding Punjab province, the provincial government has started planning to prepare the RE Policy of Punjab, and requested the Study team to convey their request for assistance in policy making to JICA. With the policy making, it is recommended for the dissemination of RE to build up rules and regulations to exempt the scheduled load shedding from feeders to which the RE-based electricity generators are connected. This will lead to trading of the saved electricity from load shedding and generating electricity through RE generation. Besides, the database preparation for hydro power development is a potential area of interest for the JICA technical assistance.

4. Wind Power Generation Project in Sindh Province

Large-scale wind power generation project in Sindh province is recommendable for Yen loan project. In the southern part of Sindh province, there is the wind power potential and land is properly arranged for the developers. The private sector has already commenced the wind farm project, thus, the risk of the project implementation is relatively low.

Appendix of Draft of Final Report

Data Collection Survey
on
Renewable Energy Development
in
Pakistan
by
Japan International Cooperation Agency (JICA)

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Information of AEDB

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EXTRAORDINARY
PUBLISHED BY AUTHORITY

ISLAMABAD, TUESDAY, MAY 25, 2010

PART I

Acts, Ordinances, President's Orders and Regulations

SENATE SECRETARIAT

Islamabad, the 25th May, 2010

No. F. 9 (18)/2010-Legis.—The following Act of Majlis-e-Shoora (Parliament) received the assent of the President on 21st May, 2010, is hereby published for general information:—

ACT NO. XIV OF 2010

An Act to provide for establishment of Alternative Energy Development Board

WHEREAS it is expedient to provide for establishment of Alternative Energy Development Board (AEDB) as an autonomous body for the purpose of implementation of various policies, programmes and projects in the field of Alternative or Renewable Energy Technologies;

AND WHEREAS the objective of the Alternative Energy Development Board is to assist and facilitates development and generation of Alternative or Renewable Energy in order to achieve sustainable economic growth with transfer of technology

(407)

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for development of an indigenous technological base through a diversified energy generation.

It is hereby enacted as follows:—

CHAPTER I
PRELIMINARY

1. **Short title, extent and commencement.**—(1) This Act may be called the Alternative Energy Development Board Act, 2010.

(2) It extends to the whole of Pakistan.

(3) It shall come into force at once.

2. **Definitions.**—In this Act unless there is anything repugnant in the subject or context,—

(a) "alternative or renewable energy" means energy that is produced by alternative or renewable resources as compared to the conventional or that are replenished naturally which do not deplete when consumed and are non-polluting and environment friendly;

(b) "Board" means Alternative Energy Development Board (AEDB), established under section 3;

(c) "Chairman" means the Chairman of the Board;

(d) "Chief Executive Officer (CEO)" means the Chief Executive Officer of the Board appointed under section 5;

(e) "Chief Secretary" means Chief Secretary of a Province;

(f) "Fund" means the Alternative Energy Fund (AEF) established under section 13;

(g) "Institute" means Institute of Alternative and Renewable Energy Technologies established under section 11;

(h) "Member" means Member of the Board;

(i) "organization" means an organization of alternative and renewable energy established under section 10;

(j) "prescribed" means prescribed by rules or regulations made under this Act;

(k) "President" means President of the Islamic Republic of Pakistan;

(l) "Prime Minister" means Prime Minister of the Islamic Republic of Pakistan;

(m) "Provincial Secretary" means a Secretary of a Provincial Government;

(n) "regulations" means the regulations made under this Act; and

(o) "rules" means the rules made under this Act.

CHAPTER II

ALTERNATIVE ENERGY DEVELOPMENT BOARD

3. **Establishment of the Board.**—(1) There shall be established an Alternative Energy Development Board for carrying out the purposes and objectives of this Act.

(2) The Board shall be a body corporate having perpetual succession and a common seal, with administrative and financial powers, subject to the provisions of this Act, to enter into agreements, contracts, acquire and hold property, both moveable and immoveable and to sue and be sued in its name.

(3) The head office of the Board shall be at Islamabad and the Board may set up sub-offices at such place or places as it may deem necessary.

(4) The Board shall consist of the Chairman and Members.

4. **Chairman of the Board.**—The Chairman of the Alternative Energy Development Board shall be appointed by the Federal Government on such terms and conditions as may be determined by the Federal Government.

5. **Terms and conditions of office of the Chief Executive Officer (CEO).**—(1)The Chief Executive Officer shall be appointed by the Federal Government and the terms and conditions of the Chief Executive Officer, his remuneration and privileges shall be such as may be determined by the Federal Government.

(2) The Chief Executive Officer shall be an eminent engineering professional of known integrity, competence and expertise in handling Alternative Energy development projects.

(3) The Chief Executive Officer may resign from his office by giving one month notice, by writing under his own hand, addressed to the Federal Government. The age of Chief Executive Officer shall not be more than sixty five years.

(4) The Chief Executive Officer will be answerable to the Board for all administrative, financial and technical matters of the Board. The Board may delegate such administrative and financial powers to the Chief Executive Officer for carrying out day to day affairs of the Board.

6. **Members of the Board.**—(1) The composition of the Board shall be as follows:—

(a) Chairman;

(b) Secretary, Finance Division or his nominee not below the rank of Additional Secretary or equivalent;

(c) Secretary, Ministry of Water and Power or his nominee not below the rank of Additional Secretary or equivalent;

(d) Secretary, Planning and Development Division or his nominee not below the rank of Additional Secretary or equivalent;

(e) Secretary, Ministry of Petroleum and Natural Resources or his nominee not below the rank of Additional Secretary or equivalent;

(f) Secretary, Ministry of Science and Technology or his nominee not below the rank of Additional Secretary or equivalent;

(g) Secretary, Ministry of Environment or his nominee not below the rank of Additional Secretary or equivalent;

(h) Six Members from private sector, of whom at least three shall be experts on alternative energy, as full-time Members to be appointed by the Prime Minister on the recommendations of the Board;

(i) Chief Secretaries of the governments of Balochistan, Khyber Pakhtunkhwa, Punjab and Sindh or their nominees, not below the rank of Provincial Secretary; and

(j) The Chief Executive Officer of the AEDB.

(2) The Secretary of the Board shall be appointed by the Federal Government on the recommendations of the Board.

(3) The Federal Government may increase or decrease the number of Members of the Board from time to time as it may consider appropriate.

(4) The Federal Government may prescribe the qualifications and mode of appointment of Members from private sector in such manner as it may consider appropriate.

(5) The business of the Board shall be conducted as prescribed.

(6) One-half of the total membership of the Board shall constitute the quorum and in case of equality of votes the Chairman shall have the casting vote.

(7) In the absence of the Chairman, a Member designated by the Chairman shall preside over the Board meeting.

7. **Terms and conditions of office of Members.**—(1) A Member, other than an *ex officio* Member, shall be appointed by the Federal Government for a period of three years, extendable for another term of three years.

(2) A Member, other than *ex officio* Member, may at any time resign from his office by giving one month's notice, in writing under his own hand, addressed to the Federal Government.

(3) The Federal Government may remove any Member, other than *ex officio* Member, on grounds of misconduct and physical incapacitation.

8. **Functions of the Board.** —The functions of the Board shall be following, namely:—

(a) to develop national strategy, policies and plans for utilization of alternative and renewable energy resources to achieve the targets approved by the Federal Government in consultation with the Board;

(b) to act as a forum for evaluating, monitoring and certification of alternative or renewable energy projects and products;

(c) to act as a coordinating agency for commercial application of alternative or renewable technology; and

(d) to facilitate energy generation through alternative or renewable energy resources by,—

(i) acting as one window facility for establishing, promoting and facilitating alternative or renewable energy projects based on wind, solar, micro-hydel, fuel cells, tidal, ocean, biogas, biomass, etc;

(ii) setting up alternative and renewable energy projects on it's own or through joint venture or partnership with public or private entities in order to create awareness and motivation of the need to take such initiatives for the benefit of general public as well as by evaluating concepts and technologies from technical and financial perspective;

(iii) conducting feasibility studies and surveys to identify opportunities for power generation and other applications through alternative and renewable energy resources;

(iv) undertaking technical, financial and economic evaluation of the alternative or renewable energy proposals as well as providing assistance in filing of required licensing applications and tariff petitions to National Electric Power Regulatory Authority (NEPRA) established under the Regulation of Generation, Transmission and Distribution of Electric Power Act, 1997 (XL of 1997);

(v) interacting and co-ordinating with national and international agencies for promotion and development of alternative energy;

(vi) assisting the development and implementation of plans with concerned authorities and provincial governments and special areas for off-grid electrification of rural areas; and

(vii) making legislative proposals to enforce use and installation of equipment utilizing renewable energy.

9. **Committees of Board.**—(1) The Board may, for carrying out its functions, constitute such committees, from time to time, as may be considered appropriate by the Board.

(2) The committees shall conduct their business in such manner as may be prescribed by the Board.

10. **Organization of the Board.**—(1) The Board may, for carrying out its functions for promotion of alternative and renewable energy, development of alternative and renewable energy technologies, certification of alternative and renewable energy products and projects and project management may establish one or more organizations as it may consider necessary.

(2) The organization established under sub-section (1) shall be subject to control and supervision of the Board and shall function within the framework of this Act.

(3) An organization established under sub-section (1) shall perform such business as may be prescribed by regulations by the Board for the purpose.

11. **Institute of Alternative and Renewable Energy Technologies.**—(1) The Board may, for carrying out its functions of commercial application of alternative or renewable energy and corresponding human resource development in the area of alternative and renewable energy, establish an Institute of Renewable Energy Technologies.

(2) The Institute shall conduct the business in such manner as may be prescribed by regulations by the Board.

12. **Appointment of officers and staff of the Board.**—(1) The Board may appoint such officers, experts, advisors, consultants and members of staff as it may consider necessary for the efficient performance of its functions on such terms and conditions as may be prescribed.

(2) The officers, members of the staff, advisors, consultants and experts and other persons appointed by the Board shall not be civil servants within the meaning of the Civil Servants Act, 1973 (LXXI of 1973).

(3) The Chairman and non-official Members of the Board, officers, advisors, consultants, employees and staff of the Board when acting or purporting to act under any of the provisions of this Act, or rules and regulations, shall be deemed to be public servants within the meaning of section 21 of Pakistan Penal Code (Act XLV of 1860).

CHAPTER III
FUND, ACCOUNTS AND AUDIT

13. **Alternative Energy Fund.**—(1) There shall be established a non-lapsable fund vesting in the Board to be known as the "Alternative Energy Fund" for the purpose of meeting expenses in connection with the functions and operations of the Board, Institute, Projects and Organizations under this Act, including payment of salaries and other remuneration payable to the CEO, Members, members of its staff, experts, consultants, advisors and other officers and employees of the Board, Institute and the Organizations.

(2) The fund shall consist of,—

(a) funds provided by the Federal Government for payment of salaries, establishing infrastructure and running the day to day business of the Board;

(b) loans or grants by the Federal Government or any Provincial Government or local authority;

(c) other loans or funds obtained by the Board;

(d) foreign aid, grants and loans negotiated and raised, or otherwise obtained by the Board, directly or through the Economic Affairs Division;

(e) charges for services or for the provision of any information or report automated or otherwise to any government, private or any other person or entity;

(f) fees and commissions collected by the Board as prescribed from time to time;

(g) income from the sale of moveable or immoveable property;

(h) funds from floating bonds, shares, debentures, commercial papers, or other securities issued by the Board or through any other means;

(i) all other sums received or earned by the Board; and

(j) income from investments; receipts.

(3) The Alternative Energy Fund shall be kept in one or more accounts maintained by the Board, in local or foreign currency in any commercial bank in Pakistan and shall be operated in accordance with the directions of the Board.

(4) The Federal Government shall fund all administrative, operational and any other expenses:

Provided that the responsibility of the Federal Government to exclusively fund the operations and functions of the Board shall cease at such appropriate time when in the opinion of the Federal Government the Board shall have become capable of funding its functions and operations envisaged under this Act to be funded by the Board;

14. **Accounts and audit.**—(1) The Board, Institute and Organizations, shall prepare their own budget in respect of each financial year, in accordance with the prescribed procedure and shall maintain complete and accurate books of accounts of their actual expenses, and receipts including that of the Alternative Energy Fund.

(2) The accounts of the Board, Institute and Organizations, shall be audited by a reputable firm of Chartered Accountants, who are, within the meaning of the

Chartered Accountants Ordinance, 1961 (X of 1961), appointed by the Board in consultation with the Auditor-General of Pakistan, from a panel of chartered accountants proposed by the Board on such terms and conditions as the Board may determine.

(3) The Auditors appointed under sub-section (2) shall be provided access to the books, accounts and other documents as may be considered necessary by them for audit of the accounts.

(4) The Auditor-General may conduct each year external audit of the Board as per Auditor General's (Functions, Powers and Terms and Conditions of Service) Ordinance, 2001 (XXIII of 2001).

CHAPTER IV
MISCELLANEOUS

15. **Delegation of powers.**—(1) The Board may delegate all or any of its powers and functions to the Chief Executive Officer (CEO) subject to such conditions and limitations, as it may prescribe.

(2) The Board may delegate all or any of its powers and functions under this Act to any Member or Officer of the Board, subject to such conditions and limitations, as may be prescribed.

16. **Issuance of policy directives.**—The Federal Government may, as and when it considers necessary, issue policy directives to the Board in respect of its activities and the compliance of such directives shall be binding on the Board.

17. **Annual report.**—On conclusion of each financial year, the Chief Executive Officer shall submit an annual report to the Federal Government in respect of all activities of the Board including the status of its existing programmes, projects and future plans formulated in furtherance of its aims and objectives and the Federal Government shall cause a copy of the report to be presented in the Committees of the National Assembly and Senate and to be laid before the Parliament.

18. **Power to make rules.**—The Federal Government may, on the recommendations of the Board, make rules to carry out the purposes of this Act.

19. **Power to make regulations.**—(1) The Board, may make regulations, not inconsistent with this Act and the rules, to carry out the purposes of this Act.

(2) Without prejudice to the generality of the forgoing provisions, the regulations may provide for.—

(a) disciplinary proceedings and award of punishments;

(b) terms and conditions alongwith remuneration and privileges, etc. appointments of officers, staff members, experts, advisors and consultants etc;

(c) prescription of different scales and grades etc. for the remuneration and privileges of officers, staff members, experts, advisors and consultants of the Board;

(d) procedure for appointment of members of different committees and laying down regulations for the conduct of their business; and

(e) all or any of the matters which by this Act are to be or may be prescribed by the regulations.

20. **Authorities to aid the Board.**—All executive authorities in the Federation and in the Provinces shall render such assistance to the Board as may be necessary for the execution of its programmes and projects being carried out under this Act.

21. **Indemnity of the Board.**—No suit, prosecution or other legal proceeding shall lie against the Board, the Chairman, the Chief Executive Officer (CEO), the Members, professionals, officers, advisors, consultants, and other persons and employees of the Board, in respect of anything done or intended to be done in good faith under this Act.

22. **Removal of difficulties.**—If any difficulty arises in giving effect to any of the provisions of this Act, the President may make such order, not inconsistent with the provisions of this Act, as may appear to be necessary for removing the difficulty.

23. **Dissolution of Board.**—Upon the commencement of this Act, the Alternative Energy Development Board established *vide* Notification No. F. 1/7/2003-Admn II, dated 12th May 2003, hereinafter referred to as the former Board, shall stand dissolved and upon such dissolution.—

(a) all assets, rights, powers, authorities and privileges and property, moveable and immoveable, cash and bank balance, reserve funds, investments and all other interests and rights in, or arising out of such property and all debts, liabilities and obligations of whatever kind of the former Board subsisting immediately before its dissolution shall stand transferred to and vest in the Board;

(b) all officers and other employees of the former Board shall, notwithstanding anything contained in any law or in any agreement, deed, document or other instrument, stand transferred to the Board and shall be deemed to have been appointed or engaged by the Board in accordance with the terms and conditions of service applicable to them; and no officer or other employee whose services are so transferred shall be entitled to any compensation because of such transfer;

(c) all debts and obligations incurred or contracts entered into or rights acquired and all matters and things engaged to be done by, with or for the former Board before its dissolution shall be deemed to have been incurred, entered into, acquired or engaged to be done by, with or for the Board; and

(d) all suits and other legal proceedings instituted by or against the former Board before its dissolution shall be deemed to be suits and proceedings by or against the Board and may be proceeded or otherwise dealt with accordingly.

24. **Exemption from taxes.**—Notwithstanding anything contained in the Income Tax Ordinance, 2001 (XLIX of 2001), or any other law for the time being in force relating to income tax, the Board shall not be liable to pay any such tax on its income, investment, capital profit, wealth, gifts or gains.

RAJA MUHAMMAD AMIN,
Secretary.

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Appendix A-1-2: Main Staffs of AEDB

Name	Designation	Phone Number
Mr. Arif Alauddin	Chief Executive Officer	051-9262956
Mr. Muhammad Anwar Ali	Secretary AEDB	051-9262947
Dr. Basharat Hasan Bashir	Consultant	051-9262947
Mr. Navid Hassan Bokhari	Director (Solar)	051-9266374
Mr.Imran Ahmed	Director (REP)	051-2215348
Mr. Jahanzeb Dilazaq	Director (F&A)	051-9262957
Mr. Nadeem Sabir Virk	DD(Admin)	051-9262953
Mr. Jahangir Kakar	DDO(Dev)	051-9262947
Mr. Irfan Yousuf	Dy.Director(PA & CDM)	051-9262948
Mr. Sheeraz Anwar Khan	Dy.Director(DM) / Officer Incharge(COK)	021-35342708
Syed Aqeel Hussain Jafri	Dy.Director(Policy)	051-9262947
Mr. Naeem Memon	Dy.Director(Compilation)	021-35342708
Mr. Sulman Ishaque Malik	Dy.Director (H&W)	051-9262964
Mr. Muhammad Asghar	Assistant Director(HR)	051-9262948
Mr. Muhammad Bilal	Assistant Director(IT)	051-9262951
Mr. Haq Nawaz Malik	Protocol Officer	051-9262948
Mr. Ali Nawaz Channa	Admin / Financial Officer(COK)	021-35342708

Source: Website of AEDB (http://www.aedb.org/StaffMembers.htm) as of October 19. 2012

Appendix A-2

Information of PCRET

Appendix A-2-1: Renewable Energy Experts of PCRET

Name	Designation / Field
Mr. Shaheen Raja	Director General
Mr. Syed Jalaluddin Shah	Deputy Director General
Engr Anwer Aziz	Head Commercialization
Photovoltaic (Solar Energy Systems Fabrication and Installation)	
Mr. Munwar Ahmed	Head Solar Energy (Photovoltaic)
Mr. Ashraf Baig	Photovoltaic Device Fabrication, Solar Cell Fabrication, Photovoltaic Systems Sizing and Installation
Mr. Muhammad Nadeem Zakir	In charge: Crystal Growth, Photovoltaic Systems Sizing and Installation
Mr. Muhammad Hashim Sheikh	In charge: Lamination Laboratory
Dr. Afzal Kamboh	In charge: Organic Solar Cells Laboratory
Engr. Amjad Khan	Field: Photovoltaic, Electronic
Solar Thermal (Solar Water Heating, Drying, Cooking and Desalination)	
Mr. Saeed Hussain	In charge: Solar Thermal and Solar Testing Laboratory
Mr. Muhammad Akram	Solar Testing Labs PV and Solar Thermal Systems Testing
Mr.Azam Ali Khan	Field: Solar Thermal (Solar Cooking, Solar Water Heating, Solar Drying and Solar Desalination), Biogas
Wind, Biogas and Micro hydel Power	
Engr.Samiullah Sheikh	Head of Regional Office Lahore
Mr. Hakim Ali Siyal	Head of Regional Office, Karachi
Mr. Badar-ud-Din	Head of Regional Office, Quetta
Mr. Sarfraz Khan Khattak	Head of Regional Office, Peshawar
Mr. Muhammad Nabi	Field: Microhydel, Biogas
Mr. Rauf Ahmed	Project Director
Mr. M. Sultan Khoso	Field: Appropriate Technology / Renewable Energy (Biogas)
Mr. Abdul Hameed Saand	Field: Computer Science /Renewable Energy
Miss. Sohaila Andalib	Field: Biogas, Analytical Chemistry
Project Up gradation of facilities to produce Silicon Solar Modules up to 80kW annual capacity	
Mr. S.D. Orfi	Project Director
Engr. Zafar Javed	Advisor
Dr. Jalal Bukhari	Consultant
Engr. Malik Muhammad Aslam	Consultant
Engr. Ch Bashir Ahmed	Advisor
Mr. Abdul Majeed	Deputy Director
Miss. Farhana Jabeen	Field: Photovoltaic, Physics
Mr. Azmat Ullah	Field: Photovoltaic, Physics

Source: Website of PCRET (http://www.pcret.gov.pk/) as of October 19. 2012

Appendix A-3

Regulation and Tariff

Appendix A-3-1: Parts of Regulation and Rules of the RE Policy

(i) Scope of the RE Policy

The RE Policy deals the following renewable energies:

- Small hydro power of 50 MW or less capacity
- Solar photovoltaic (PV) and thermal energy for power generation
- Wind power generation

Other RE power generation technologies are out of the scope of the RE Policy.

(ii) Categories of Power Generation Project for Private Sector

The major objective of the RE Policy is to attract the private sector investments for renewable energy development. In order to regulate the participation of private sector, the following categories of renewable energy projects are stipulated in the RE Policy.

i) Independent power projects based on new plants for sale of power to the grid only : the projects of Independent Power Producers (IPPs)
ii) Captive and grid spillover projects (i.e., self-use and sale to utility)
iii) Captive power projects (i.e., for self or dedicated use)
iv) Isolated grid power projects (i.e., small, stand-alone)

The projects categorized into i) and iv) of the above are further categorized into the following two types.

- Solicited
- Unsolicited

Solicited projects are those where feasibility study has already been conducted and the implementation of new power generation projects will be processed as solicited proposals. Unsolicited sites are raw sites where feasibility study works needs to be initiated for exploring the site power potential. In other words where no feasibility study has been conducted or initiated, those projects will be analyzed as raw site or unsolicited site projects.

(iii) General Incentives for RE Power Generators of All Categories

The following provisions are stated in the RE Policy. It is stated that the provisions shall be made available to all the renewable energy-based power projects of all the categories.

i. Mandatory Purchase of Electricity

It shall be mandatory for the power distribution utilities to buy all the electricity offered to them by RE projects.

ii. Grid Connection, Off-take Voltage and Interface

Electricity shall be purchased from RE power producers at the outgoing bus bar of power station at the designated voltages 220 kV, 132 kV, 11 kV, and 400 V depending on the distance from the

power station to the existing transmission line.

iii. Wheeling

RE power producers shall be allowed to enter into direct (bilateral) sales contracts with end-user consumers. For direct sales, RE power producers shall be required to pay wheeling charges for the use of transmission and/or distribution grid network used to transport he power from the plant to the purchaser.

(iv) Specific Incentives for Grid-connected RE IPPs

The following provisions are stated in the RE Policy for the projects of the category i.e.: the projects of IPPs selling all generated electricity (minus auxiliary consumption) to the grid.

i. RE Resource Variability Risk

The risk of variability in wind speeds (for wind power projects) and water flow (for small hydro power project) shall be borne by the power purchaser in the manner described in Guideline for Determination of Tariff for Grid-Connected IPPs (referred to as "the Guideline-A" in this report) which is a part of the RE Policy document as Annex-A.

"Benchmark" electricity production levels based on mean availability of wind or water flow for the month shall be determined for each project location on the basis of independently monitored data. The IPPs shall be ensured revenues corresponding to this benchmark level, including potential loss of corresponding carbon credits.

ii. Production Incentives

For all power produced above than the benchmark level, a production bonus payment shall be made to the IPP, detailed for wind and hydro generation in the Guideline-A.

iii. Carbon Credits

All RE power projects of wind and small hydro IPPs eligible for financing under the Clean Development Mechanism (CDM) shall be encouraged to resister for Certified Emission Reduction (CER) credits with the CDM Executive Board, either collectively or individually.

iv. Security Package

The power purchaser shall enter into a specific Power Purchase Agreement (PPA), based on a standard model agreement, with RE power producer. The GOP shall also enter into an Implementation Agreement (IA) which will guarantee the payment obligation of the public sector power purchaser on account of sales extending over the term of the PPA.

(v) Facilities for Captive and Grid Spillover Projects

The following provisions are stated as facilities in the RE Policy for the projects of the category ii: the captive and spillover power projects.

i. Net Purchase and Sales - or Net Billing

An RE power project of the capacity greater than 1 MW set up for self (captive) or dedicated use

may supply surplus electricity to the power utility (grid spillover), while at other times drawing electricity from the utility. In such case, the net electricity:

- supplied by the power producer to the utility in a month (i.e., units supplied by the producer minus units received by the producer, if it is greater than zero) shall be paid for by the utility at the tariff equal to the average energy cost per kWh for oil based-based power generation (as determined by the NEPRA for GENCOs/IPPs over applicable quarter of the year) less 10%, or
- supplied by the utility to the power producer in a month (i.e., units received by the producer minus units supplied by the producer, if it is greater than zero) shall be paid for by the producer at the applicable retail tariff

ii. Net Metering

An RE power project of the capacity up to 1 MW set up for self (captive) or dedicated use may also supply surplus electricity to the power utility, while at other times drawing electricity from the utility. In such case, the net electricity:

- supplied by the power producer to the utility in a month (i.e., units supplied by the producer minus units received by the producer, if it is greater than zero), or
- supplied by the utility to the power producer in a month (i.e., units received by the producer minus units supplied by the producer, if it is greater than zero),

shall be paid for by the utility or the producer, at the applicable retail tariff.

iii. Banking of Net Energy Units for Net Billing

For net billing purposes, a rolling account of energy units will be maintained on the pattern of a bank account (i.e., debit or credit basis). Such banking accounts of net energy units shall be maintained on a monthly basis and final balance will be reconciled at the end of the year.

iv. Wheeling Charges for Net Billing

Under the arrangement of net billing, a producer may generate and supply power to the grid at one location and receive equivalent number of units for self use (say, factory) at a different or physically distant location on the grid at different time without paying any wheeling charges.

(vi) Facilities for Off-grid and Dispersed RE Power Generation

Off-grid power generation wholly for captive or dedicated use (category iii), or for supply to a local community through small isolated distribution lines not connected to the utility grid (category iv), shall be greatly deregulated and simplified.

(vii) Procedure for Setting Up IPPs for Sale of All Power to Grid

The procedure for setting up an IPP is different for solicited and unsolicited or raw sites. Proposals for solicited sites will be processed for selection of successful bidders on the basis of minimum levelized tariff through competitive bidding. Variable tariff over the life of the project will be permitted under the terms specified in the Request for Proposal (RFP). The process of selection involves pre-qualification, issuance of RFP, bidding and evaluation in accordance with

the bidding criteria laid down in RFP.

Unsolicited site or raw site proposals shall be submitted to either AEDB or concerned provincial authority. If the proposal is approved by AEDB or concerned provincial authority, Letter of Intent (LOI) is issued after submission of bank guarantee. In cases there is more than one investor for an unsolicited or raw site, each investor will be required to submit Pre-Qualification Documents (PQD) for the project. The procedure including the same after obtaining LOI is shown in the flow chart below.

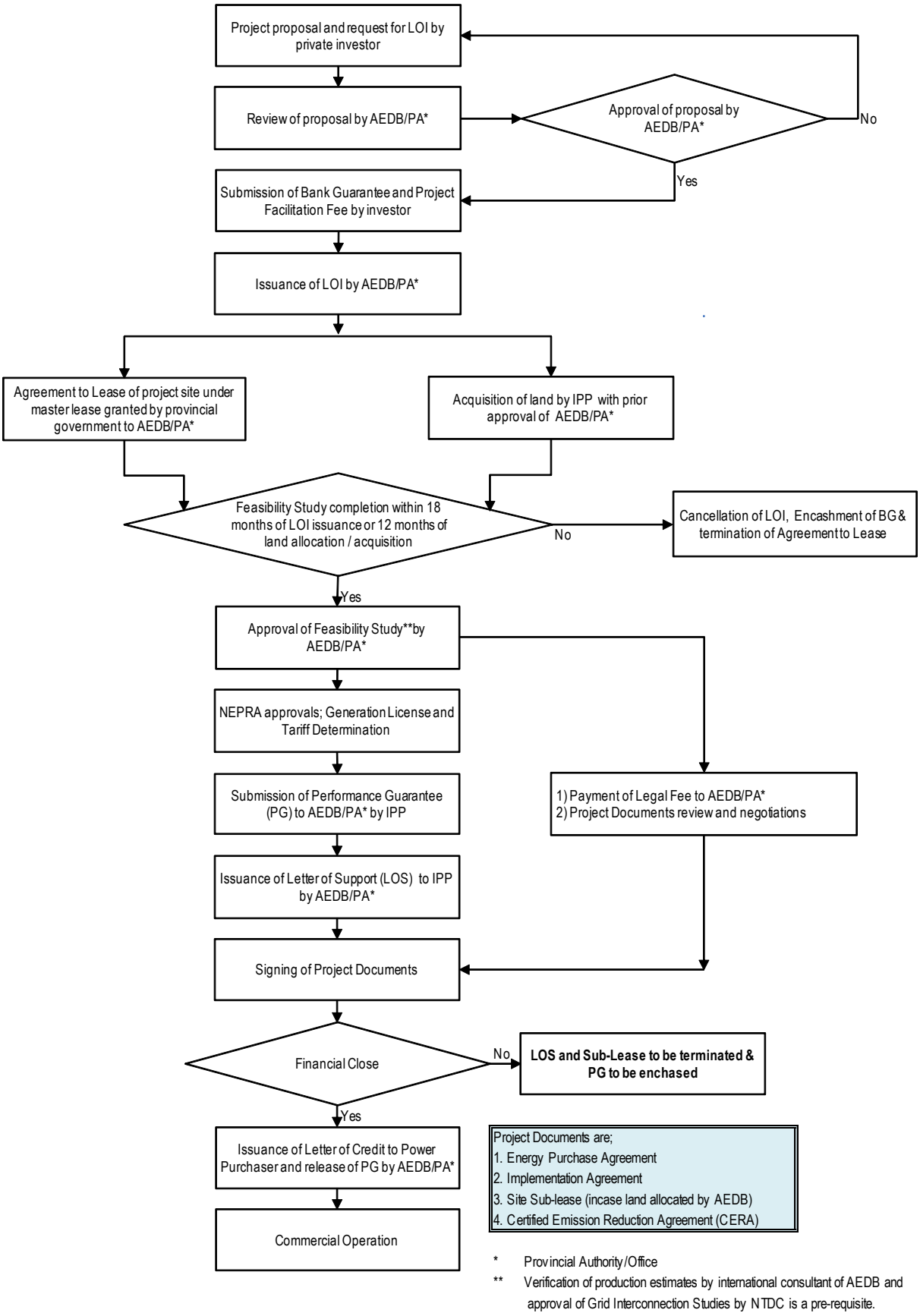


Figure: Procedure for Setting Up IPP for Unsolicited or Raw Site

Appendix A-3-2: Upfront Tariff

In RE or ARE based technologies GOP through NEPRA had already announced the upfront tariff for wind based RE Power projects in the country but so far no upfront tariff has been announced for other RE or ARE based power plants.

According to AEDB sources, NEPRA is in process of calculating upfront tariff for solar based IPPs and most likely it will be announced in next 2-3 months time: January or February 2013.

The announced upfront tariff for wind power generation is shown in the following tables.

UPFRONT TARIFF CALCULATED ON THE BASIS OF PROJECT FINANCING STRUCTURE OF EQUITY PLUS 100% LOCAL LOAN ALONG WITH ITS APPLICABLE ONETIME ADJUSTMENTS

1. Reference tariff on BOO Basis

Years	O & M (including insurance)	Return on equity, etc.	Principal repayment of debt	Interest	Total tariff
1	2.2591	5.0874	2.9588	10.7983	21.1036
2	2.2591	5.0874	3.4714	10.2857	21.1036
3	2.2591	5.0874	4.0728	9.6843	21.1036
4	2.2591	5.0874	4.7783	8.9788	21.1036
5	2.2591	5.0874	5.6061	8.1510	21.1036
6	2.2591	5.0874	6.5773	7.1798	21.1036
7	2.2591	5.0874	7.7168	6.0403	21.1036
8	2.2591	5.0874	9.0536	4.7035	21.1036
9	2.2591	5.0874	10.6220	3.1351	21.1036
10	2.2591	5.0874	12.4622	1.2949	21.1036
11 to 20	2.2591	5.0874	-	-	7.3465
Levelized – Rs./Kwh.					**17.2755**
Indexation	PKR/US $ & US CPI	PKR/US $	-	KIBOR	

2. This tariff is calculated on the basis of project financing structure of equity plus 100% local loan.

The principal loan repayment is taken at 10 years.

Table: Upfront Tariff on the basis of project structure of Equity plus 100% Foreign Loan

REFERENCE TARIFF ON BOO BASIS

Years	O & M (including insurance)	Return on equity, etc.	Principal repayment of debt	Interest	Total tariff
1	2.2591	4.6386	4.7459	3.1686	14.8122
2	2.2591	4.6386	5.0050	2.9095	14.8122
3	2.2591	4.6386	5.2781	2.6364	14.8122
4	2.2591	4.6386	5.5662	2.3483	14.8122
5	2.2591	4.6386	5.8701	2.0444	14.8122
6	2.2591	4.6386	6.1905	1.7240	14.8122
7	2.2591	4.6386	6.5284	1.3861	14.8122
8	2.2591	4.6386	6.8847	1.0298	14.8122
9	2.2591	4.6386	7.2605	0.6540	14.8122
10	2.2591	4.6386	7.6568	0.2577	14.8122
11 to 20	2.2591	4.6386	-	-	6.8977
Levelized – Rs./kWh.					**12.6100**
Indexation	PKR/US $ & US CPI	PKR/US $	PKR/US $	PKR/US $ & LIBOR	

Levelized tariff discounted at 10% per annum works out to US cents 14.6628/kWh.

Appendix A-3-3: Details of Distribution Company (DISCO) and Its License Holders

DISCO stands for Distribution Company. There are total 9 Public sector distribution companies (DISCOs) working all over Pakistan except KESC area. There are total 2 private sector distribution companies (KESC and BTPL) in the country. KESC is responsible for electricity distribution in Karachi city and its suburb only. BTPL stands for Bahria Town (Pvt.) Limited and carries out electricity distribution in IESCO (one of DISCOs) territory. KESC is not part of DISCOs.
List of all the distribution companies (Public and Private) is shown in the following table.

List of Licensed Issued to Distribution Companies

S#	Company	Date of Licence Issued	Number of Consumers (as on 30th June, 2011)	Licence Valid Until
Distribution Companies working in Public Sector				
1	Peshawar Electric Supply Company Limited*	30-04-2002	3038582	29-04-2022
2	Islamabad Electric Supply Company Limited	02-11-2001	2140728	01-11-2021
3	Gujranwala Electric Power Company Limited	23-04-2002	2550203	22-04-2022
4	Lahore Electric Supply Company Limited	01-04-2002	3313233	31-03-2022
5	Faisalabad Electric Supply Company Limited	02-03-2002	2996536	01-03-2022
6	Multan Electric Power Company Limited	25-04-2002	4226389	24-04-2022
7	Hyderabad Electric Supply Company Limited	23-04-2002	1541656	22-04-2022
8	Quetta Electric Supply Company Limited	30-04-2002	502156	29-04-2022
9	Sukkur Electric Supply Company Limited	18-08-2011	689758	17-08-2031
Distribution Company working in Private Sector				
1	Karachi Electric Supply Company Limited	21-07-2003	2109623	20-07-2023
2	Bahria Town (Pvt.) Limited	24-11-2010	350	23-11-2030
Distribution Licence Granted to Small Power Producers				
1	Monnoo Energy Limited	20-10-2006	3	07-12-2016
2	Sapphire Power Gen. Limited	20-10-2006	8	26-08-2016
3	Sitara Energy Limited	20-10-2006	16	01-01-2017
4	Gulistan Power Generation Limited	20-10-2006	4	15-11-2016
5	Mahmood Power Generation Limited	14-11-2006	1	21-10-2016
6	Kohinoor Mills Limited	14-11-2006	1	07-12-2016
7	Quetta Textile Mills Limited	14-11-2006	3	31-01-2017
8	Crescent Power Tech. Limited	18-12-2008	3	21-10-2016
9	Ibrahim Fibers (Pvt.) Limited	22-07-2008	3	30-12-2021
10	Engro Chemical Pakistan Limited	22-07-2009	Self Consumption	21-07-2029
** including TESCO*				

Source: National Electric Power Regulatory Authority

Source: State of Industry Report 2011, NEPRA

Appendix B-1

Monthly averaged Insolation incidents on Horizontal Surface

(Source: NASA)

Monthly averaged Insolation incidents on Horizontal Surface

(Unit: kWh m^{-2} day^{-1})

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual Average
Location: Lat 23 to 24N, Lon 67 to 68E						**Landhi (Western part of Karachi, Sindh province)**							
Average	4.96	5.83	6.85	7.38	7.56	6.97	6.04	5.86	6.28	5.93	5.19	4.71	6.13
Minimum	4.51	5.42	6.23	7.01	7.33	5.79	5.32	5.33	6.03	5.63	4.88	4.43	
Maximum	5.21	6.06	7.19	7.82	7.79	7.46	6.46	6.74	6.59	6.11	5.35	4.90	
Location: Lat 23 to 24N, Lon 68 to 69E						**Malir City (Western part of Karachi, Sindh province)**							
Average	4.65	5.47	6.25	6.87	6.78	6.27	5.26	5.24	5.70	5.41	4.69	4.28	5.57
Minimum	4.32	4.92	5.69	6.46	6.37	5.83	4.21	4.30	4.96	5.03	4.41	4.02	
Maximum	5.16	5.74	6.69	7.35	7.05	6.83	5.94	6.08	5.99	5.73	5.02	4.49	
Location: Lat 23 to 24N, Lon 69 to 70E						**Sujawal (Thatta district, Sindh province)**							
Average	4.24	4.95	5.67	6.31	6.47	6.18	5.24	4.96	5.28	4.94	4.33	3.99	5.21
Minimum	3.73	4.36	4.93	5.81	6.08	5.62	4.19	4.02	4.65	4.40	3.90	3.55	
Maximum	4.83	5.59	6.58	6.69	7.05	6.67	6.29	5.90	5.86	5.73	4.72	4.55	
Location: Lat 24 to 25N, Lon 66 to 67E						**Manora (South Karachi, Sindh province)**							
Average	4.76	5.67	6.68	7.31	7.60	7.23	6.30	6.11	6.32	5.91	5.11	4.53	6.13
Minimum	4.33	5.27	5.68	7.09	7.37	6.65	5.54	5.62	6.00	5.44	4.75	4.17	
Maximum	5.05	6.01	7.15	7.53	7.83	7.59	6.74	6.72	6.70	6.09	5.31	4.80	
Location: Lat 24 to 25N, Lon 67 to 68E						**Karachi (Captial of Sindh province)**							
Average	4.38	5.18	5.93	6.65	6.67	6.40	5.44	5.27	5.62	5.24	4.50	4.11	5.45
Minimum	3.94	4.87	4.98	6.18	6.20	6.02	4.52	4.85	5.23	4.82	4.19	3.82	
Maximum	4.95	5.49	6.52	7.18	7.07	6.78	6.04	6.01	5.96	5.61	4.82	4.60	
Location: Lat 24 to 25N, Lon 68 to 69E						**Kotri, Hydrebad (Sindh province)**							
Average	4.19	4.92	5.64	6.38	6.50	6.40	5.41	5.12	5.31	4.91	4.24	3.87	5.24
Minimum	3.73	4.48	5.08	5.93	6.11	5.95	4.27	4.45	4.99	4.57	3.90	3.56	
Maximum	4.47	4.97	5.74	6.59	6.72	7.02	4.96	5.12	5.34	5.02	4.25	4.09	
Location: Lat 24 to 25N, Lon 69 to 70E						**Islamkot (Tharparkar district, Sindh province)**							
Average	4.13	4.82	5.56	6.27	6.53	6.43	5.41	5.19	5.33	4.86	4.23	3.90	5.22
Minimum	3.68	4.39	4.95	5.96	6.07	5.85	4.33	4.26	4.90	4.47	3.98	3.59	
Maximum	4.41	4.78	5.59	6.25	6.56	6.61	4.98	5.02	5.25	4.78	4.37	4.13	
Location: Lat 24 to 25N, Lon 70 to 71E						**Chachro, Vira Wah(Sindh province)**							
Average	4.05	4.63	5.49	6.41	6.83	6.53	5.46	5.17	5.25	4.75	4.05	3.74	5.20
Minimum	3.76	4.44	4.38	6.03	6.32	6.29	4.94	4.97	5.23	4.53	3.77	3.39	
Maximum	4.79	5.37	6.40	6.87	7.26	7.29	6.49	6.22	6.07	5.60	4.62	4.35	
Location: Lat 25 to 26N, Lon 66 to 67E						**Gadap (North Eastern part of Karachi, Sindh province)**							
Average	4.13	4.88	5.61	6.42	6.72	6.69	5.95	5.65	5.62	5.09	4.24	3.85	5.40
Minimum	3.47	4.34	5.11	5.97	6.25	6.09	4.70	4.63	5.06	4.58	3.73	3.23	
Maximum	4.83	5.51	6.28	6.93	7.46	7.63	7.02	6.67	6.18	5.75	4.83	4.47	

(Unit: kWh m^{-2} day^{-1})

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual Average
Location: Lat 25 to 26N, Lon 67 to 68E							**Tando Adam (Sindh province)**						
Average	3.80	4.48	5.29	6.31	6.68	6.69	5.77	5.43	5.29	4.72	3.93	3.58	5.16
Minimum	3.31	3.85	4.44	5.81	6.21	5.95	4.90	4.56	4.81	4.25	3.50	3.15	
Maximum	4.13	4.39	5.29	6.39	6.77	6.67	5.69	5.25	5.25	4.89	4.02	3.87	
Location: Lat 25 to 26N, Lon 68 to 69E							**Tandu M. Khan, Tando Gulam Ali (Sindh province)**						
Average	3.70	4.42	5.41	6.41	6.88	6.98	6.20	5.95	5.62	4.54	3.70	3.42	5.27
Minimum	3.26	3.93	4.92	5.83	6.33	6.07	5.21	4.94	5.17	4.04	3.40	3.01	
Maximum	4.27	4.48	5.37	6.42	7.15	6.92	5.94	5.38	5.64	4.61	3.95	3.88	
Location: Lat 25 to 26N, Lon 69 to 70E							**Naya Chor,Mir Pur Khas (Sindh province)**						
Average	4.12	4.88	5.61	6.30	6.51	6.56	5.85	5.57	5.55	4.95	4.20	3.90	5.33
Minimum	3.71	4.49	4.82	5.99	6.18	6.04	5.09	4.85	5.05	4.36	3.91	3.63	
Maximum	4.41	4.94	5.45	6.88	6.80	7.06	5.65	5.33	5.56	4.79	4.34	4.06	
Location: Lat 25 to 26N, Lon 70 to 71E							**Chhachhro (Sindh province)**						
Average	4.08	4.74	5.47	6.10	6.40	6.36	5.47	5.21	5.32	4.87	4.15	3.75	5.16
Minimum	3.59	4.22	4.70	5.80	5.95	5.72	4.49	4.48	5.00	4.33	3.82	3.38	
Maximum	4.77	5.31	6.40	6.71	6.91	6.93	6.40	5.94	5.69	5.60	4.81	4.31	
Location: Lat 26 to 27N, Lon 67 to 68E							**Sehwan, Dadu (Sindh province)**						
Average	3.88	4.62	5.32	6.29	6.67	6.72	6.08	5.83	5.46	4.91	4.01	3.61	5.28
Minimum	3.41	4.02	4.26	5.85	5.94	6.25	5.05	4.96	5.08	4.22	3.57	3.00	
Maximum	4.69	5.17	6.06	6.98	7.34	7.26	6.87	6.59	5.90	5.50	4.49	4.22	
Location: Lat 26 to 27N, Lon 68 to 69E							**Naushro Feroz, Darbelo (Sindh province)**						
Average	3.99	4.71	5.41	6.09	6.42	6.41	5.77	5.60	5.56	5.00	4.21	3.75	5.24
Minimum	3.47	4.38	4.49	5.60	5.97	5.90	4.67	4.93	5.12	4.50	3.87	3.34	
Maximum	4.79	5.28	6.17	6.94	6.93	6.92	6.40	6.38	6.00	5.50	4.67	4.24	
Location: Lat 26 to 27N, Lon 69 to 70E							**Nawab Shah, Lashri (Sindh province)**						
Average	3.93	4.61	5.26	5.96	6.32	6.39	5.77	5.51	5.44	4.79	4.01	3.62	5.13
Minimum	3.50	4.06	4.26	5.54	5.69	5.75	5.14	5.07	5.00	4.31	3.69	3.26	
Maximum	4.76	5.30	6.15	6.68	6.76	6.90	6.52	5.95	6.26	5.41	4.57	4.16	
Location: Lat 27 to 28N, Lon 67 to 68E							**Data Chandio, Nasirabad (Sindh province)**						
Average	3.86	4.68	5.27	6.17	6.64	6.62	6.12	5.88	5.46	4.96	4.05	3.54	5.27
Minimum	3.40	4.07	4.53	5.61	5.71	5.89	5.32	5.35	5.19	4.07	3.69	2.90	
Maximum	4.67	5.29	6.17	6.73	7.37	7.35	6.85	6.47	5.84	5.56	4.62	4.14	
Location: Lat 27 to 28N, Lon 68 to 69E							**Larkana, Khair Pur (Sindh province)**						
Average	3.97	4.78	5.44	6.25	6.64	6.73	6.21	5.81	5.66	4.99	4.12	3.64	5.35
Minimum	3.30	4.25	4.57	5.81	6.18	6.06	5.46	5.52	5.15	4.49	3.79	3.24	
Maximum	4.64	5.40	6.26	7.06	7.17	7.67	6.83	6.33	6.17	5.54	4.57	4.08	

(Unit: kWh m^{-2} day^{-1})

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual Average
Location: Lat 27 to 28N, Lon 69 to 70E							**Sanghar, Panu Aqil (Sindh province)**						
Average	3.92	4.67	5.23	5.98	6.43	6.42	5.82	5.54	5.50	4.86	4.04	3.58	5.17
Minimum	3.37	4.11	4.29	5.56	5.85	5.78	5.18	5.10	4.90	4.47	3.72	3.19	
Maximum	4.51	5.28	6.12	6.76	7.01	7.06	6.40	6.04	6.16	5.25	4.48	4.05	
Location: Lat 28 to 29N, Lon 67 to 68E							**Ghari yasin (Sindh province)**						
Average	3.78	4.55	5.05	5.96	6.49	6.49	5.88	5.63	5.51	4.96	4.11	3.48	5.16
Minimum	3.29	3.96	4.14	5.13	5.71	5.71	5.17	5.12	5.07	3.97	3.62	2.82	
Maximum	4.57	5.19	6.01	6.62	7.27	7.20	6.59	6.31	5.84	5.51	4.60	4.07	
Location: Lat 28 to 29N, Lon 68 to 69E							**Ghotki (Sindh province)**						
Average	3.79	4.47	4.98	5.98	6.66	6.75	6.26	5.69	5.34	4.68	3.92	3.44	5.16
Minimum	3.15	4.07	4.18	5.26	5.99	6.08	5.26	5.23	4.81	4.12	3.49	3.06	
Maximum	4.51	5.14	5.93	7.00	7.39	7.29	7.01	6.37	5.93	5.34	4.31	3.89	
Location: Lat 28 to 29N, Lon 69 to 70E							**Kand Kot, Kashmor (Sindh province)**						
Average	3.76	4.47	5.09	6.22	6.94	7.01	6.42	5.93	5.28	4.55	3.77	3.40	5.24
Minimum	3.16	4.02	4.28	5.66	6.25	6.10	5.46	5.51	4.91	4.14	3.39	3.03	
Maximum	4.51	5.05	5.60	6.78	7.63	7.99	7.00	6.52	5.76	5.14	4.30	3.91	
Location: Lat 28 to 29N, Lon 70 to 71E							**Rahim Yar, Sadiqabad (Punjab province)**						
Average	3.56	4.37	5.05	5.86	6.43	6.58	5.93	5.51	5.16	4.55	3.79	3.34	5.01
Minimum	3.69	4.56	5.31	6.20	6.84	7.01	6.28	5.81	5.43	4.76	3.93	3.45	
Maximum	3.67	4.54	5.27	6.18	6.80	6.95	6.25	5.79	5.40	4.74	3.92	3.43	
Location: Lat 28 to 29N, Lon 71 to 72E							**LiaquatPur (Punjab province)**						
Average	3.56	4.37	5.05	5.86	6.43	6.58	5.93	5.51	5.16	4.55	3.79	3.34	5.01
Minimum	3.10	3.85	4.39	5.45	5.72	5.66	5.40	5.07	4.75	4.14	3.49	2.84	
Maximum	4.41	5.03	5.91	6.45	7.14	7.11	6.70	5.90	5.93	5.10	4.24	3.84	
Location: Lat 28 to 29N, Lon 72 to 73E							**Fort Abbas (Punjab province)**						
Average	3.59	4.28	5.05	5.94	6.51	6.57	5.92	5.53	5.09	4.48	3.76	3.28	5.00
Minimum	3.09	3.72	4.34	5.52	5.79	5.45	5.39	5.14	4.48	4.17	3.46	2.85	
Maximum	4.34	4.84	5.76	6.47	7.10	7.23	6.75	6.14	5.45	4.97	4.29	3.80	
Location: Lat 29 to 30N, Lon 69 to 70E							**Part of Baluchistan and Fort Munro (Punjab province)**						
Average	3.66	4.42	5.09	6.18	6.83	6.92	6.39	5.98	5.47	4.51	3.67	3.27	5.20
Minimum	3.00	4.07	4.28	5.75	6.15	6.02	5.50	5.38	5.14	4.06	3.30	2.94	
Maximum	4.36	4.99	5.65	6.86	7.44	7.89	6.97	6.70	5.96	4.87	4.15	3.96	
Location: Lat 29 to 30N, Lon 70 to 71E							**Rajan Pur, jam Pur (Punjab province)**						
Average	3.62	4.38	4.98	5.78	6.50	6.58	6.19	5.64	5.12	4.51	3.67	3.31	5.02
Minimum	2.90	4.03	4.13	4.97	5.98	5.72	5.69	5.19	4.76	3.88	3.23	2.88	
Maximum	4.34	4.99	5.83	6.24	7.09	7.44	6.75	6.32	5.43	5.05	4.15	3.84	

(Unit: kWh m^{-2} day^{-1})

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual Average
Location: Lat 29 to 30N, Lon 71 to 72E							**Uch, Bahawal Pur (Punjab province)**						
Average	3.61	4.47	5.25	5.99	6.53	6.67	6.21	5.67	5.31	4.65	3.84	3.34	5.13
Minimum	3.10	4.07	4.73	5.51	6.01	5.80	5.65	5.50	4.94	4.14	3.61	3.04	
Maximum	2.89	3.98	4.62	5.63	6.14	5.94	5.53	5.27	4.89	4.28	3.46	2.87	
Location: Lat 29 to 30N, Lon 72 to 73E							**Hasilpur (Punjab province)**						
Average	3.51	4.26	4.97	5.73	6.19	6.36	5.72	5.47	5.15	4.61	3.83	3.26	4.92
Minimum	3.02	3.75	4.37	5.27	5.63	5.41	5.26	5.20	4.69	4.29	3.49	2.93	
Maximum	4.32	4.73	5.67	6.36	6.69	7.00	6.58	6.02	5.72	5.21	4.17	3.78	
Location: Lat 30 to 31N, Lon 70 to 71E							**Taunsa (Punjab province)**						
Average	3.59	4.33	5.01	5.65	6.18	6.10	5.70	5.45	5.23	4.75	3.86	3.32	4.93
Minimum	2.87	3.81	4.16	4.75	5.44	5.43	5.13	5.01	4.76	3.71	3.36	2.86	
Maximum	4.16	5.11	5.91	6.50	6.74	6.83	6.33	6.10	5.81	5.32	4.32	3.75	
Location: Lat 30 to 31N, Lon 71to 72E							**Multan,Khenwal (Punjab province)**						
Average	3.44	4.22	4.99	5.78	6.19	6.36	5.76	5.44	5.21	4.69	3.79	3.19	4.92
Minimum	2.89	3.84	4.24	5.03	5.69	5.66	5.24	5.06	4.69	4.27	3.45	2.87	
Maximum	4.16	4.68	5.74	6.47	6.87	7.00	6.51	6.04	5.84	5.25	4.09	3.83	
Location: Lat 30 to 31N, Lon 72to 73E							**Tobe Tekh Singh, Jhang Sadar (Punjab province)**						
Average	3.41	4.28	5.13	6.05	6.34	6.41	5.78	5.54	5.36	4.76	3.88	3.23	5.01
Minimum	2.83	3.94	4.41	5.32	5.64	5.64	5.26	5.15	4.88	4.33	3.53	2.91	
Maximum	4.13	4.71	5.95	6.72	6.97	7.18	6.47	6.15	6.00	5.38	4.23	3.71	
Location: Lat 31 to 32N, Lon 70 to 71E							**Daraban, Dera Ismail Khan (Punjab province)**						
Average	3.48	4.22	4.94	5.54	6.22	6.32	5.80	5.38	5.05	4.50	3.63	3.20	4.86
Minimum	2.89	3.67	4.05	4.65	5.60	5.44	5.28	4.95	4.75	3.65	3.27	2.78	
Maximum	4.04	5.02	5.78	6.37	6.78	7.02	6.50	5.92	5.40	4.91	4.10	3.62	
Location: Lat 31 to 32N, Lon 71 to 72E							**Gojra (Punjab province)**						
Average	3.44	4.34	5.13	5.76	6.21	6.35	5.79	5.56	5.23	4.53	3.67	3.13	4.93
Minimum	2.79	3.86	4.36	5.07	5.59	5.78	5.38	5.06	4.55	4.12	3.38	2.88	
Maximum	3.96	4.99	5.75	6.45	6.96	6.92	6.37	6.39	5.86	4.94	4.07	3.51	
Location: Lat 31 to 32N, Lon 72 to 73E							**Jaranwala (Punjab province)**						
Average	3.35	4.29	5.12	5.84	6.78	6.92	6.19	5.67	5.16	4.33	3.53	3.09	5.02
Minimum	2.75	3.78	4.25	5.31	5.83	5.95	5.57	5.05	4.39	3.68	3.18	2.84	
Maximum	3.89	4.93	5.84	6.48	7.59	7.75	7.12	6.46	5.88	4.89	3.99	3.58	
Location: Lat 31 to 32N, Lon 73 to 74E							**Faisalabad, Sheikhupura (Punjab province)**						
Average	3.25	4.19	5.09	6.01	6.71	6.65	5.99	5.60	5.37	4.65	3.73	3.14	5.03
Minimum	2.67	3.73	4.53	5.41	5.77	5.52	5.57	4.98	4.67	3.95	3.47	2.64	
Maximum	3.84	4.73	5.60	6.67	7.58	7.51	6.95	6.61	6.01	5.25	4.18	3.58	

(Unit: kWh m^{-2} day^{-1})

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual Average
Location: Lat 31 to 32N, Lon 74 to 75E								**Lahore (Punjab province)**					
Average	3.31	4.30	5.41	6.53	7.34	7.26	6.14	5.69	5.58	5.04	4.01	3.24	5.32
Minimum	2.58	3.53	4.87	6.01	6.61	6.24	5.22	5.01	4.69	4.54	3.73	2.75	
Maximum	3.84	4.90	6.49	7.12	8.00	7.84	7.37	7.00	6.25	5.59	4.41	3.73	
Location: Lat 32 to 33N, Lon 71 to 72E								**Khushab, Mian Wali (Punjab province)**					
Average	3.30	4.16	5.09	6.21	6.37	7.10	6.20	5.80	5.21	4.59	3.69	3.08	5.07
Minimum	2.74	3.70	3.97	5.34	5.67	5.89	5.52	5.22	4.74	3.86	3.25	2.68	
Maximum	3.73	4.87	6.21	7.20	6.82	7.67	7.07	6.50	5.94	5.42	4.10	3.67	
Location: Lat 32 to 33N, Lon 72 to 73E								**Sahiwal, Sargodha (Punjab province)**					
Average	3.26	4.13	5.08	6.24	7.12	7.14	6.01	5.56	5.19	4.63	3.76	3.08	5.10
Minimum	2.71	3.72	4.11	5.43	6.05	6.21	5.59	4.78	4.67	3.84	3.27	2.71	
Maximum	3.81	4.79	6.30	7.24	7.83	7.85	6.91	6.39	6.02	5.46	4.10	3.67	
Location: Lat 32 to 33N, Lon 73 to 74E								**Khewra, Jhelum (Punjab province)**					
Average	3.21	4.13	5.18	6.43	7.32	7.35	5.88	5.64	5.47	4.93	3.92	3.12	5.22
Minimum	2.50	3.63	4.40	5.66	6.44	6.32	5.29	4.96	4.65	4.04	3.61	2.71	
Maximum	3.72	4.75	6.32	7.27	7.91	7.94	6.53	6.82	6.13	5.57	4.23	3.71	
Location: Lat 32 to 33N, Lon 74 to 75E								**Wazirabad, Gujranwala (Punjab province)**					
Average	3.20	4.12	5.22	6.51	7.37	7.47	6.15	5.75	5.77	5.19	4.03	3.15	5.33
Minimum	2.27	3.54	4.59	5.86	6.49	5.98	4.92	5.18	4.79	4.26	3.63	2.65	
Maximum	3.81	4.82	6.32	7.29	7.96	7.84	7.81	6.79	6.35	5.55	4.35	3.75	
Location: Lat 32 to 33N, Lon 75 to 76E								**Sialkot, Sharkargar (Punjab province)**					
Average	3.25	4.15	5.22	6.55	7.32	7.33	5.86	5.48	5.75	5.29	4.13	3.18	5.29
Minimum	2.63	3.53	4.49	5.76	6.08	5.79	4.40	4.66	4.72	4.28	3.59	2.64	
Maximum	3.84	4.94	6.47	7.53	7.98	7.99	7.62	6.52	6.33	5.71	4.50	3.82	
Location: Lat 33 to 34N, Lon 72 to 73E								**Chakwal, Rawalpindi (Punjab province)**					
Average	3.19	3.92	4.87	6.22	7.16	7.43	6.48	5.75	5.51	4.93	3.84	2.97	5.19
Minimum	2.58	3.41	3.75	5.35	6.23	6.98	5.51	4.60	4.63	3.65	3.49	2.55	
Maximum	3.76	4.66	6.23	7.28	7.73	7.95	7.39	6.67	6.28	5.47	4.15	3.62	
Location: Lat 33 to 34N, Lon 73 to 74E								**Islamabad Capital City (Pakistan)**					
Average	3.18	3.87	4.95	6.31	7.27	7.54	6.44	5.72	5.69	5.07	3.89	2.99	5.24
Minimum	2.58	3.33	3.91	5.36	6.47	6.64	5.28	4.80	4.67	4.01	3.46	2.57	
Maximum	3.78	4.61	6.29	7.32	7.71	7.92	7.60	6.81	6.37	5.53	4.20	3.68	

Source: NASA website

Note: (1) Data also referred to as global horizontal radiation

(2) Average data for that month over 22 years period (Jul 1983 -Jun 2005)

(3) Minimum and Maximum values is calculated from provided value in percentage

(4) The minimum and maximum values for a given month indicate the difference between the year that has the least (minimum) or most (maximum) monthly averaged insolation and the 22-year monthly averaged insolation.

Appendix B-2

Average, Minimum and Maximum of the Daily Mean Earth Temperature

(Source: NASA)

Average, Minimum and Maximum of the Daily Mean Earth Temperature

(Unit: ^{O}C)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual Average
Location: Lat 23 to 24N, Lon 67 to 68E						**Landhi (Western part of Karachi, Sindh province)**							
Minimum	18.0	19.0	21.7	24.3	26.7	28.1	27.8	26.9	26.5	25.3	22.8	19.6	
Maximum	30.2	32.1	35.6	37.2	37.3	37.0	34.8	34.2	35.3	37.4	35.4	31.6	
Average	24.1	25.6	28.7	30.8	32.0	32.6	31.3	30.6	30.9	31.4	29.1	25.6	9.7
Location: Lat 23 to 24N, Lon 68 to 69E						**Malir City (Western part of Karachi, Sindh province)**							
Minimum	19.1	20.1	22.9	25.4	27.4	28.5	28.0	27.2	27.0	26.4	24.0	20.7	
Maximum	30.4	32.4	36.2	38.1	38.2	37.2	35.0	34.3	36.1	37.8	35.5	31.8	
Average	24.8	26.3	29.6	31.8	32.8	32.9	31.5	30.8	31.6	32.1	29.8	26.3	9.6
Location: Lat 23 to 24N, Lon 69 to 70E						**Sujawal (Thatta district, Sindh province)**							
Minimum	16.8	18.3	22.1	24.9	26.8	27.7	27.0	26.3	26.4	25.5	22.3	18.5	
Maximum	35.7	39.0	44.2	46.3	44.5	41.2	37.1	36.7	40.5	43.9	41.3	36.8	
Average	26.3	28.7	33.2	35.6	35.7	34.5	32.1	31.5	33.5	34.7	31.8	27.7	14.8
Location: Lat 24 to 25N, Lon 66 to 67E						**Manora (South Karachi, Sindh province)**							
Minimum	21.3	21.6	23.2	25.4	27.6	28.8	28.5	27.5	27.1	26.7	25.2	22.9	
Maximum	26.2	26.8	28.9	30.8	32.0	32.4	31.4	30.5	30.8	31.8	30.3	27.7	
Average	23.8	24.2	26.1	28.1	29.8	30.6	30.0	29.0	29.0	29.3	27.8	25.3	5.6
Location: Lat 24 to 25N, Lon 67 to 68E						**Karachi (Captial of Sindh province)**							
Minimum	12.0	14.2	18.6	22.0	25.0	26.9	26.8	26.1	25.1	22.5	18.4	13.7	
Maximum	36.7	40.7	46.7	48.5	47.0	45.1	41.6	41.1	43.3	47.5	43.7	37.9	
Average	24.4	27.5	32.7	35.3	36.0	36.0	34.2	33.6	34.2	35.0	31.1	25.8	18.3
Location: Lat 24 to 25N, Lon 68 to 69E						**Kotri, Hydrebad (Sindh province)**							
Minimum	12.8	14.9	19.7	23.2	26.0	27.5	27.3	26.5	25.8	23.5	19.2	14.5	
Maximum	37.0	41.3	48.5	51.2	49.8	47.0	42.9	42.2	45.5	48.4	44.1	38.4	
Average	24.9	28.1	34.1	37.2	37.9	37.3	35.1	34.4	35.7	36.0	31.7	26.5	19.2
Location: Lat 24 to 25N, Lon 69 to 70E						**Islamkot (Tharparkar district, Sindh province)**							
Minimum	13.0	15.1	20.0	23.7	26.3	27.5	27.1	26.3	26.0	23.8	19.3	14.8	
Maximum	38.2	42.4	49.5	52.7	51.1	47.5	43.0	42.0	46.2	49.1	44.9	39.4	
Average	25.6	28.8	34.8	38.2	38.7	37.5	35.1	34.2	36.1	36.5	32.1	27.1	19.9
Location: Lat 24 to 25N, Lon 70 to 71E						**Chachro, Vira Wah(Sindh province)**							
Minimum	13.1	15.0	20.0	24.0	26.4	27.3	26.7	26.0	25.9	23.7	19.2	14.9	
Maximum	39.0	43.1	50.2	53.7	51.7	47.1	42.1	41.3	46.0	49.1	45.2	40.0	
Average	26.1	29.1	35.1	38.9	39.1	37.2	34.4	33.7	36.0	36.4	32.2	27.5	20.3
Location: Lat 25 to 26N, Lon 66 to 67E						**Gadap (North Eastern part of Karachi, Sindh province)**							
Minimum	15.2	16.3	19.5	22.8	25.6	27.3	27.3	26.5	25.6	23.3	20.3	16.8	
Maximum	29.8	32.1	36.9	40.8	42.2	41.4	38.1	37.7	39.5	39.9	36.0	31.3	
Average	22.5	24.2	28.2	31.8	33.9	34.4	32.7	32.1	32.6	31.6	28.2	24.1	13.5

(Unit: ^{O}C)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual Average
Location: Lat 25 to 26N, Lon 67 to 68E							**Tando Adam (Sindh province)**						
Minimum	10.8	13.0	17.8	21.8	25.0	26.9	26.9	26.2	25.2	22.0	17.4	12.5	
Maximum	35.7	39.9	47.1	51.2	50.9	48.1	44.2	43.8	46.4	48.9	43.4	37.0	
Average	23.3	26.5	32.5	36.5	38.0	37.5	35.6	35.0	35.8	35.5	30.4	24.8	20.2
Location: Lat 25 to 26N, Lon 68 to 69E							**Tandu M. Khan, Tando Gulam Ali (Sindh province)**						
Minimum	10.0	12.1	17.7	22.1	25.5	27.3	27.4	26.6	25.5	22.0	16.9	12.0	
Maximum	35.5	39.9	48.6	53.2	53.1	50.2	45.6	44.7	47.6	49.5	43.8	37.3	
Average	22.8	26.0	33.2	37.7	39.3	38.8	36.5	35.7	36.6	35.8	30.4	24.7	21.6
Location: Lat 25 to 26N, Lon 69 to 70E							**Naya Chor,Mir Pur Khas (Sindh province)**						
Minimum	10.1	12.1	17.5	22.0	25.4	27.2	27.2	26.4	25.3	21.9	16.7	12.0	
Maximum	36.6	40.9	49.1	53.5	53.0	49.7	45.3	43.9	47.5	49.5	44.2	38.2	
Average	23.4	26.5	33.3	37.8	39.2	38.5	36.3	35.2	36.4	35.7	30.5	25.1	21.7
Location: Lat 25 to 26N, Lon 70 to 71E							**Chhachhro (Sindh province)**						
Minimum	10.3	12.1	17.3	21.9	25.3	26.8	26.7	25.9	25.0	21.6	16.6	12.2	
Maximum	37.5	41.7	49.3	53.6	52.6	48.4	44.2	42.7	46.8	49.3	44.4	38.8	
Average	23.9	26.9	33.3	37.8	39.0	37.6	35.5	34.3	35.9	35.5	30.5	25.5	21.7
Location: Lat 26 to 27N, Lon 67 to 68E							**Sehwan, Dadu (Sindh province)**						
Minimum	8.5	10.8	16.1	21.0	24.8	27.0	27.2	26.6	25.0	20.4	15.2	10.3	
Maximum	33.6	38.2	46.6	53.6	56.2	54.4	49.1	48.2	50.9	49.2	42.2	35.1	
Average	21.1	24.5	31.4	37.3	40.5	40.7	38.2	37.4	38.0	34.8	28.7	22.7	23.8
Location: Lat 26 to 27N, Lon 68 to 69E							**Naushro Feroz, Darbelo (Sindh province)**						
Minimum	8.3	10.3	16.2	21.3	25.3	27.5	27.7	26.9	25.5	20.9	15.4	10.3	
Maximum	33.3	37.7	47.1	53.6	55.7	53.4	47.9	46.3	49.3	49.0	42.4	35.3	
Average	20.8	24.0	31.7	37.5	40.5	40.5	37.8	36.6	37.4	35.0	28.9	22.8	23.7
Location: Lat 26 to 27N, Lon 69 to 70E							**Nawab Shah, Lashri (Sindh province)**						
Minimum	8.6	10.5	16.1	21.0	25.0	27.2	27.5	26.5	25.2	20.8	15.3	10.5	
Maximum	33.6	37.9	46.5	51.9	53.3	50.7	45.9	44.0	47.3	48.0	41.9	35.4	
Average	21.1	24.2	31.3	36.5	39.2	39.0	36.7	35.3	36.3	34.4	28.6	23.0	22.4
Location: Lat 27 to 28N, Lon 67 to 68E							**Data Chandio, Nasirabad (Sindh province)**						
Minimum	6.5	8.9	14.4	19.7	24.1	26.7	27.4	26.6	24.2	18.5	13.2	8.3	
Maximum	31.9	36.5	45.2	53.3	57.4	57.3	52.2	49.6	52.2	48.1	40.5	33.5	
Average	19.2	22.7	29.8	36.5	40.8	42.0	39.8	38.1	38.2	33.3	26.9	20.9	25.4
Location: Lat 27 to 28N, Lon 68 to 69E							**Larkana, Khair Pur (Sindh province)**						
Minimum	7.3	9.5	15.2	20.5	25.0	27.7	28.3	27.1	25.0	19.4	13.8	9.1	
Maximum	32.1	37.0	46.4	53.7	57.4	55.4	49.9	46.4	49.2	47.4	40.5	33.7	
Average	19.7	23.2	30.8	37.1	41.2	41.6	39.1	36.8	37.1	33.4	27.2	21.4	25.1

(Unit: ^{O}C)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual Average
Location: Lat 27 to 28N, Lon 69 to 70E						**Sanghar, Panu Aqil (Sindh province)**							
Minimum	7.4	9.4	15.0	20.3	24.7	27.6	28.0	26.8	24.8	19.4	13.8	9.2	
Maximum	32.0	36.6	45.5	51.7	54.6	52.7	47.0	43.8	46.8	46.4	39.9	33.6	
Average	19.7	23.0	30.3	36.0	39.7	40.2	37.5	35.3	35.8	32.9	26.9	21.4	23.6
Location: Lat 28 to 29N, Lon 67 to 68E						**Ghari yasin (Sindh province)**							
Minimum	4.8	7.2	12.3	17.7	22.3	25.2	26.4	25.3	22.3	16.5	11.4	6.7	
Maximum	29.9	34.4	42.7	50.8	55.1	55.5	50.7	47.3	50.6	46.1	38.7	31.7	
Average	17.4	20.8	27.5	34.3	38.7	40.4	38.6	36.3	36.5	31.3	25.1	19.2	25.3
Location: Lat 28 to 29N, Lon 68 to 69E						**Ghotki (Sindh province)**							
Minimum	6.5	8.7	14.0	19.4	23.8	27.0	27.9	26.5	23.9	18.1	12.8	8.3	
Maximum	30.5	35.3	44.3	51.6	55.9	54.6	49.1	44.9	48.3	45.7	38.6	32.1	
Average	18.5	22.0	29.2	35.5	39.9	40.8	38.5	35.7	36.1	31.9	25.7	20.2	24.7
Location: Lat 28 to 29N, Lon 69 to 70E						**Kand Kot, Kashmor (Sindh province)**							
Minimum	6.6	8.6	14.1	19.4	23.9	27.2	27.9	26.6	24.1	18.2	12.8	8.3	
Maximum	30.4	35.2	44.2	50.8	54.7	53.1	47.3	43.2	46.2	45.1	38.3	32.0	
Average	18.5	21.9	29.2	35.1	39.3	40.2	37.6	34.9	35.2	31.7	25.6	20.2	24.1
Location: Lat 28 to 29N, Lon 70 to 71E						**Rahim Yar, Sadiqabad (Punjab province)**							
Minimum	5.1	7.3	12.6	18.3	22.9	26.5	27.2	26.0	23.2	17.1	11.6	7.0	
Maximum	28.1	32.6	41.7	49.1	53.3	52.3	46.6	42.2	44.9	43.4	36.4	30.0	
Average	16.6	19.9	27.2	33.7	38.1	39.4	36.9	34.1	34.1	30.3	24.0	18.5	24.1
Location: Lat 28 to 29N, Lon 71 to 72E						**LiaquatPur (Punjab province)**							
Minimum	6.2	8.3	13.9	19.2	23.9	26.9	27.4	26.4	24.0	18.4	12.7	8.1	
Maximum	30.6	35.0	44.0	50.0	52.5	50.1	44.7	41.6	44.1	45.0	38.4	32.2	
Average	18.4	21.6	29.0	34.6	38.2	38.5	36.1	34.0	34.1	31.7	25.6	20.1	23.1
Location: Lat 28 to 29N, Lon 72 to 73E						**Fort Abbas (Punjab province)**							
Minimum	6.4	8.4	13.9	19.1	23.7	26.6	26.9	26.0	23.9	18.5	13.0	8.4	
Maximum	30.7	35.0	43.8	49.5	51.7	48.9	43.2	40.7	43.7	45.2	38.7	32.6	
Average	18.6	21.7	28.9	34.3	37.7	37.8	35.1	33.4	33.8	31.9	25.9	20.5	22.6
Location: Lat 29 to 30N, Lon 69 to 70E						**Part of Baluchistan and Fort Munro (Punjab province)**							
Minimum	5.0	7.0	12.1	17.4	21.9	25.4	26.2	25.1	22.4	16.7	11.5	6.9	
Maximum	27.5	32.0	40.7	47.8	52.6	52.3	46.5	42.4	46.1	43.5	36.3	29.6	
Average	16.2	19.5	26.4	32.6	37.3	38.9	36.4	33.8	34.3	30.1	23.9	18.3	23.8
Location: Lat 29 to 30N, Lon 70 to 71E						**Rajan Pur, jam Pur (Punjab province)**							
Minimum	5.1	7.3	12.6	18.3	22.9	26.5	27.2	26.0	23.2	17.1	11.6	7.0	
Maximum	28.1	32.6	41.7	49.1	53.3	52.3	46.6	42.2	44.9	43.4	36.4	30.0	
Average	16.6	19.9	27.2	33.7	38.1	39.4	36.9	34.1	34.1	30.3	24.0	18.5	24.1

(Unit: ^{O}C)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual Average
Location: Lat 29 to 30N, Lon 71 to 72E							**Uch, Bahawal Pur (Punjab province)**						
Minimum	5.0	7.2	13.0	19.0	23.7	27.3	28.0	26.7	23.8	17.3	11.5	6.8	
Maximum	28.6	33.0	42.4	50.6	53.9	52.5	46.8	42.5	44.1	43.5	36.7	30.4	
Average	16.8	20.1	27.7	34.8	38.8	39.9	37.4	34.6	34.0	30.4	24.1	18.6	24.5
Location: Lat 29 to 30N, Lon 72 to 73E							**Hasilpur (Punjab province)**						
Minimum	5.0	7.2	13.2	19.0	23.7	27.2	27.6	26.5	23.9	17.4	11.6	6.8	
Maximum	28.5	32.8	42.2	50.1	52.9	51.3	45.0	41.4	43.0	43.3	36.7	30.5	
Average	16.8	20.0	27.7	34.6	38.3	39.3	36.3	34.0	33.5	30.4	24.2	18.7	23.9
Location: Lat 30 to 31N, Lon 70 to 71E							**Taunsa (Punjab province)**						
Minimum	3.8	5.9	11.2	17.0	21.6	25.6	26.4	25.1	22.2	16.0	10.5	5.9	
Maximum	25.6	30.2	39.2	47.3	52.4	53.5	48.0	43.1	45.5	42.5	34.9	28.1	
Average	14.7	18.1	25.2	32.2	37.0	39.6	37.2	34.1	33.9	29.3	22.7	17.0	24.9
Location: Lat 30 to 31N, Lon 71to 72E							**Multan,Khenwal (Punjab province)**						
Minimum	4.2	6.5	12.2	18.6	23.4	27.4	28.2	26.8	23.6	16.7	10.8	6.1	
Maximum	26.8	31.3	40.6	50.1	54.4	55.2	49.0	43.7	44.8	42.9	35.7	29.1	
Average	15.5	18.9	26.4	34.4	38.9	41.3	38.6	35.3	34.2	29.8	23.3	17.6	25.5
Location: Lat 30 to 31N, Lon 72 to 73E							**Tobe Tekh Singh, Jhang Sadar (Punjab province)**						
Minimum	4.1	6.5	12.7	19.1	23.9	27.7	28.3	26.9	23.8	16.5	10.5	5.8	
Maximum	26.4	30.7	40.3	50.4	54.3	54.2	47.1	42.1	42.5	41.4	35.0	28.6	
Average	15.2	18.6	26.5	34.8	39.1	41.0	37.7	34.5	33.2	29.0	22.8	17.2	25.1
Location: Lat 31 to 32N, Lon 70 to 71E							**Daraban, Dera Ismail Khan (Punjab province)**						
Minimum	2.7	4.9	10.0	15.7	20.5	24.7	25.7	24.4	21.3	15.2	9.7	4.9	
Maximum	23.6	28.5	37.4	45.7	51.5	54.0	49.3	44.4	45.7	41.8	33.7	26.6	
Average	13.1	16.7	23.7	30.7	36.0	39.4	37.5	34.4	33.5	28.5	21.7	15.8	25.7
Location: Lat 31 to 32N, Lon 71 to 72E							**Gojra (Punjab province)**						
Minimum	3.8	6.1	11.5	17.6	22.7	27.0	27.8	26.4	23.1	16.3	10.5	5.7	
Maximum	25.8	30.4	39.7	49.0	54.8	56.9	50.4	44.8	45.3	42.8	35.3	28.4	
Average	14.8	18.3	25.6	33.3	38.8	42.0	39.1	35.6	34.2	29.6	22.9	17.0	26.6
Location: Lat 31 to 32N, Lon 72 to 73E							**Jaranwala (Punjab province)**						
Minimum	4.1	6.6	12.4	18.6	23.6	27.8	28.2	26.8	23.8	16.7	10.9	5.8	
Maximum	25.3	29.6	38.9	49.3	55.2	56.6	48.5	43.2	43.1	41.2	34.4	27.6	
Average	14.7	18.1	25.7	34.0	39.4	42.2	38.4	35.0	33.5	29.0	22.7	16.7	26.3
Location: Lat 31 to 32N, Lon 73 to 74E							**Faisalabad, Sheikhupura (Punjab province)**						
Minimum	4.2	6.9	12.9	19.5	24.4	28.2	28.0	26.6	23.9	17.4	11.5	6.2	
Maximum	24.4	28.5	37.3	48.0	53.6	54.7	46.5	41.8	41.6	39.8	33.5	26.9	
Average	14.3	17.7	25.1	33.8	39.0	41.5	37.3	34.2	32.8	28.6	22.5	16.5	25.2

(Unit: ^{O}C)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual Average
Location: Lat 31 to 32N, Lon 74 to 75E							**Lahore (Punjab province)**						
Minimum	3.6	6.2	11.9	18.1	22.8	26.3	26.3	25.0	22.3	15.9	10.2	5.3	
Maximum	23.3	27.1	35.7	46.8	52.3	52.4	43.0	38.7	38.6	37.2	31.9	25.8	
Average	13.4	16.6	23.8	32.5	37.6	39.4	34.7	31.9	30.5	26.6	21.1	15.5	24.4
Location: Lat 32 to 33N, Lon 71 to 72E							**Khushab, Mian Wali (Punjab province)**						
Minimum	3.6	6.0	11.0	16.9	22.0	26.3	26.8	25.4	22.2	16.0	10.3	5.5	
Maximum	23.6	27.9	36.8	46.1	52.9	56.0	49.2	44.2	44.1	41.1	33.7	26.4	
Average	13.6	16.9	23.9	31.5	37.5	41.2	38.0	34.8	33.2	28.6	22.0	16.0	26.2
Location: Lat 32 to 33N, Lon 72 to 73E							**Sahiwal, Sargodha (Punjab province)**						
Minimum	4.0	6.5	11.9	17.7	22.7	26.8	27.1	25.8	22.7	16.4	10.8	5.8	
Maximum	23.8	28.1	36.6	46.5	53.4	55.7	48.0	43.0	42.2	40.0	33.3	26.3	
Average	13.9	17.3	24.3	32.1	38.1	41.3	37.6	34.4	32.5	28.2	22.1	16.0	25.9
Location: Lat 32 to 33N, Lon 73 to 74E							**Khewra, Jhelum (Punjab province)**						
Minimum	4.2	6.6	11.9	18.1	23.1	26.6	26.2	24.9	22.3	16.7	11.4	6.3	
Maximum	22.3	26.1	34.0	44.2	50.6	52.1	44.4	40.3	39.9	37.8	31.7	25.0	
Average	13.3	16.3	23.0	31.2	36.9	39.4	35.3	32.6	31.1	27.3	21.6	15.6	24.0
Location: Lat 32 to 33N, Lon 74 to 75E							**Wazirabad, Gujranwala (Punjab province)**						
Minimum	2.6	4.7	9.5	15.3	19.8	23.0	23.1	22.0	19.1	13.5	8.8	4.5	
Maximum	19.5	22.6	30.2	40.4	46.2	46.7	38.7	35.1	35.0	33.3	28.4	22.4	
Average	11.1	13.6	19.8	27.9	33.0	34.9	30.9	28.6	27.1	23.4	18.6	13.4	22.0
Location: Lat 32 to 33N, Lon 75 to 76E							**Sialkot, Sharkargar (Punjab province)**						
Minimum	-2.2	-0.5	3.7	9.2	13.6	16.9	18.1	17.2	13.7	7.9	3.8	0.1	
Maximum	13.9	16.3	23.1	32.7	38.8	39.6	32.3	29.3	29.1	27.3	22.7	17.2	
Average	5.9	7.9	13.4	21.0	26.2	28.3	25.2	23.3	21.4	17.6	13.2	8.6	20.9
Location: Lat 33 to 34N, Lon 72 to 73E							**Chakwal, Rawalpindi (Punjab province)**						
Minimum	2.9	5.3	10.0	15.8	20.6	24.3	24.2	22.9	19.6	14.2	9.4	4.8	
Maximum	20.4	24.1	31.7	41.4	47.8	50.3	42.5	38.2	37.4	35.6	29.9	23.1	
Average	11.7	14.7	20.9	28.6	34.2	37.3	33.4	30.6	28.5	24.9	19.7	14.0	23.7
Location: Lat 33 to 34N, Lon 73 to 74E							**Islamabad Capital City (Pakistan)**						
Minimum	1.5	3.4	7.6	13.1	17.7	21.1	21.4	20.4	17.1	11.9	7.5	3.4	
Maximum	17.1	20.1	27.2	36.6	42.5	44.4	37.5	34.4	34.1	32.0	26.7	20.2	
Average	9.3	11.7	17.4	24.9	30.1	32.8	29.5	27.4	25.6	22.0	17.1	11.8	21.4

Source: NASA website

Note: (1) The data is over 22-years period (Jan 1983 - Dec 2004)

(2) The data is minimum and maximum of the daily earth's surface temperature for given month.

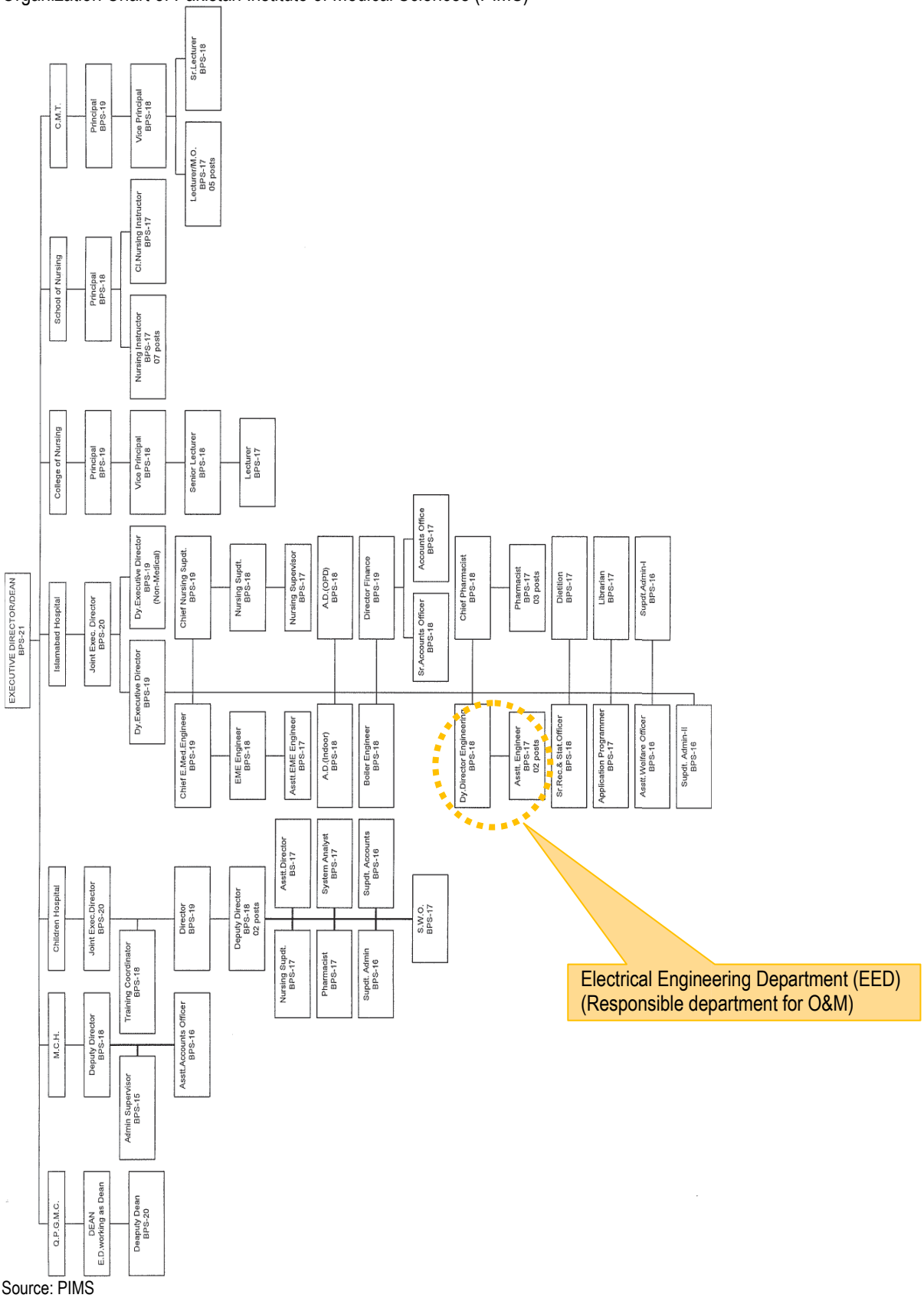
(3) The average data is derived from Amplitude that is; one half of the difference between the minimum and maximum of 22 years average.

Appendix B-3

Information of PIMS

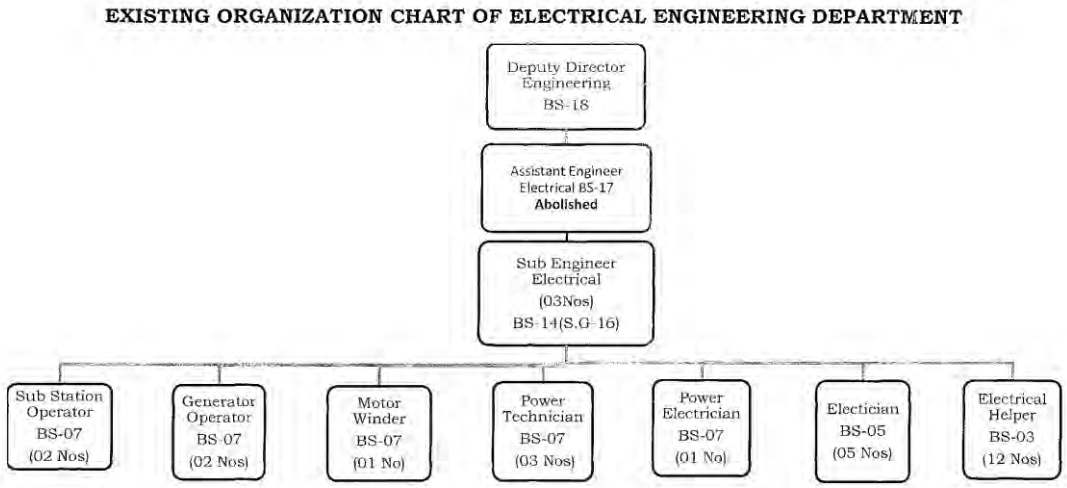
Appendix B-3-1: Organization Chart of PIMS and EED

Organization Chart of Pakistan Institute of Medical Sciences (PIMS)



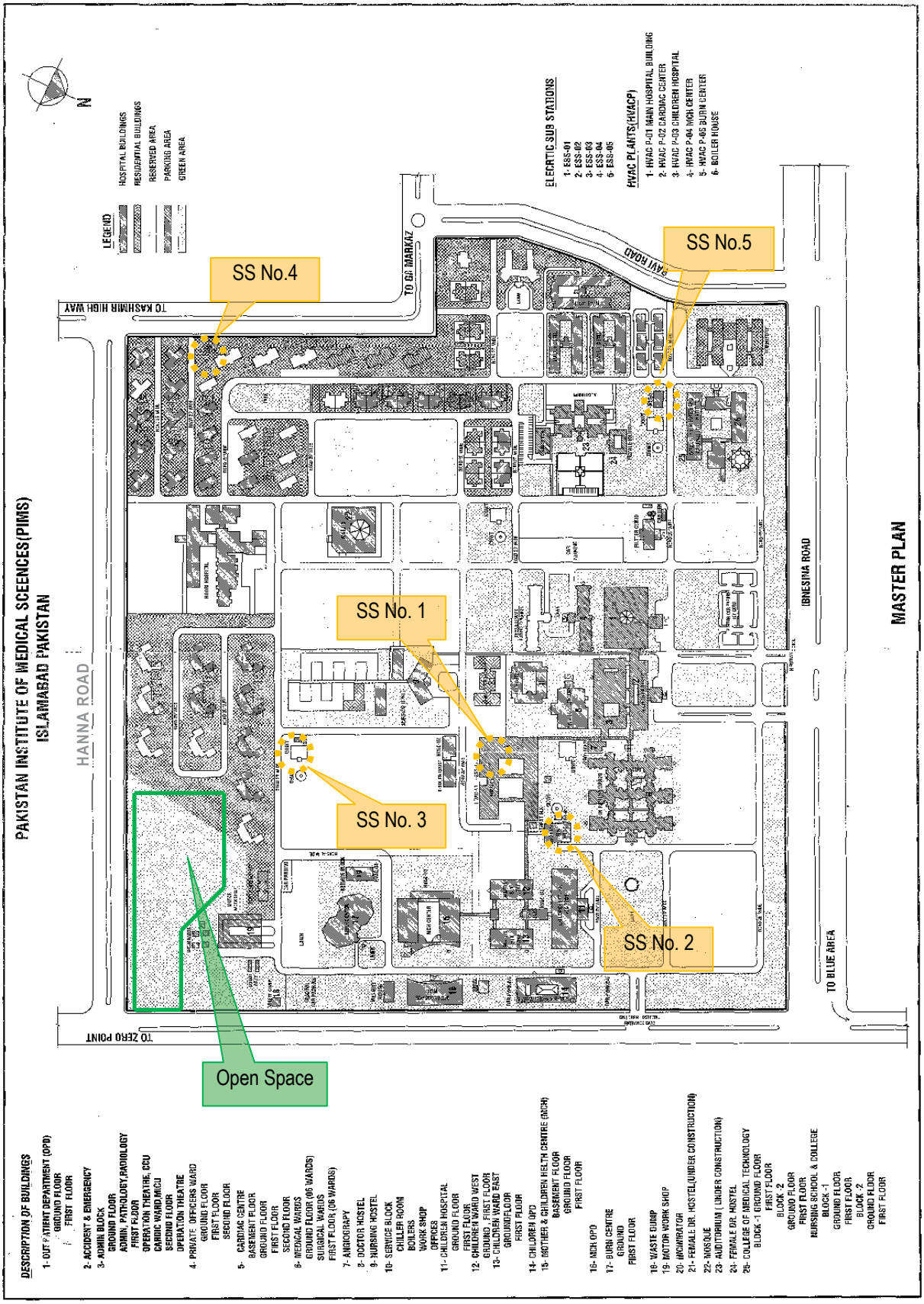
Source: PIMS

Organization Chart of Electrical Engineering Department (EED) of PIMS



Source: PIMS

Appendix B-3-2: Layout of PIMS



Source: PIMS

Appendix B-3-3: Power Consumption Record of PIMS

Substation No.1

Summery of Electricity Consumption (Sub-station No. 1)			
Serial No.	**Month**	**Total Unit Consumed (kWh)**	**Total paid amount (Rs.)**
Year	**2011**		
1	January	430,770	7,509,712
2	February	435,850	4,832,337
3	March	327,350	0
4	April	262,490	3,545,750
5	May	362,250	4,025,609
6	June	577,380	9,827,194
7	July	656,490	0
8	August	573,240	7,766,804
9	September	725,200	6,617,434
10	October	634,910	8,560,216
11	November	275,240	7,308,445
12	December	276,870	3,971,270
	Average	**461,503**	**5,330,398**
	Total	**5,538,040**	**63,964,771**
Year	**2012**		
1	January	378,090	4,354,979
2	February	396,660	0
3	March	352,350	4,468,028
4	April	247,280	6,057,326
5	May	303,110	7,781,558
6	June	409,900	0
7	July	709,670	0
8	August	726,010	0
9	September	668,670	16,733,344
10	October	432,110	34,640,968
11	November	323,290	10,160,638
	Average	**449,740**	**7,654,258**
	Total	**4,947,140**	**84,196,841**

Source: Prepared by JICA Study Team based on Monthly Electricity Bill of PIMS

Note: (1) In total paid amount (i) N.J. Surcharge (ii) GST and (iii) Fuel Price Adjustment (FPA) is included

(2) If amount paid is "0" then it is adjusted to other months.

(3) In total amount, depending on months includes penalty of due date payment too.

(4) The unit consumed at above table is of previous month, billed and paid on given months.

Electricity supply area from this substation:

Children Hospital, Burn Care Centre,
Mother and Child Health Centre including OPD,
Heating Ventilator Air Conditioner (HAVC) Plant
Nursing Hostel, Services Block including Laundry, Kitchen, etc.

Substation No.2

Summery of Electricity Consumption (Sub-station No. 2)			
Serial No.	**Month**	**Total Unit Consumed (kWh)**	**Total paid amount (Rs.)**
Year	**2011**		
1	January	293,660	3,171,011
2	February	296,080	3,401,417
3	March	262,480	0
4	April	299,320	2,969,168
5	May	352,760	7,205,884
6	June	454,140	5,714,977
7	July	461,280	0
8	August	486,060	5,423,730
9	September	440,860	5,657,335
10	October	364,340	5,771,801
11	November	350,920	4,439,723
12	December	258,420	8,897,896
	Average	**360,027**	**4,387,745**
	Total	**4,320,320**	**52,652,942**
Year	**2012**		
1	January	278,100	3,361,510
2	February	319,780	0
3	March	230,520	3,701,513
4	April	276,280	4,513,635
5	May	315,920	7,954,510
6	June	326,240	5,405,000
7	July	561,900	0
8	August	533,080	0
9	September	487,460	15,746,947
10	October	333,880	14,501,699
11	November	316,800	11,566,206
	Average	**361,815**	**6,068,275**
	Total	**3,979,960**	**66,751,020**

Source: Prepared by JICA Study Team based on Monthly Electricity Bill of PIMS

Note: (1) In total paid amount (i) N.J. Surcharge (ii) GST and (iii) Fuel Price Adjustment (FPA) is included

(2) If amount paid is "0" then it is adjusted to other months.

(3) In total amount, depending on months includes penalty of due date payment too.

(4) The unit consumed at above table is of previous month, billed and paid on given months.

Electricity supply area from this substation:

Inpatient wards building (Medical ward & Surgical ward)
CT Angio, MRI, Radiology, Pathology, Blood bank, OPD, Private ward,
CCU, SICU, MICU, Cardiology ward, Operation Theaters,
Cardiac Surgery, ICU, Lithotripsy, Water supply pumps and tube well,
Administration and Account branch

Substation No.3

Summery of Electricity Consumption (Sub-station No. 3)			
Serial No.	**Month**	**Total Unit Consumed (kWh)**	**Total paid amount (Rs.)**
Year	**2011**		
1	January	147,000	1,679,179
2	February	114,000	1,034,969
3	March	130,000	0
4	April	125,000	1,141,442
5	May	123,000	650,000
6	June	135,000	1,622,790
7	July	154,000	450,000
8	August	179,000	2,105,216
9	September	140,000	2,512,051
10	October	139,000	867,220
11	November	163,000	1,256,295
12	December	160,000	3,658,056
	Average	**142,417**	**1,414,768**
	Total	**1,709,000**	**16,977,218**
Year	**2012**		
1	January	173,000	1,720,505
2	February	219,000	0
3	March	228,000	2,104,184
4	April	236,000	2,855,007
5	May	262,000	3,439,089
6	June	266,000	3,168,666
7	July	275,000	524,188
8	August	285,000	614,476
9	September	287,000	3,376,002
10	October	210,000	8,334,971
11	November	210,000	2,456,107
	Average	**241,000**	**2,599,381**
	Total	**2,651,000**	**28,593,195**

Source: Prepared by JICA Study Team based on Monthly Electricity Bill of PIMS

Note: (1) In total paid amount (i) N.J. Surcharge (ii) GST and (iii) Fuel Price Adjustment (FPA) is included

(2) If amount paid is "0" then it is adjusted to other months.

(3) In total amount, depending on months includes penalty of due date payment too.

(4) The unit consumed at above table is of previous month, billed and paid on given months.

Electricity supply area from this substation:

Cardiac Surgery facility including HVAC plant, Burn Care Centre,
Federal Government Model School PIMS, Dhobi Ghat,
Laundry and Services building, Transport,
B type flats water supply pumps and Tube well etc.

Substation No.4

Summery of Electricity Consumption (Sub-station No. 4)			
Serial No.	**Month**	**Total Unit Consumed (kWh)**	**Total paid amount (Rs.)**
Year	**2011**		
1	January	45,860	767,192
2	February	43,140	820,405
3	March	39,900	819,238
4	April	45,400	1,114,026
5	May	58,020	1,351,254
6	June	102,000	1,677,971
7	July	118,900	0
8	August	119,500	1,562,834
9	September	110,940	1,320,920
10	October	74,720	1,978,530
11	November	52,440	943,194
12	December	44,860	600,000
	Average	**71,307**	**1,079,630**
	Total	**855,680**	**12,955,564**
Year	**2012**		
1	January	45,150	797,147
2	February	45,820	0
3	March	44,660	0
4	April	44,780	925,501
5	May	55,280	2,846,327
6	June	387,500	0
7	July	119,000	0
8	August	145,700	0
9	September	115,760	2,396,421
10	October	58,800	3,479,287
11	November	52,800	644,343
	Average	**101,386**	**1,008,093**
	Total	**1,115,250**	**11,089,026**

Source: Prepared by JICA Study Team based on Monthly Electricity Bill of PIMS

Note: (1) In total paid amount (i) N.J. Surcharge (ii) GST and (iii) Fuel Price Adjustment (FPA) is included

(2) If amount paid is "0" then it is adjusted to other months.

(3) In total amount, depending on months includes penalty of due date payment too.

(4) The unit consumed at above table is of previous month, billed and paid on given months.

Electricity supply area from this substation:

Residential area block-C, D, E & type Bungalows and Mosque

Substation No.5

Summery of Electricity Consumption (Sub-station No. 5)			
Serial No.	**Month**	**Total Unit Consumed (kWh)**	**Total paid amount (Rs.)**
Year	**2011**		
1	January	286,500	4,240,770
2	February	240,000	2,492,934
3	March	120,900	0
4	April	124,200	1,315,686
5	May	148,200	1,446,566
6	June	251,100	1,323,635
7	July	265,500	0
8	August	250,200	5,806,464
9	September	217,800	2,759,835
10	October	220,800	2,680,793
11	November	132,600	0
12	December	133,200	4,275,336
	Average	**199,250**	**2,195,168**
	Total	**2,391,000**	**26,342,019**
Year	**2012**		
1	January	133,500	8,343,400
2	February	339,600	0
3	March	195,900	0
4	April	196,500	2,776,688
5	May	221,400	5,072,424
6	June	224,700	2,570,172
7	July	230,100	0
8	August	171,300	442,076
9	September	177,300	2,475,947
10	October	249,900	6,691,914
11	November	206,673	3,488,646
	Average	**213,352**	**2,896,479**
	Total	**2,346,873**	**31,861,267**

Source: Prepared by JICA Study Team based on Monthly Electricity Bill of PIMS

Note: (1) In total paid amount (i) N.J. Surcharge (ii) GST and (iii) Fuel Price Adjustment (FPA) is included

(2) If amount paid is "0" then it is adjusted to other months.

(3) In total amount, depending on months includes penalty of due date payment too.

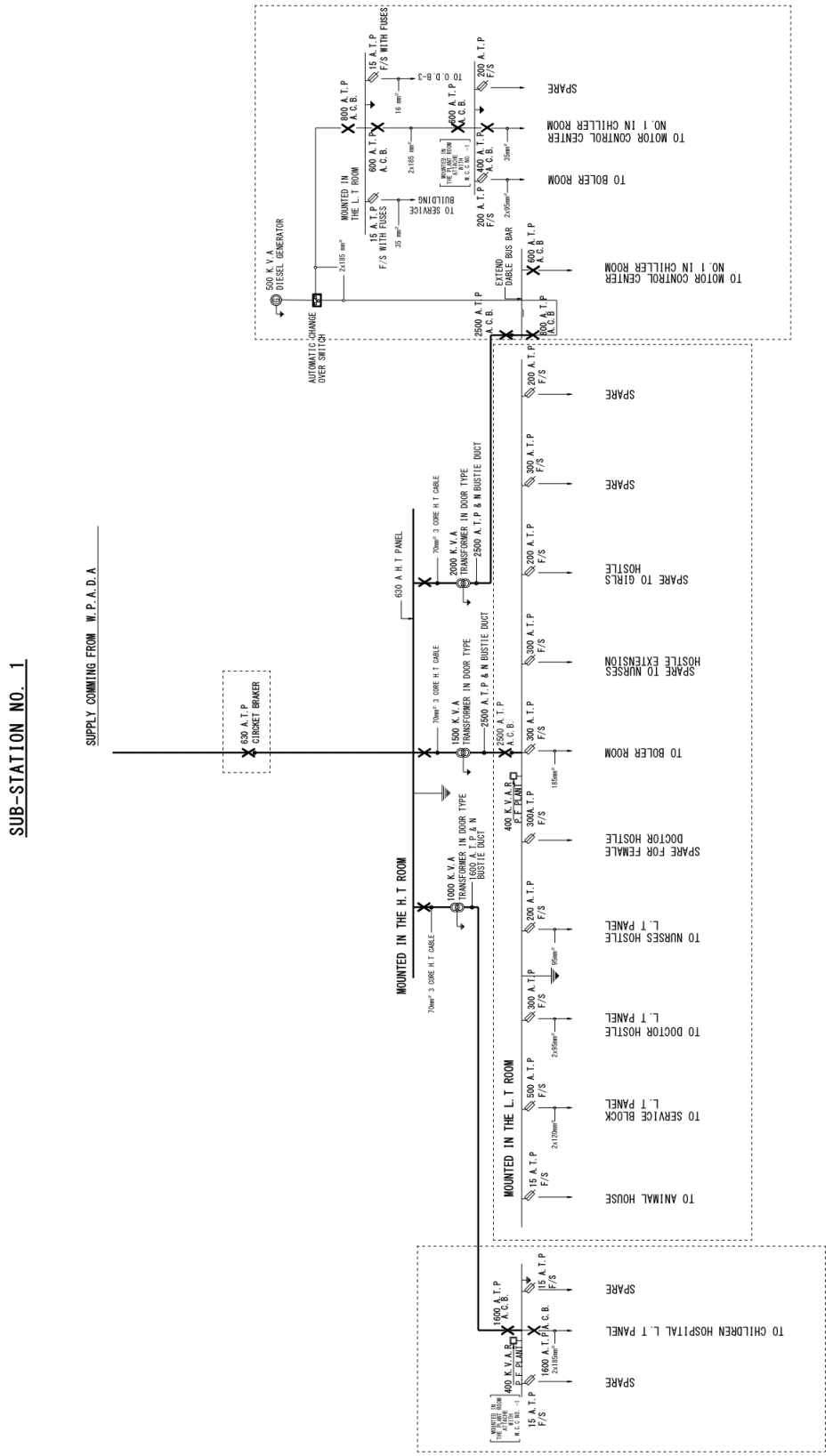
(4) The unit consumed at above table is of previous month, billed and paid on given months.

Electricity supply area from this substation:

Collage of medical Technology, Collage of Nursing,
Schools of Nursing including both male and female hostels,
QPGMC (Administration Block), PG female hostel

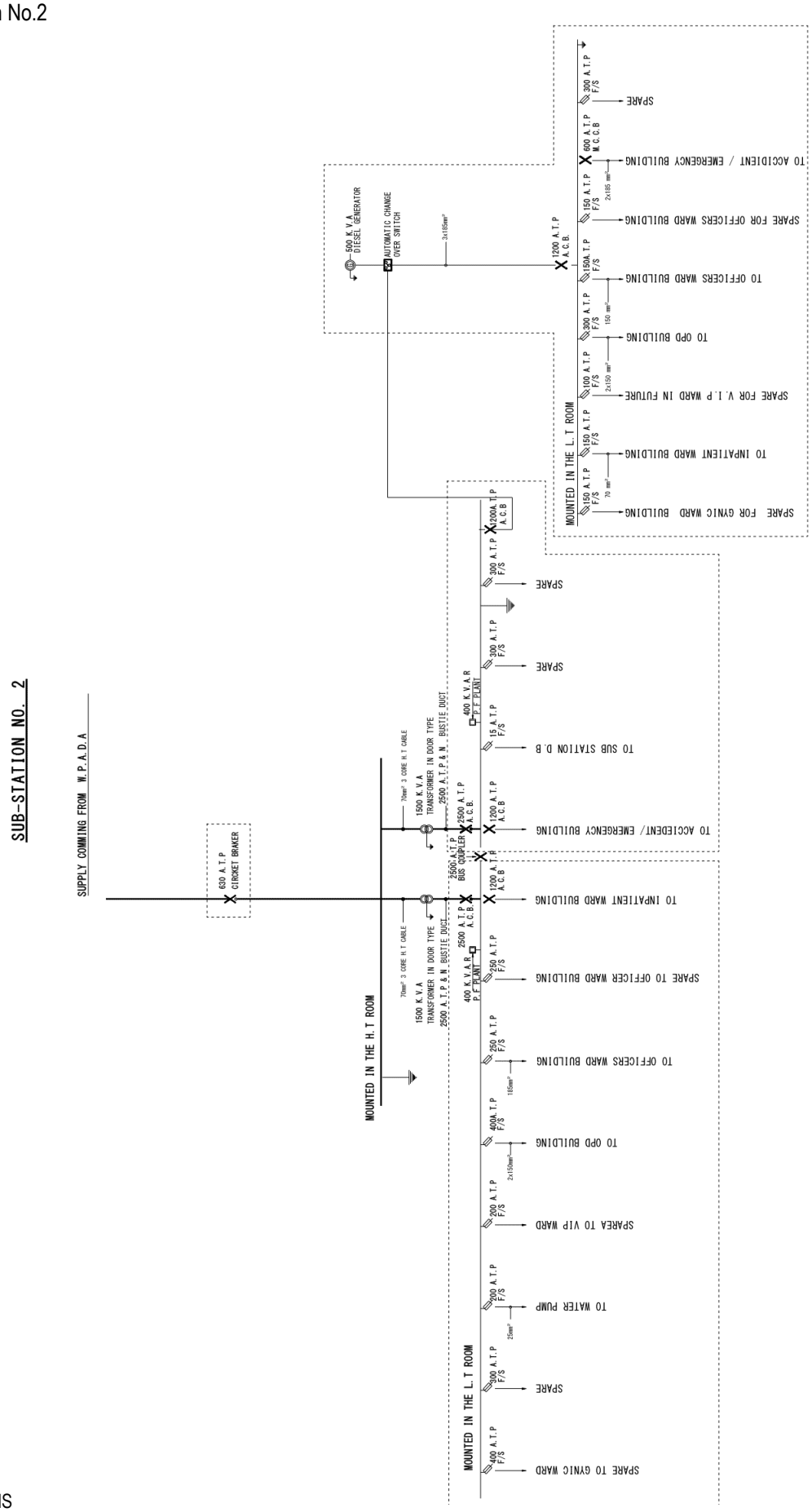
Appendix B-3-4: Skeleton Diagram of PIMS

Substation No.1



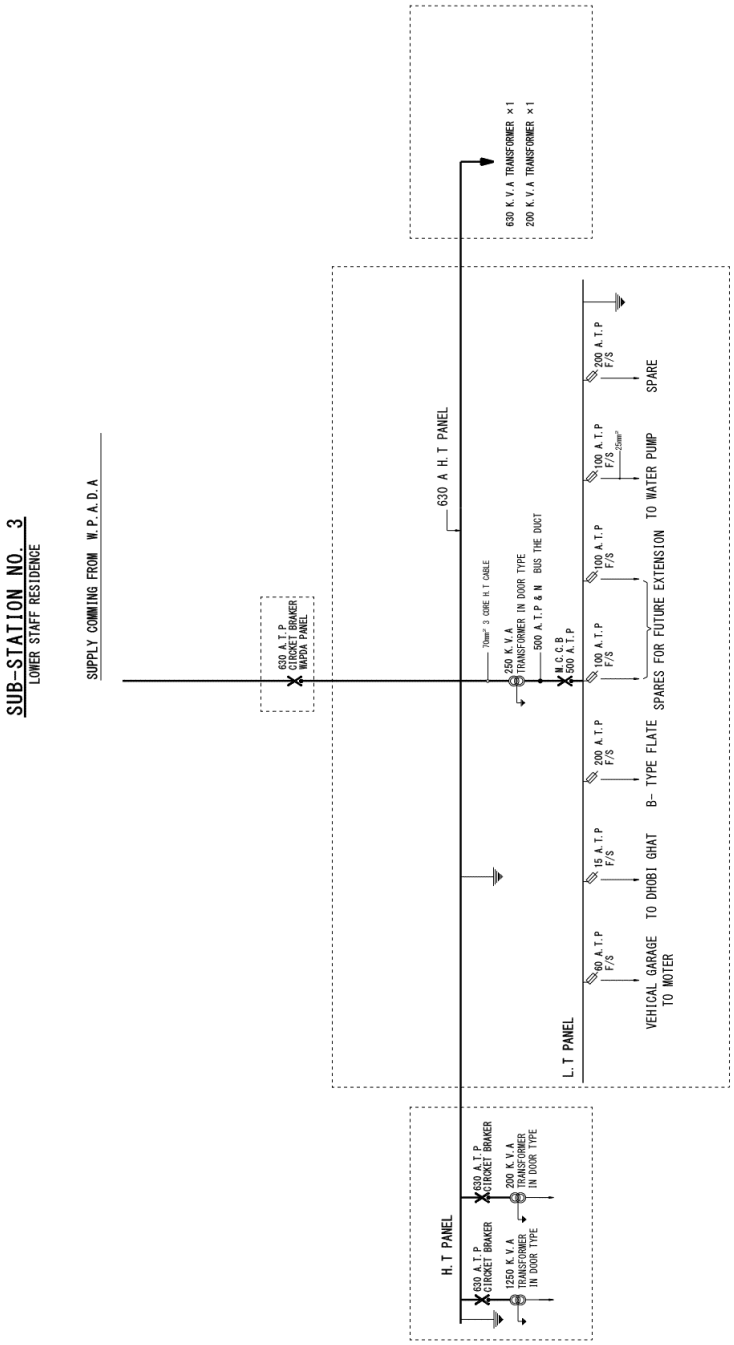
Source: PIMS

Substation No.2



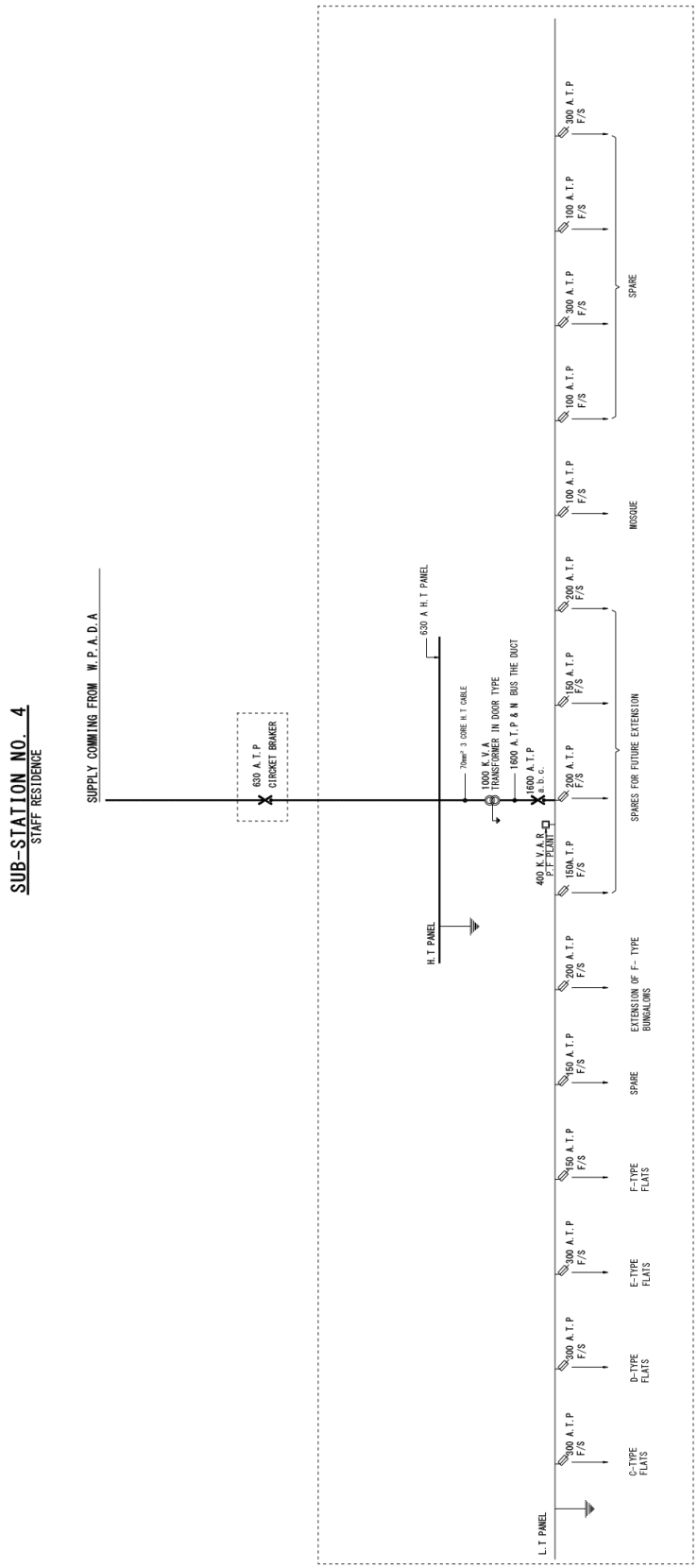
Source: PIMS

Substation No.3



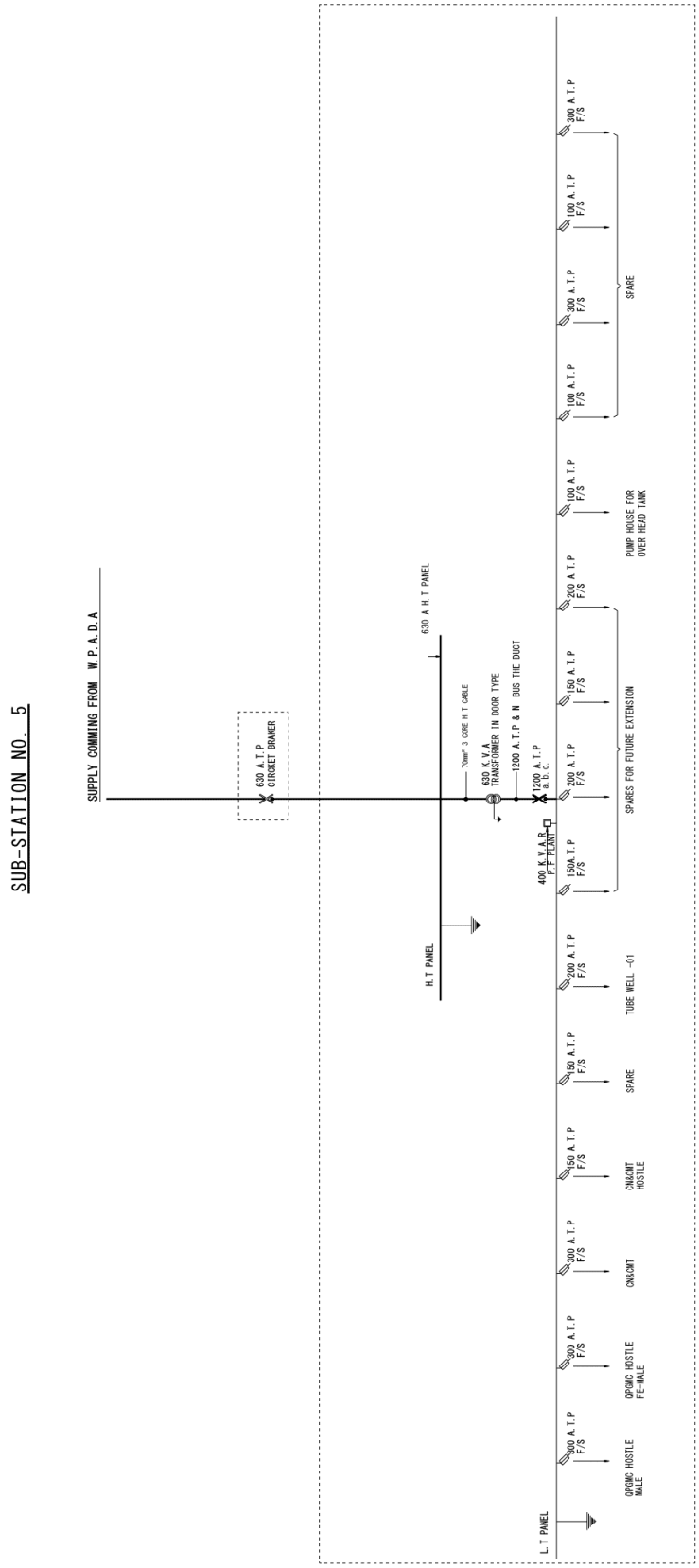
Source: PIMS

Substation No.4



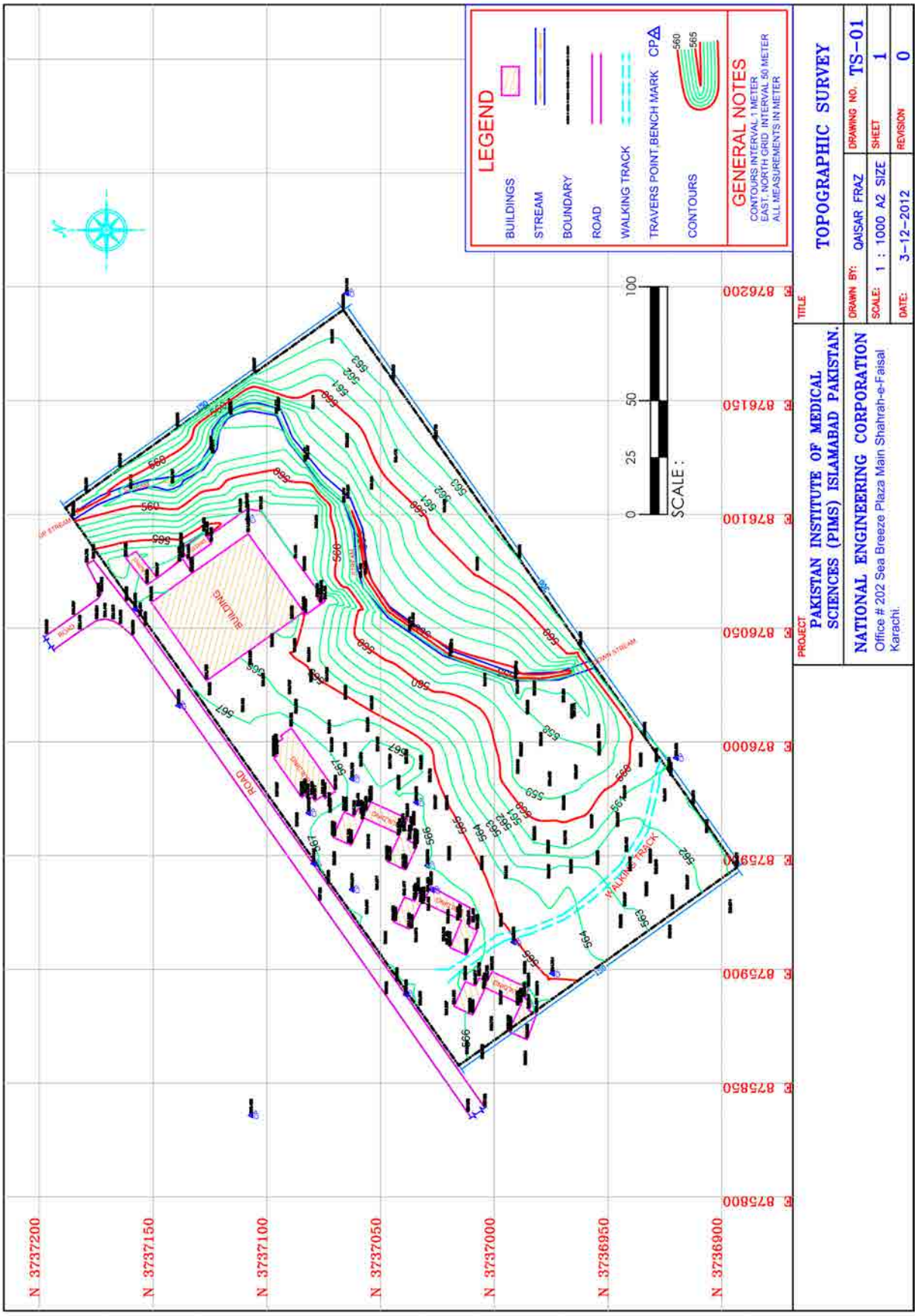
Source: PIMS

Substation No.5



Source: PIMS

Appendix B-3-5: Topographic Map of PIMS Site



Source: Topographic Survey implemented by JICA Study Team