Enertech Bostan Solar (Pvt.) Ltd

Wholly owned Subsidiary of

Enertech Holding Company, Kuwait

May 21, 2018

The Registrar
National Electric Power Regulatory Authority

Subject: Application for Generation License for 50MW EnerTech Bostan Solar (Pvt.) Limited

I, Yasser Malik, CEO of EnerTech Bostan Solar (Pvt.) Limited, being the duly authorized representative of EnerTech Bostan Solar (Pvt.) Limited by virtue of [BOARD RESOLUTION] dated 8-12-2017, hereby apply to the National Electric Power Regulatory Authority for the grant of a Generation License to the EnerTech Bostan Solar (Pvt.) Limited pursuant to section 15 of the Regulation of Generation, Transmission and Distribution of Electric Power Act, 1997.

I certify that the documents-in-support attached with this application are prepared and submitted in conformity with the provisions of the National Electric Power Regulatory Authority Licensing (Application and Modification Procedure) Regulations, 1999, and undertake to abide by the terms and provisions of the above-said regulations. I further undertake and confirm that the information provided in the attached documents-in-support is true and correct to the best of my knowledge and belief.

A [BANK DRAFT/ PAY ORDER] In the sum of Rupees 311,376 /-, being the nonrefundable licence application fee calculated in accordance with Schedule II to the National Electric Power Regulatory Authority Licensing (Application and Modification Procedure) Regulations, 1999, is also attached herewith.

The application is filed in triplicate with all the annexures appended with each set of the application.

ENERTECH BOSTAN SOLAR (PVT.) LIMITED

Yasser Malik
CEO
EnerTech Bostan Solar (Pvt.) Limited

BOARD RESOLUTION

The following resolutions were discussed in detail by the Board and approved unanimously on 08th December, 2017.

"RESOLVED THAT **EnerTech Bostan Solar (Pvt.) Limited**, a company incorporated under the laws of Pakistan with its registered office located at Office 712, Al Hafeez Business Centre, 89-B/III, Gulberg III, Lahore, Pakistan, (the **"Company")** be and is hereby authorized to submit an application for the grant of a Generation license (including any modifications thereto) to the National Electric Power Regulatory Authority **("NEPRA")** for determination of the reference generation tariff in respect of its 50 MWp Solar Power Project to be located at Kuchlak-Zhob Highway, Bostan Regions, District Pishin, Balochistan, Pakistan (the **"Project")** and in relation thereto, enter into and execute all required documents, make all filings and pay all applicable fees, in each case, of any nature whatsoever, as required."

"FURTHER RESOLVED THAT in respect of submitting an application for the Generation License (including any modifications thereto) to NEPRA, Yasser Malik, CEO & Director be empowered and authorized for and on behalf of the Company to:

i. review, execute, submit, and deliver the Generation License application (including any modifications thereto) and any related documentation required by NEPRA for the grant of Generation License, including any contacts, documents, powers of attorney, affidavits, statements, letters, forms, applications, deeds, guarantees, undertakings, approvals, memoranda, amendments, letters, communications, notices, certificates, requests, statements and any other instruments of any nature whatsoever;

ii. represent the Company in all negotiations, representations, presentations, hearings, conferences and /or meetings of any nature whatsoever with any entity (including, but in no manner limited to NEPRA, any private parries, companies, partnerships, individuals, governmental and /or semi-governmental authorities and agencies, ministries, boards, departments, regulator)' authorities and /or any other entity of any nature whatsoever);

iii. sign and execute the necessary documentation, pay the necessary fees, appear before NEPRA as needed, and do all acts necessary for the completion and processing of the generation license application (including any modifications thereto) and procuring the Generation License;

iv. appoint or nominate any one or more officers of the Company or any other person or persons, singly or jointly, in its discretion to communicate with, make presentations to and attend NEPRA hearings;

v. do all such acts, matters and things as may be necessary for carrying out the purposes aforesaid and giving full effect to the above resolutions / resolution."

"AND FURTHER RESOLVED THAT Yasser Malik, CEO & Director, be and is hereby authorized to delegate all or any of the above powers in respect of the forgoing to any other officials of the Company as deemed appropriate.

Yasser Malik	**Asad Khan**
Chief Executive Officer	**Director**

IN WITNESS THEREOF, I hereunder set my hands as such Chief Executive Officer and affixed the corporate seal of said company.

BOSTAN SOLAR (PVT.) LIMITED ENERTECH

Yasser Malik
Chief Executive Officer

(i).	Total	50 MWp	
(d).	**Inverters**		
(i).	Capacity of each unit	90 KW	
(ii).	Inverter Model	Sun2000 90KTL	
(iii).	Manufacturer	Huawei	
(iv).	Rated Input Voltage	1080V	
(v).	Input Operating Voltage Range	600-1450 V	
(vi).	Number of Inverters	464 units	
(vii).	Total Power	39.44 MW AC	
(viii).	Efficiency	99% (Euro: 98.4%; CEC:98.5%)	
(ix).	Max. Allowable Input voltage	1000V	
(x).	Max. Current	3104A	
(xi).	Max. Power Point Tracking Range	0~1422 KW	
(xii).	Output electrical system	AC	
(xiii).	Rated Output Voltage	85V	
(xiv).	Rated Frequency	50 Hz	
(xv).	Power Factor	Adjustable 0.9 Induction to 0.9 Capacitance	
(xvi).	Power Control	MPP Tracker	
(xvii).	Environmental Enclosures	Operating Temperature Range	-25° C to 62° C
		Relative Humidity	15% - 95% non-condensing

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SCHEDULE-I

The Location, Size, Type of Technology, Interconnection Arrangements, Technical Limits, Technical/Functional Specifications and other details specific to the Generation Facility/Solar Farm of the Licensee are described in this Schedule

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Location of the Generation Facility/Solar Power Plant/Solar Farm

The Project Site is acquired in the Bostan region of Kuchlak Zhob highway (N50) in District Pishin, Balochistan. The project site is located around 35 kilometers away from Quetta City. The land area of the project site is 250 Acres whereas about 500 Acres has been leased for the other Solar PV project of 50 MW capacity. The proposed site located at latitude of 30.452256N and longitude of 67.100602E.

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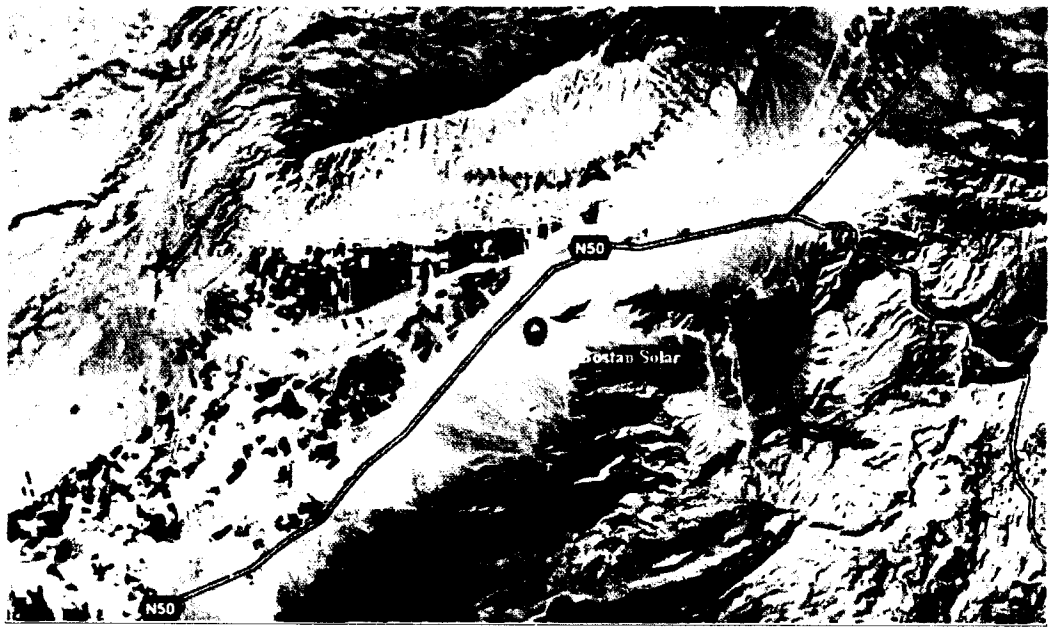

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Location of the Generation Facility/Solar Power Plant/Solar Farm (Coordinates)

Sr No.	Latitude	Longitude
1	30.468553	67.118524
2	30.460173	67.110318
3	30.454661	67.116144
4	30.461910	67.124735

Bostan and its surrounding areas are mountainous. There are also small rock and gravel formations resembling hills along the boundary of the Suleiman Mountains. The site is bounded by Qila Abdullah to the north, Qila Saifullah to the east, Quetta and Ziarat to the south and Afghanistan to the west. The general character of the district is mountainous. The mountains are uniform, with long central ridges from which frequent spurs descend.

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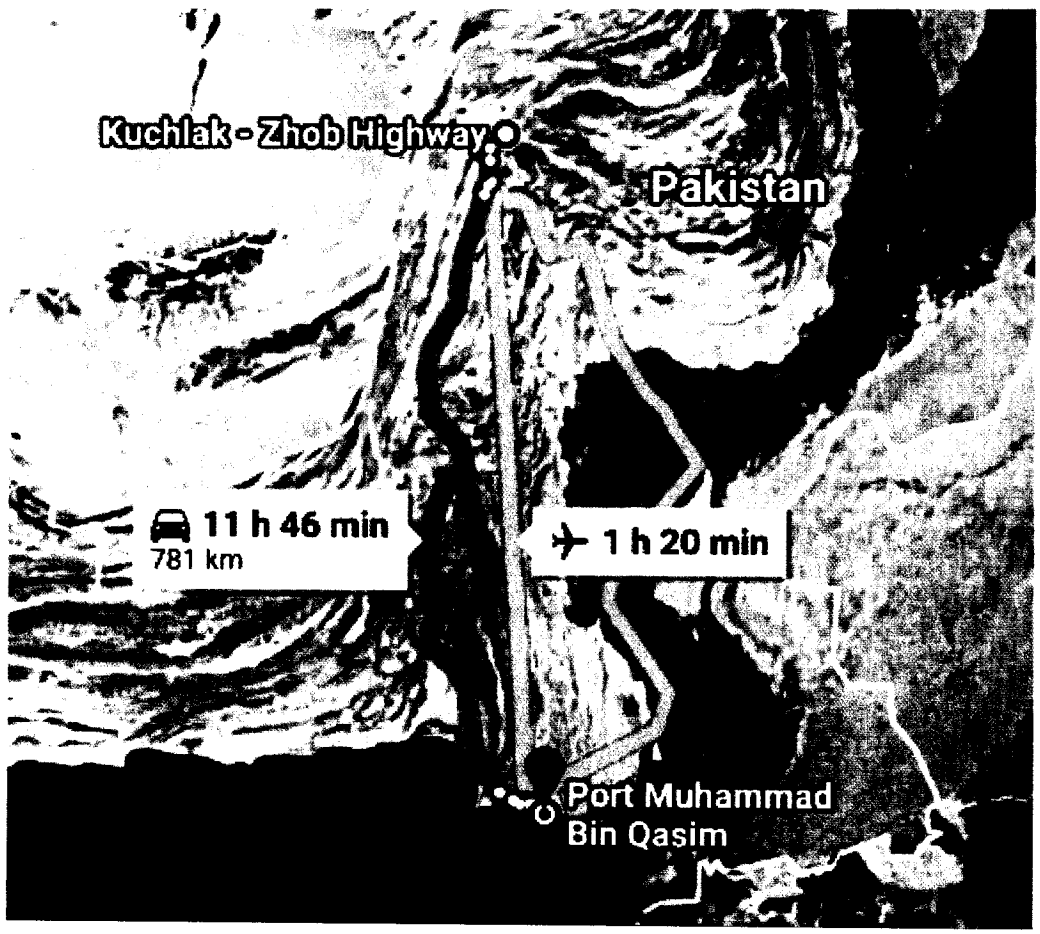
Site Accessibility of the Generation Facility/Solar Power Plant/Solar Farm

The Project is located on Zhob-Kuchluck Highway in Bostan region near Umarabad town, District Pishin, Balochistan. The machinery for the Project will be routed from Port Qasim Karachi, as that is closest to the Project site. The distance of Project site from Port Qasim is 781 km. The proposed route to the Project site is given below.



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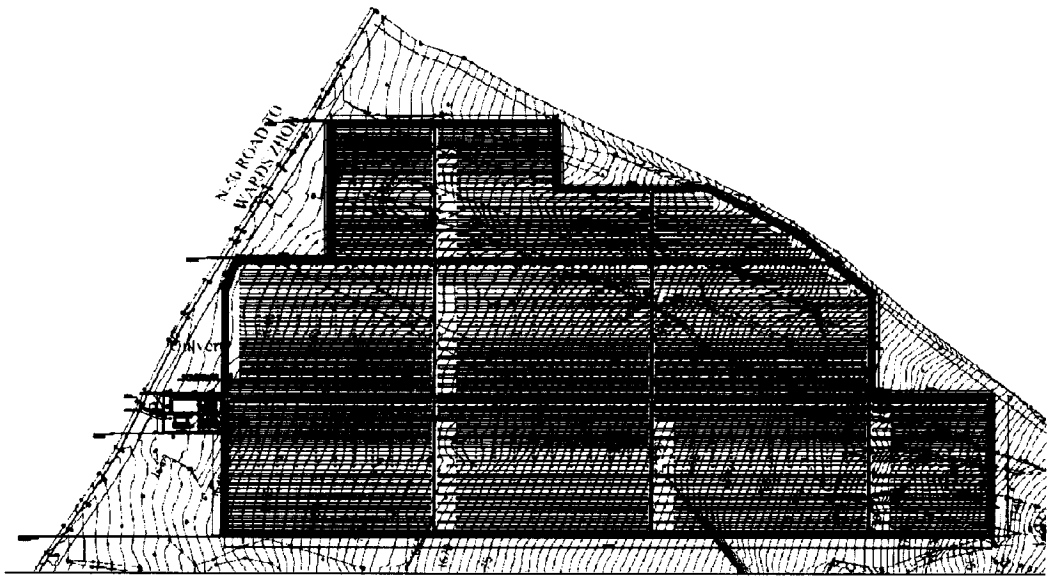
Layout of the Generation Facility/Solar Power Plant/Solar Farm



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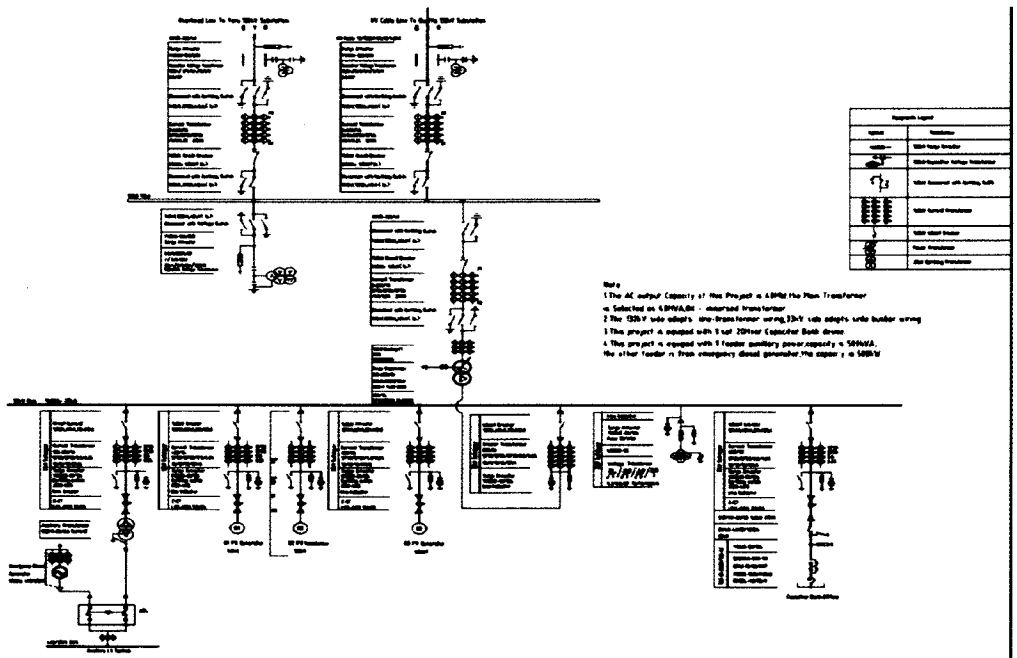
Single Line Diagram of Electrical Layout of the Generation Facility/Solar Power Plant/Solar Farm



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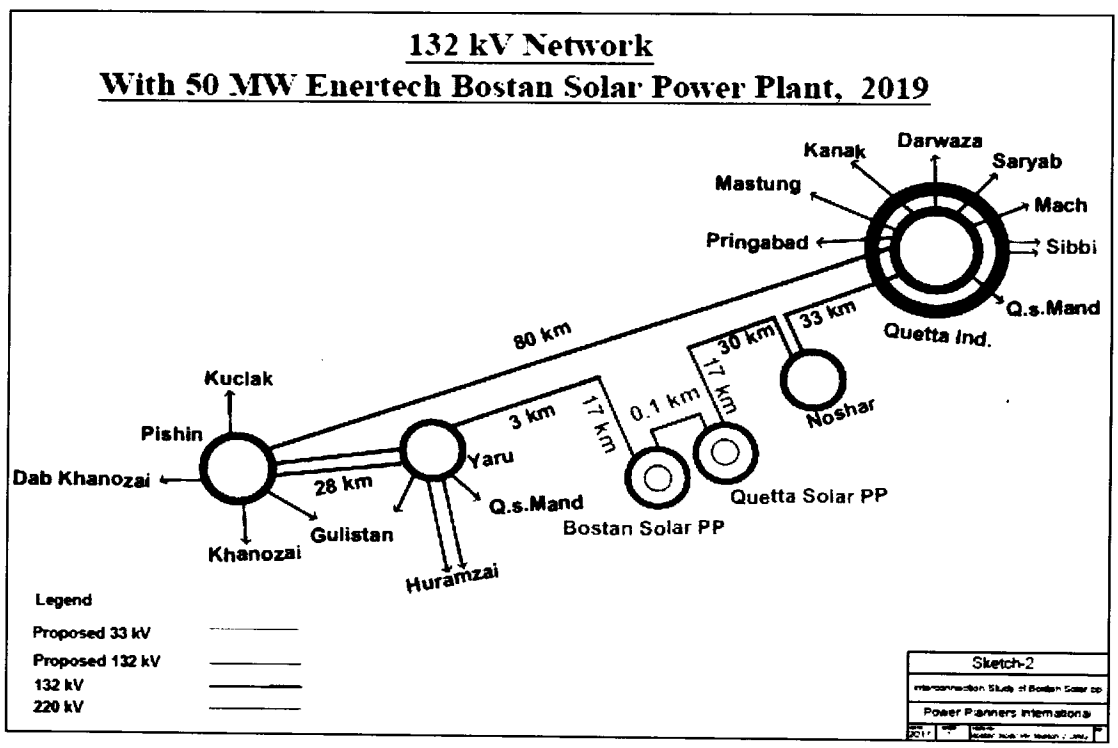
Interconnection Arrangement / Transmission Facilities for Dispersal of Power from the Generation Facility Solar Power Plant / Solar Farm

The electric power generated from the Generation Facility/Solar Farm/Solar Power Plant of EnerTech Bostan Solar (Private) Limited (EBSPL) shall be dispersed to the load center of QESCO.

The proposed Interconnection/dispersal arrangement for the project will be consisting of two (02) Feeders of 132 KV voltage, using ACSR OSPREY Conductor connecting the Generation Facility/Solar Farm/Solar Power Plant with 132 KV Yaru and Nohsar Grid Stations located in the service area of QESCO.

Any change in the above Interconnection Arrangement/Transmission Facilities duly agreed by EQSPL, CPPA-G, NTDC and QESCO, shall be communicated to the Authority in due course of time.



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Details of
Generation Facility/Solar Power Plant/Solar Farm

(A). General Information

(i).	Name of the Company/Licensee	EnerTech Bostan Solar (Pvt.) Limited
(ii).	Registered/Business Office of the Company	712, Al Hafeez Business Centre, 89 B/3, Gulberg 3, Lahore.
(iii).	Location of the Generation Facility	Bostan, District Pishin, Balochistan
(iv).	Type of Generation Facility	Solar Photovoltaic (PV).

(B). Solar Power Generation Technology & Capacity

(i).	Type of Technology	Poly Crystalline Photovoltaic (PV) Cell
(ii).	System Type	Grid Connected
(iii).	Installed Capacity of Solar (MW)	50 MW_p

(C). Technical Details of Equipment

(a).	**Solar Panels – PV Modules**	
(i).	Type of Module	Poly Crystalline PV modules Canadian Solar CS3U-340P
(ii).	Type of Cell	Poly Crystalline
(iii).	Dimension of each Module	2000mm x 992mm x 40mm
(iv).	No. of Panel/ Modules	147,060

(v).	Total Module Area	291,743m^2
(vi).	Total Land Area Used	250 Acres
(vii).	Frame of Panel	Hot Dip Galvanized Steel
(viii).	Weight of one Module	–22.6 Kg
(ix).	Module Output Warranty	25 years Warranty for depreciation not more than 0.5 %
(x).	Number of Solar Cells in each module	144 Half Cells
(xi).	Efficiency of module	17.14%
(xii).	Environment Protection System	Encapsulation and sealing arrangements for protection from environment.
(xiii).	Maximum Power (P_{max})	340W_P
(xiv).	Voltage @ (P_{max})	38.4V
(xv).	Current @ P_{max}	8.86A
(xvi).	Open circuit voltage (V_{oc})	45.9V
(xvii).	Short circuit current (I_{sc})	9.36 A
(xviii).	Maximum system open Circuit Voltage	1500V
(b).	**PV Array**	
(i).	No. of Sub-arrays	2
(ii).	Modules in a string	30
(iii).	Total No. of Strings	4902 (30X2)
(iv).	Total Modules	147,060
(c).	**PV Capacity**	

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		Audible Noise	<61 dB(A)
		Operating Elevation	<2000 m
		Warranty Period	10 Years
(xviii).	Grid Operation Protection	(a).	DC circuit breaker
		(b).	AC circuit breaker
		(c).	DC overvoltage protection
		(d).	Lightning protection level III
		(e).	Grid monitoring
		(f).	Insulation monitoring
		(g).	Anti-Islanding
(e).	**<u>Junction Boxes Installed and fixed on main steel structure in Array Yard.</u>**		
(i).	Number of Junction Box units	232	
(ii).	Input circuits in each box	16	
(iii).	Max. Input current for each circuit	10 A	
(iv).	Max. Input voltage	1000 V	
(v).	Power at each box	99.2 KW	
(vi).	Protection Level	IP 65	
(vii).	Over-Current protection	Fuse	
(viii).	Output switch	125A, 1000V disconnector	
(ix).	Surge protection	1500V, Type II	
(x).	Purpose of Junction Box	(a).	To provide Isolation of Sub Arrays

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		(b).	In case of fault provide arrangement for disconnection of each of the Sub-Arrays or Strings.
		(c).	To ensure safety of the electric works in the Solar Module Arrays
		(d)	Protection from back flow of short circuit current through use of semi-diodes.
		(e)	To combine groups of strings into Sub-Arrays that will be wired into the Inverter
(f).	**<u>Data Collecting System</u>**		
(i).	Weather Data	(a).	data collected for Direct Solar Radiation (W/m^2) using two Li-COR Pyranometer installed with the NRG Symphonies Plu3 Data Logger at the site
		(b).	data collected for Temperature (0°C) using NRG 110s Sensor attached to the Solar Resource Assessment Equipment
		(c).	data collected for Rain in mm/m^2 using Rain Sensor attached to the Solar Resource Assessment Equipment
		(d).	data collected for Wind Speed (ms-1) using Wind Speed Sensor attached to the Solar Resource Assessment Equipment

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		(e).	data collected for Wind Direction (deg) using Wind Vane Sensor attached to the Solar Resource Assessment Equipment
(ii).	System Data	(a).	DC input voltage (V), Current (A) of each module, string, sub array & Inverter
		(b).	Total Sub Array Power Generated and Inverter Power
		(c).	AC output voltage (V) and current (A) of each inverter (Phase, total)
		(d).	AC Output power (kW) and Energy (kwh) of each inverter
		(e).	Frequency (Hz)
		(f).	Power Factor (PF)
		(g).	Temperature inside inverter station
(g).	**<u>Isolating Transformer</u>**		
(i).	Rating	132KV/33KV 1260/630-630KVA	
(ii).	Type of Transformer	Box Type Oil Immersed	
(iii).	Input voltage	3150V	
(iv).	Output Voltage	132kV	
(v).	Purpose of Transformer	Step Up Voltage, Galvanic Isolation and Eliminate DC Current Injection	
(vi).	Efficiency	98.89%	

(h).	**Outdoor Cubicle Control Room**	
(i).	Data record	Data Logging using software and hardware provided by Huawei
(ii).	Control Room System	Computerized Data Monitoring and communication systems using latest Satellite Technology
(iii).	Control room System Detail	Interfacing, Hardware and Software, suitable for such Multi-MW systems
(i).	**Mounting Structure**	
(i).	Structure	HDG Steel
(ii).	Tilt of Array Frame	27 Degrees
(iii).	Array Specification	Designed and Certified for Wind Speed and Seismic Requirements.
(j).	**Foundation Pillars**	
(i).	No. of Foundations	31,863
(ii).	Foundation Structure	Ground Screw

(D). Other Details

(i).	COD of the Generation Facility (Anticipated)	June 30, 2019
(ii).	Expected Useful Life of the Generation Facility from the COD	25 Years

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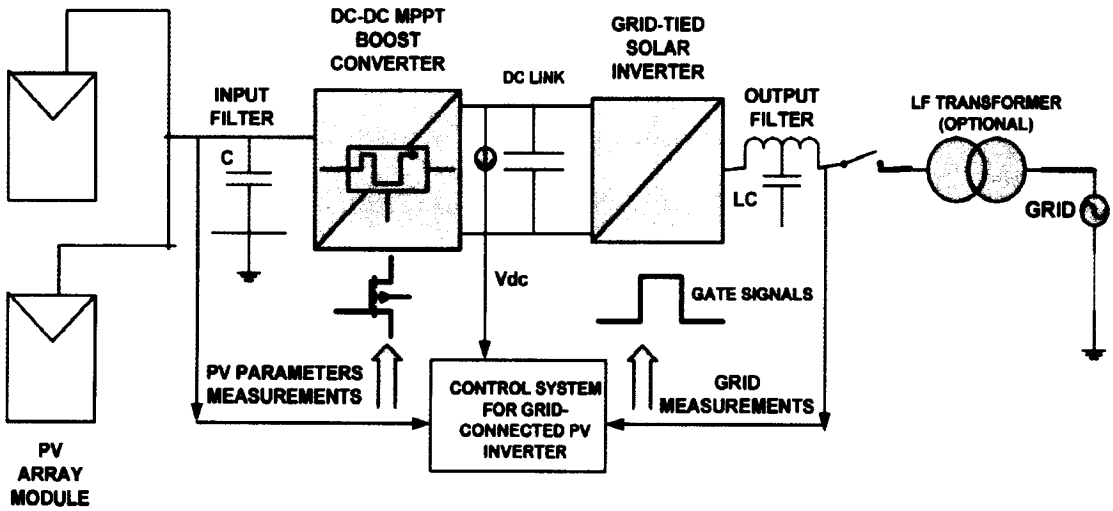
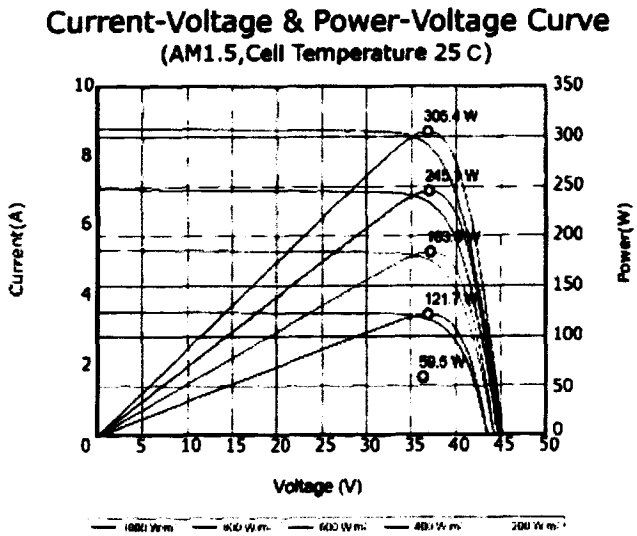
Process Flow Diagram of the Generation Facility/Solar Power Plant/Solar Farm



V-I Curve of Solar Cell



SCHEDULE-II

The Total Installed Gross ISO Capacity of the Generation Facility/Power Plant/Solar Plant (MW), Total Annual Full Load (Hours), Average Sun Availability, Total Gross Generation of the Generation Facility/Solar Farm (in kWh), Annual Energy Generation (25 years Equivalent Net Annual Production-AEP) KWh and Net Capacity Factor of the Generation Facility/Power Plant/Solar Farm of Licensee is given in this Schedule

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1)	Total PV Installed Capacity of Generation facility	50 MWp
2)	Average sun hour availability /day (Irradiation on Inclined surface)	6.0 Hrs
3)	Days per Year	365
4)	PV Plant Annual Generation Capacity	95.081 GWH
5)	Expected Total Generation in 25 Years	
6)	Generation per Year if Plant operational 24/7	438.161 GWH
7)	Net Capacity Factor	21.70%

NOTE

All the above figures are indicative as provided by the Licensee. The Net Energy available to the Power Purchaser for dispatch will be determined through procedures contained in the Energy Purchase Agreement.

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A022842

SECURITIES AND EXCHANGE COMMISSION OF PAKISTAN

COMPANY REGISTRATION OFFICE, LAHORE

CERTIFICATE OF INCORPORATION

[Under section 32 of the Companies Ordinance, 1984 (XLVII of 1984)]

Corporate Universal Identification No. 0102186

I hereby certify that ENERTECH BOSTAN SOLAR (PRIVATE) LIMITED is this day incorporated under the Companies Ordinance, 1984 (XLVII of 1984) and that the company is Limited by Shares.

Given under my hand at Lahore this Sixth day of September, Two Thousand and Sixteen.

Fee Rs.2,000/-

CERTIFIED TO BE TRUE COPY

(SHAUKAT HAMEED)
Joint Registrar

ADDITIONAL JOINT REGISTRAR OF COMPANIES
COMPANY REGISTRATION OFFICE
LAHORE

No.ARL/ 4859 DATED: 06-09-2016

Annexure E – Articles of Association

THE COMPANIES ORDINANCE, 1984

(PRIVATE COMPANY LIMITED BY SHARES)

Articles of Association

of

ENERTECH BOSTAN SOLAR (PRVATE) LIMITED

PRELIMINARY

1. Subject as hereinafter provided, the Regulations contained in Table 'A' of the First Schedule to the Companies Ordinance, 1984, (hereinafter referred to as Table 'A') shall apply to the Company so far as those are applicable to Private Companies, with the exception of the Regulations which are modified, altered or added hereunder.

PRIVATE LIMITED COMPANY

2. The Company is a Private Company within the meaning of Clause (28) of Section 2(1) of the Companies Ordinance, 1984 and accordingly:

   (a) No invitation shall be issued to the public to subscribe for any shares, debentures or debentures-stocks of the Company.

   (b) The number of members of the Company (exclusive of persons in the employment of the Company) shall be limited to fifty provided that for the purpose of this provision when two or more persons hold one or more shares in the Company jointly they shall for the purposes of this clause be treated as a single member ; and

   (c) The right to transfer shares in the Company is restricted in the manner and to the extent hereinafter appearing.

BUSINESS

3. The Company is entitled to commence business from the date of its incorporation.

4. The business of the Company shall include all or any of the objects enumerated in the Memorandum of Association.

5. The business of the Company shall be carried out at such place or places in the whole of Pakistan or elsewhere as the Directors may deem proper or advisable from time to time.

CAPITAL

6. The Authorized Share Capital of the Company is Rs. 53,000,000 divided into 5,300,000 ordinary shares of Rs 10 each with the rights and privileges attaching thereto as are or may be provided by the Regulations of the Company for the time being. The Company shall have power to increase or reduce the capital and to divide the shares in the Capital for the time being into several classes in accordance with the provisions of Companies Ordinance, 2016.

7. The shares shall be under the control of the Board of Directors who may allot or otherwise dispose of the same to such persons, firms, corporation or corporations on such terms and conditions and at any such time as may be thought fit.

8. The shares in the capital of the Company may be allotted or issued in payment of any property, land, machinery or goods supplied or any services rendered to the Company or promotion or formation of the Company or conduct of its business.

SHARES, TRANSFER AND TRANSMISSION

9. Every person whose name is entered as a member in the Register of Members shall without payment, be entitled to a certificate under the Common Seal of the Company specifying the shares held by several persons. The Company shall not be bound to issue more than one certificate and delivery of a share certificate to any one of several joint holders shall be sufficient delivery to all.

10. The Directors may decline to register any transfer of share to transferee of whom they do not approve and shall be bound to show any reasons for exercising their discretion subject to the provisions of Sections 77 and 78 of the Companies Ordinance, 1984.

11. No share can be mortgaged, pledged, sold, hypothecated, transferred or disposed off by any member to a non-member without the previous sanction of the Board of Directors.

12. The legal heirs, executors or administrators of a deceased holder shall be the only persons to be recognized by the Directors as having title to the shares. In case of shares registered in the name of two or more holders the survivors and the executors of the deceased shall be the only persons to be recognized by the Company as having any title to the shares.

GENERAL MEETING

13. The First Annual General Meeting shall be held within 18 months from the date of incorporation of the Company in accordance with the provisions of Section 158 and

thereafter once at least in every year and within a period of four months following the close of its financial year and not more than fifteen months after the holding of its last preceding Annual General Meeting as may be determined by Directors. The Directors may, whenever they think fit, call an Extraordinary General Meeting of the shareholders in terms of Section 159 of the Companies Ordinance, 1984.

PROCEEDINGS AT GENERAL MEETING

14. Twenty one days' notice at least specifying the place, day and hour of the General Meeting and in case of special business the general nature of such business, shall be given to the members in the manner provided in Table "A" but accidental omission to give such notice to or non-receipt of such notice by the member shall not invalidate the proceedings of the General Meeting.

15. The Chairman, with the consent of a meeting at which quorum is present and shall if so directed by the meeting may adjourn the meeting from time to time and from place to place, but no business shall be transacted at any adjourned meeting other than the business left unfinished at the meeting from which the adjourned took place.

QUORUM

16. No business shall be transacted at any General Meeting unless a Quorum of members is present at the time when the meeting proceeds to business. Two members, present in person, representing not less than 25% of the total voting power either on their own account or as proxies, shall form a Quorum for a General Meeting.

VOTES OF MEMBERS

17. At any General Meeting a resolution put to the vote of the General Meeting shall be decided on a show of hands, unless a poll is demanded in accordance with the provisions of Section 167 of the companies Ordinance, 1984.

18. On a show of hands every member present shall have one vote and on a poll, every member present in person or by proxy shall have one vote in respect of each share held by him.

19. The instrument appointing a proxy and the power of attorney or other authority under which it is signed or notarially certified copy of that power of attorney or authority shall be deposited at the Registered Office of the Company not less than forty eight hours before the time for holding the meeting at which the person named in the instrument proposes to vote and in default, the instrument of proxy will not be treated as valid.

CHAIRMAN

20. The Directors may from time to time appoint one of their members to be the Chairman of the company for a period not exceeding three years on such terms and conditions as they deem fit. The Chairman shall preside over the meetings of the Board of Directors and members of the Company. In his absence, the Directors may elect one of them to preside over Board's/ General Meetings. The question arising at the meeting of the Directors shall be decided by a majority of votes. In the case of equality of votes, the Chairman or the director presiding over the meeting, as the case may be, shall have a casting vote.

CHIEF EXECUTIVE

21. The first Chief Executive of the Company will be appointed by the Board of Directors within fifteen days from the date of incorporation of the Company who shall hold office till the first Annual General Meeting.

DIRECTORS

22. Unless otherwise determined, the number of Directors shall not be less than two. The following are the first Directors of the Company.

    1. **Yasser Malik**

    2. **Muhammad Asad Khan**

23. The election of the Directors shall be held in accordance with the provision of Section 178 of the Companies Ordinance, 1984.

24. The first Directors including the Chief Executive, shall hold office upto the First Annual General Meeting in accordance with the provisions of the Companies Ordinance, 1984, unless any one of them resigns earlier or becomes disqualified for being Director or otherwise ceases to hold office.

25. A resolution for removing a Director shall not be deemed to have been passed if the number of votes against him is equal to, or less than the number of votes that would have been necessary for the election of Directors at the immediately preceding annual election of Directors in the manner aforesaid but as provided under Section 181 of the Companies Ordinance, 1984.

26. The remuneration of Directors except regularly paid Chief Executive and full time working Directors shall, from time to time, be determined by the Board of Directors.

27. The Directors may sanction the payment of such additional sums as they may think fit to any Director for any special service he may render to the Company or be thought capable of rendering either by fixed sum or an any other form as may be determined by the directors subject to the provisions of the companies Ordinance, 1984.

28. The Director who resides out of station shall also be entitled to be paid such traveling and other expenses for attending the meeting for the Company as may be fixed by the Directors from time to time according to the provisions of the Companies Ordinance, 1984.

29. Any casual vacancy occurring on the Board of directors shall be filled in by a resolution of the Board of Directors and the person so appointed shall hold office for the remainder of the term of the Directors in whose place he is appointed.

30. No Director shall be disqualified from his office by contracting with the Company either as vendor, purchaser or otherwise nor shall any Director be liable to account for any profit released from any such contract or arrangement or the fiduciary relation thereby established, but the nature of his interest must be disclosed by him at the first meeting of the Directors after acquisition of his interest.

NOTICES

31. Notices for every meeting of the Board of Directors will be given in writing and there must be given a reasonable time in advance. The nature of the business to be transacted at an intended Board meeting will be specified in the notice.

MANAGEMENT

32. The whole business and affairs of the Company shall, subject to the control and supervision of the Board of directors, be managed and controlled by the Chief Executive.

33. Subject to the limit fixed by the Directors, the Chief Executive may from time to time raise or borrow any sums of money for and on behalf of the Company from other companies, banks or financial institutions on such terms as may be approved by the Board of Directors from time to time.

34. Without prejudice to the powers conferred by these Articles, the Board of Directors shall have the following powers:

(a) To take on lease, purchase, erect or otherwise acquire for the Company any assets, stocks, lands, buildings, property. Rights or privileges which the

Company is authorized to acquire at such price and generally on such terms and conditions as they think fit.

(b) To let, mortgage, sell exchange or otherwise dispose of absolutely or conditionally all or any part of the assets, stocks, raw materials, properties, privileges and undertaking of the Company upon such terms and conditions and for such consideration as they think fit.

(c) To appoint any person or persons to be attorney or attorneys of the Company for such purposes and with such powers authorities and discretions and for such period and subject to such conditions as they may, from time to time, think fit.

(d) To enter into, carry out, rescind or vary all financial arrangements with any bank, person, company, firm or corporation or in connection with such arrangements to deposit, pledge or hypothecate property of the Company or the documents representing or relating to the same.

(e) To make and give receipts, release and discharge all moneys payable to the Company and for the claims and demands of the Company.

(f) To compound or allow time to the payment or satisfaction of any debt due to or by the Company and any claim and demands by or against the Company and to refer claims or demands by or against the Company to arbitration and observe and perform the awards.

(g) To institute, prosecute, compromise, withdraw or abandon any legal proceedings, by or against the Company or its affairs or otherwise concerning the affairs of the Company.

(h) To raise and borrow money from time to time for the purposes of the Company, on the mortgage of its property or any part there and/or on any bond or debenture payable to bearer otherwise repayable in such a manner and generally upon such terms as they think fit.

(i) To open, operate and maintain bank/banks account(s) individually or jointly as the Board may authorize or to any other person on its behalf.

BORROWING POWERS

35. The Directors may from time to time raise, borrow or secure the payment of any sums for the purposes of the Company in such manner and upon such terms and conditions as they think fit and in particular by the issue of debentures, debenture-stock or other securities charged upon all or any part of the property of the Company present or future.

36. Debentures, debenture-stock, or other securities may be issued with any special privileges as to redemption, surrender, allotment of shares, attending and appointment of Directors or other privileges subject to any permission required by law.

THE SEAL

37. The Company shall have Common Seal and the Director shall provide for the safe custody of the same. The Seal shall not be applied on any instrument except by the authority of the Board of Directors and in the presence of at least two Directors who shall sign every instrument to which the Seal shall be affixed in their presence. Such signatures shall be conclusive evidence of the fact that the Seal gas been properly affixed.

ACCOUNTS

38. The Director shall cause to be kept proper books of account as required under Section 230 of the Companies Ordinance, 1984.

39. The Books of account shall be kept at the registered office of the Company or at such other place as the Directors shall think fit subject to the provisions of Section 230 of the Companies Ordinance, 1984.

AUDIT

40. Once at least in every year the accounts of the Company shall be audited and correctness of the Balance Sheet shall be ascertained by one or more Auditors. The Auditors shall be appointed and their duties regulated in accordance with the provisions of Section 252 to 255 of the Companies Ordinance, 1984.

INDEMNITY

41. In connection with carrying on the business of the Company, the Chief Executive, every Director, or other officers of the Company shall be indemnified by the Company for all losses and expenses occasioned by error of judgment or oversight on his part, unless the same happens through his own dishonesty or willful act and defaults.

42. In the event that a dispute, claim or controversy arises between the company, its management and its shareholders, or between the shareholders inter-se, or the directors inter-se, all steps may be taken to settle the dispute and resolve the issue

through mediation by an accredited mediator before taking recourse to formal dispute resolution such as arbitration or legislation.

SECRECY

43. No member shall be entitled to visit and inspect the Books of the Company without the permission of the Chief Executive or one of the Directors or to require discovery of any information regarding any detail of the Company's business or any matter which is or may be in the nature of trade secret, or secret process which may relate to the conduct of the Company's business and which in the opinion of the Directors, will not be in the interest of the members of the Company to communicate to the public.

ARBITRATION

44. In the event that a dispute, claim or controversy arises between the company, its management and its shareholders, or between the shareholders inter-se. all steps may be taken to settle the dispute and resolve the issue through mediation by an accredited mediator before taking recourse to formal dispute resolution such as arbitration or litigation.

45. Whenever any difference arises between the company on the one hand and the members, their executors, administrators or assignee on the other hand, touching the true intent or construction or the incident or consequence of these present or of the statutes or touching any thing thereafter done, executed, omitted or suffered in pursuance of these present or otherwise relating to these present or to any statutes affecting the Company, every such difference shall be referred for the decision of the arbitrator who will be qualified in Islamic law.

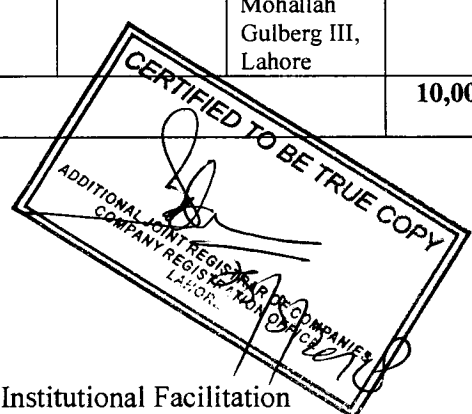
46. The cost incidental to any such reference and award shall be at the discretion of the arbitrator or umpire respectively who may determine the amount thereof and direct the same to be shared between the attorney and client or otherwise and may award by whom and in what manner the same shall be borne and paid.

WINDING UP

47. If the Company is wound up whether voluntarily or otherwise the liquidator may, with the sanction of a special resolution, divide among the contributories in specie any part of the assets and liabilities of the Company, subject to Section 421 and other provisions of the Companies Ordinance, 1984 as may be applicable.

We, the several persons whose names and addresses are subscribed below, are desirous of being formed into a Company, in pursuance of these Articles of Association, and we respectively agree to take the number of shares in the Capital of the Company as set opposite to our respective names.

Name and Surname (present and former) full (in Block letter)	Father's/ Husband's Name	Nationality with any former Nationality	Occupation	Registered Office/ Residential Address in full	Number of Shares taken by each subscriber	Signature
Muhammad Asad Khan (42201-3642391-5)	Muhammad Sardar Khan	Pakistan	Businessman	House No. R 2, Shaheed Milat Road, Mohallah Karachi Administrati on Society, Block 9, Karachi	5,000	
Yasser Malik (35202-2832765-7)	Muhammad Nawaz Malik	Pakistan	Businessman	House No. 17- E- 3 Mohallah Gulberg III, Lahore	5,000	
Total Number of share taken					**10,000**	



Dated this 31th day of August 2016

Witness to the above Signatures:

Signature: _____

Full Name: National Institutional Facilitation Technologies (Private) Limited

Occupation: NIFT

Full Address: 5th Floor, AWT Plaza, I. I. Chundrigar Road, Karachi.

Annexure F - Memorandum of Association

THE COMPANIES ORDINANCE, 1984

(COMPANY LIMITED BY SHARES)

Memorandum of Association

of

ENERTECH BOSTAN SOLAR (PRIVATE) LIMITED

I. The name of the Company is "ENERTECH BOSTAN SOLAR (PRIVATE) LIMITED".

II. The Registered Office of the Company will be situated in the Province of the Punjab.

III. The objects for which the Company is established are all or any of the following:

1. To carry on all or any of the businesses of generating, purchasing, importing, transforming, converting, distributing, supplying, exporting and dealing in electricity and all other forms of energy and products or services associated therewith and of promoting the conservation and efficient use of electricity and to perform all other acts which are necessary or incidental to the business of electricity generation, transmission, distribution and supply subject to permission from NEPRA.

2. To locate, establish, construct, equip, operate, use, manage and maintain all types of power plants (including without limitation power plants based on solar energy power plants, power grid station, transforming, switching, conversion, and transmission facilities, grid stations, cables, overhead lines, sub-stations, switching stations, tunnels, cable bridges, link boxes, heat pumps, plant and equipment for combined heat and power schemes, offices, dispensing machines for pre-payment cards and other devices, showrooms, depots, factories, workshops, plants, printing facilities, warehouses and other storage facilities.

3. To carry on all or any of the businesses of wholesalers, retailers, traders, importers, exporters, suppliers, distributors, designers, developers, manufacturers,

installer, filters, testers, repairers, maintainers, contractors, constructors, operators, users, inspectors, reconditioners, improvers, alterers, protectors, removers, hirers, replacers, importers and exporters of and dealers in, electrical appliances, systems, products and services used for energy conservation, equipments, machinery, materials and installations, including but not limited to cables, wires, meters, pylons, tracks, rails, pipelines and any other plant, apparatus equipment, systems and things incidental to the efficient generation, procurement, transformation, supply and distribution of electricity.

4. To ascertain the tariff for bulk supply that will secure recovery of operating costs, interest charges and depreciation of assets, redemption at due time of loans other than those covered by depreciation, expansion projects, payment of taxes, and reasonable return on investment, to quote the tariff to bulk purchasers of electrical power, and to prefer petition to the appropriate authority for approval of the schedule of tariff and of adjustments or increases in its bulk supply tariff, where desirable or necessary.

5. For the purposes of achieving the above objects, the company is authorized:-

(1) to purchase/import raw materials and allied items required in connection thereto in any manner the company may think fit;

(2) to do and perform all other acts and things as are incidental or conducive to the attainment of the objects of the company;

(3) to own, establish or have and maintain shops, branches and agencies all over Pakistan or elsewhere for sale and distribution of cables, wires, meters, pylons, tracks, rails, pipelines and any other plant, apparatus equipment, systems and things incidental to the efficient generation, procurement, transformation, supply and distribution of electricity;

(4) to make known and give publicity to the business and products of the company by such means as the company may think fit;

(5) to purchase, acquire, protect, renew, improve, use and sell, whether in Pakistan or elsewhere any patent, right, invention, license, protection or concession which may appear advantageous or useful to the company for running the business;

(6) to pay all costs, charges and expenses, if any, incidental to the promotion, formation, registration and establishment of the company;

(7) to borrow and arrange the repayment of money from banks/financial institutions or any lawful sources whether in Pakistan or elsewhere and in such manner as the company may think fit, including the issue of debentures, preference shares, bonds, perpetual or otherwise charged upon the whole or any part of the company's property or assets, whether present or future, and to purchase, redeem or payoff such securities;

(8) to purchase, hold and get redeemed shares, debentures, bonds of any business, company, financial institution or any Government institutions;

(9) to guarantee the performance of contracts, agreements, obligations or discharge of any debt of the company in relation to the payment of any financial facility including but not limited to loans, advances, letters of credit or other obligations through creation of any or all types of mortgages, charges, pledges, hypothecations, on execution of the usual banking documents or instruments or otherwise encumbrance on any or all of the movable and immovable properties of the company, either present or future or both and issuance of any other securities or sureties by any other means in favour of banks, Non-Banking Finance Companies (NBFCs) or any financial institutions and to borrow money for purpose of the company on such terms and conditions as may be considered proper.

6. It is, hereby, undertaken that the Company shall not engage in banking business or any business of investment company or non-banking finance company or insurance or leasing or business of managing agency or in any unlawful business and that nothing contained in the object clauses shall be so construed to entitle it to engage in such business directly or indirectly and the Company shall not launch multi-level marketing (MLM), P*yramid* and *Ponzi* schemes.

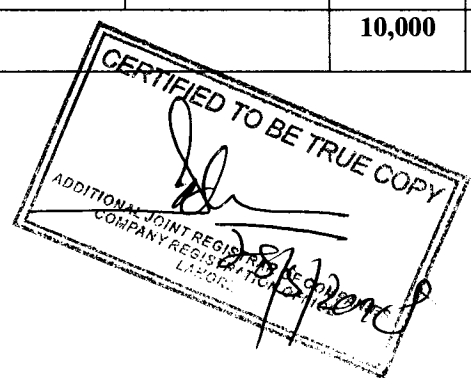
7. Notwithstanding anything stated in any object clause, the company shall obtain such other approval or license from the competent authority, as may be required under any law for the time being in force, to undertake a particular business.

IV. The liability of the members is limited.

V. The Authorized Share Capital of the Company is Rs. 53,000,000 divided into 5,300,000 ordinary shares of Rs 10 each with the rights and privileges attaching thereto as are or may be provided by the Regulations of the Company for the time being. The Company shall have power to increase or reduce the capital and to divide the shares in the Capital for the time being into several classes in accordance with the provisions of Companies Ordinance, 2016.

We, the several persons whose names and addresses are hereto subscribed, are desirous of being formed into a Company in pursuance of this Memorandum of Association and we respectively agree to take the number of ordinary shares in the capital of the Company set opposite our respective names.

Name and Surname (present and former) full (in Block letter)	Father's/ Husband's Name	National ity with any former National ity	Occupation	Registered Office/ Residential Address in full	Number of Shares taken by each subscriber	Signature
Muhammad Asad Khan (42201-3642391-5)	Muhammad Sardar Khan	Pakistan	Businessman	House No. R 2, Shaheed Milat Road, Mohallah Karachi Administration Society, Block 9, Karachi Sharqi, Karachi	5,000	
Yasser Malik (35202-2832765-7)	Muhammad Nawaz Malik	Pakistan	Businessman	House No. 17-E- 3 Mohallah Gulberg III, Lahore	5,000	
Total Number of share taken					**10,000**	



Dated this 31th day of August 2016

Witness to the above Signatures:

Signature: _____

Full Name: National Institutional Facilitation Technologies (Private) Limited

Occupation: NIFT

Full Address: 5th Floor, AWT Plaza, I. I. Chundrigar Road, Karachi.

Annexure K – Project Cost

PROJECT COST

The total Project Cost, expressed in US Dollars, has been calculated after thorough analysis, evaluation and understanding of the dynamics that affect the development and operation of a solar PV project. A planned Levelized Generation Tariff for the EnerTech Bostan Solar is proposed at US cents 6.0/kWh. The EPC contractor is yet to be finalized, as under the NEPRA 'Guidelines for Selection of EPC Contractor 2017', the Feasibility Studies need to be approved before the firm bids can be submitted. A summary of the indicative Project Cost is given below:

PROJECT COST	**USD ' million**
Procurement and Supply of Equipment	37
Construction, Installation and commissioning	8
Project Design Services	0.3
EPC Costs	**45.3**
Project Development Costs	1.25
Insurance During Construction	0.3
Interest during Construction	1.0
Project Security	0.7
Financial Charges	1.5
Total Project Costs	**49.85**

PROJECT FINANCING

The Project financing will be based on a debt to equity ratio of 80:20. Under the base case financial projections, debt is assumed to be 100% foreign financed with debt repayment of 13 years after COD amortized over the period through fixed annuity-based instalments. Key parameters of the Project funding are provided in Table below:

Project Cost	USD 49.85 million
Debt	USD 39.88 million
Equity	USD 9.97 million
Lending Rate	LIBOR+ 4.5% fixed
Repayment Period	13 years

Annexure L - Prospectus

PROSPECTUS

The Government of Pakistan has formulated a policy to standardize and encourage the participation of the private sector in the development and application of renewable energies. A Government organization, the Alternative Energy Development Board (AEDB), has been established to facilitate the implementation of renewable energy projects. Likewise, the provincial government is also addressing this objective within Balochistan, making significant efforts through the Department of Energy and the Balochistan Power Development Board (BPDB).

The Government of Balochistan Department of Energy issued Letter of Intent (LOIs) under the policy. The LOI to EnerTech Bostan Solar Private Limited (EBSL) for the development of a 50MW Solar PV Power Project was issued on 26th October, 2016. Land representing a suitable site for the project has been allocated on the Kuchlak-Zhob Highway (N50) in Bostan region of District Pishin, Balochistan. The Project Company intends to apply for cost plus tariff announced by NEPRA under the Alternative and Renewable Energy Policy 2011.As the project uses a renewable source of energy (the Sun), it will displace 66,821 metric tons of Carbon every year. This is equivalent to the carbon sequestered by 63,253 acres of forests in one year or 7,518,920 gallons of petrol consumed.

The project will supply electricity to almost 20,000 homes in the regions of Quetta and Pishin. EBSL will also create employment opportunities for locals both during the construction phase and the operations phase of the power plant.

The Applicant obtained the Letter of Intent (LOI) from the Balochistan Power Development Board in October 2016 for the development of two Solar Power Projects for a capacity of 50 MW each. The land for the Project has been allocated by the Government of Balochistan through a Lease Order.

The Project Site is acquired on the Zhob-Kuchlak Highway in the Bostan Region of District Pishin, Balochistan. The site is located around 35 km away from the Quetta Airport. The land area for the project is 250 acres, whereas about 250 acres more has been allocated in the same location for the other Solar PV project

The complete feasibility study was submitted to the Balochistan Power Development Board in September 2017 and approval has been granted by the panel of experts.

The Electrical and Grid Interconnection Studies have been submitted to the National Transmission and Dispatch Company ('NTDC') and QESCO approval for interconnection has been granted.

Initial Environmental Examination Report was submitted to the Balochistan Environmental Protection Agency in September 2017 and approval was accorded by the Agency vide its Letter no. DG/EPA/5069-71/2017-2018 dated 26-12-2017.

This document is submitted pursuant to Section 5 of Article 3 of NEPRA Licensing (Application and Modification Procedure) Regulation, 1999 ('Regulation'); and list of documents required are attached as Annexure as mentioned in the Document Structure.

PROJECT SPONSOR

EnerTech Holding Company is the sponsor of the project company. Enertech Holding Company is a fully owned by National Technology Enterprises Company (NTEC) which in turn is a wholly owned subsidiary of Kuwait Investment Authority. Kuwait Investment Authority is the oldest and one of the largest Sovereign Wealth Funds in the world. KIA is responsible for the management and administration of the General Reserve Fund (GRF), and the assets of the Future Generation Fund (FGF), as well as any other funds entrusted to it by the Minister of Finance for and on behalf of the State of Kuwait.

100% Shareholding

100% Shareholding

100% Shareholding

Enertech Bostan Solar (Pvt.) Ltd

100% Shareholding

Enertech Quetta Solar (Pvt.) Ltd

EnerTech's leadership team is globally recognized in the fields of renewable energy technology and project development and finance. EnerTech's portfolio companies have been involved in the development of numerous pioneering solar technologies including Photovoltaic (PV), Concentrated Photovoltaic (CPV) and Concentrated Solar Power (CSP), PV trackers, as well as breakthrough energy storage technologies, and high-dispatch-ability and high-capacity factor solar solutions. In addition, our team has substantial experience working with a variety of solar panels including high efficiency CPV, mono-crystalline, poly-crystalline and thin film panels.

Portfolio Companies of EnerTech

P21

The P21 develops, produces and markets high quality fuel cell systems and related components for applications in the 2 to 20 kW power range. With its patented, hydrogen-powered PEM fuel cells, P21 is the leading supplier of uninterruptible power supply (UPS) – especially for use in the telecommunications industry.

Petra Solar

Petra Solar's core technology is the Sun Wave™ UP Series, an integrated utility grade solar, smart grid, and power management solution primarily designed for deployment on utility distribution and streetlight poles. Petra Solar's Sun Wave™ UP Series systems mount quickly and safely to utility distribution and streetlight poles and deliver power directly to the grid.

Controlled Power Technologies Limited

Controlled Power Technologies Limited was founded in early 2007 by senior automotive executives to focus on carbon reduction issues. Asset and technology acquisitions from Visteon Corporation, together with the signing of associated licensing and collaboration agreements with Switched Reluctance Drives Limited, give the new company immediate access to a portfolio of production-ready and near-term solutions to the problem of automotive CO2 reduction.

PEMEASPEMEAS

PEMEASPEMEAS is a leading supplier of key components and subsystems to the emerging fuel cell industry. PEMEAS has been incorporated during April 2004 through a Venture Capital backed spin- off and continues the fuel cell business of Hoechst Chemical Group initiated in 1994. For serving its global customer base PEMEAS is operating two divisions. The Celtec division of PEMEAS is focusing on the development and commercialization of high temperature membranes and MEAs enabling PEM fuel cells to be operated at an elevated temperature of approximately 180 C.

Cellex Power Products, Inc.

Cellex Power Products, Inc. Cellex Power Products, Inc. is a Canadian company based in Vancouver,
B.C. focused on the development and commercialization of fuel cell power product solutions for Industrial Vehicles. Cellex's strategy is to develop proprietary system and component technology required to integrate fuel cell stacks, fuel processors, hydrogen systems and other components into commercial products.

Heliocentris

Heliocentris is a specialist in energy management and innovative hybrid energy storage solutions consisting of fuel cells and batteries. They offer Fuel Cell Systems and Integration Components, Energy Storage Solutions for Commercial & Institutional Users and Training Systems and Research Solutions.

Kinetic RES, a Dubai DMCC registered organization; a spinoff of pioneering US company in renewable energy and EnerTech. It has been set up to provide one-stop solution for renewable and sustainable energy power plants across the developing world including; technology development, transfer and manufacturing licensing, project development, complete structured financing services, design, optimization and EPCM Services, O&M services. Design, build, finance and owns renewable energy generating assets for the long term, including solar, small-hydro, biomass, W2E, WHR and upgrading transmission infrastructure into smart grid system.

TouGas Oilfield Solutions is a rapidly growing technology company focused on developing and commercializing chemicals and services for well stimulation, hydraulic fracturing, friction reducers, and enhanced oil recovery.

Tougas, is a German based company providing synthetic chemical to the oil and gas industry, the company's products represent a breakthrough technology solution in new and fast growing sub-sector of hydraulic fracturing.

Morgan Solar is a technology company founded in 2007 in Toronto Canada with the goal of making unsubsidized solar energy competitive with traditional sources of generation. In this pursuit, it has pioneered an entirely new approach to the design and manufacture of solar modules and Balance of System (BOS) components.

Their first innovation was the Light-guide Solar Optic (LSO), an ultra-thin, non-imaging solar concentrator that eliminated the bulk and complexity of traditional lens and mirror-based Concentrated Photovoltaic (CPV) optics.

Morgan Solar have developed the revolutionary Sun Simba™ Concentrated Photovoltaic (CPV) module and Savanna™ dual-axis tracker - two solar energy technologies that fundamentally change the economics of solar power. Their next generation Sun Simba™ CPV module is the first to concentrate sunlight in a planar direction, enabling an ultra-thin module that generates industry-leading energy yields, at unprecedented low costs. We've also reinvented the way solar energy is deployed with the self-ballasted Savanna™ tracker, a human-scale tracking system set up and serviced manually with simple hand tools – no concrete foundations to pour, and no cranes or other heavy lifting equipment required.

Ecore Gulf FZE is a limited liability company (L.L.C) based in Jebel Ali Free Zone - Dubai /UAE. The company has a good market penetration through its subsidiaries in Kingdom of Saudi Arabia, Egypt, Iran and have agent networks in Iran, Tunisia, Libya, South Africa, Jordan, Oman, Yemen, Bahrain, Kuwait and Qatar.The company is engaged in trading and distribution of industrial specialty chemicals serving the industrial customers in the GCC and MENA region.

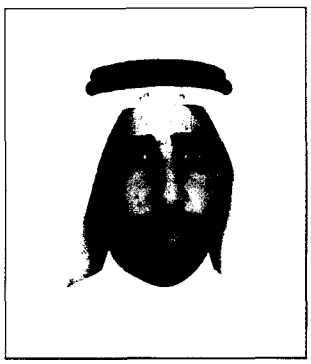
Ecore has state-of-the-art regional sales facilities, strategically located warehousing facilities and a comprehensive network of sub- providers in secondary and tertiary markets allow ECORE to meet and exceed expectations of the region's specialty ingredients sector.

RedWave Energy is a Chicago-based start-up with an energy harvesting technology that has the potential to disrupt a billion- dollar market. RedWave's core thin film technology converts waste heat into electricity across a wide range of temperatures and with better efficiency. This Nano antenna based technology is built from exclusively-licensed and patent-protected IP from Idaho National Labs, University of Colorado and premier roll to roll manufacturing firm Micro Continuum. EnerTech is an investor in RedWave Energy and will be working with local industry to identify pilot project opportunities

Al Madadd Company was established in 1975 located in the main dynamic location for water solution trading areas. It is known to the water solution Contractors, the end-Users as one of the main suppliers of water equipment & water treatment products. Al Madadd is known to the concerned Contractors & end-to-end water & sewage Solution provider. Al Madadd Company Goal is to maintain & complete our professional image of services & products range in the field of water solution

PROJECT TEAM

Abdullah Al Mutairi - Chief Executive Officer of EnerTech Holding Company and Chairman EnerTech Bostan Solar Private Limited



Mr. Abdullah Al-Mutairi is the Chief Executive Officer (CEO) of EnerTech Holding Company, a Kuwaiti company owned by the National Technology Enterprises Company (NTEC), a wholly owned subsidiary of the Kuwait Investment Authority (KIA).

EnerTech's venture capital and private equity investments focus on oil and gas (fossil and renewable generation, efficiency and storage), water (desalination, treatment, distribution and conservation), and clean technology (emissions monitoring and control, waste management and recycling, and environmental remediation).

Previously, Mr. Al-Mutairi served as a senior investment manager for NTEC and headed its energy, water and clean technology division. Prior to NTEC, he served as an investment analyst for the KIA. Abdullah is the Vice-Chairman of the Executive Committee and a founding member of the Kuwait Green Building Council (KGBC).

Mr. Al-Mutairi sits on the board of the following companies:

- Morgan Solar: a company founded in 2007 and based in Canada. Morgan Solar has developed the revolutionary Sun Simba™ Concentrated Photovoltaic (CPV) module and Savanna™ dual-axis tracker.
- Heliocentris Energy Solutions AG (An energy management company based in Germany),
- Control Power Technologies (A fuel efficiency company based in London)
- Kinetic Renewable Energy Services: a Dubai-based company that designs, develops, finances, constructs and operates renewable generation power plants.
- Conduit Ventures: Limited Partner representing National Technology and Eneterprise Company

He holds a master's degree in Business Administration from Kuwait University, and a Bachelor of Science in Civil Engineering from California State University Long Beach.

Yasser Malik: CEO EnerTech Bostan Solar Private Limited

Yasser Malik is the Chief Executive Officer for EnerTech Bostan Solar Private Limited.

He was most recently responsible for the Strategic Solutions Group covering Central Eastern Europe, the Middle East and Africa ("CEEMEA") at Bank of America Merrill Lynch. He was working on financing , risk management and private investments for the firm's key clients across the CEEMEA region. He was involved in originating, structuring and co-investing in a number of landmark transactions including British Energy Right-Way Risk.

Prior to that he was Director and Partner heading the Strategy Group at ePlanet Capital, one of the top Venture Capital firms in the world ranked by Forbes. Eplanet's top three investment achieved a combined market capitalization of $ 20 billion (Baidu, Skype, Focus Media).

During his time at ePlanet Capital he was instrumental in putting together strategic partnership with Kuwait Finance House and securing OPIC funding to invest in Muslim Majority Countries(MMC) in order to promote entrepreneurship. OPIC funding for MMC was a key initiate of President Obama post his speech in Egypt.

He made Vice President at Merrill Lynch in 2008. Prior to Merrill Lynch he has worked at JP Morgan Chase and and PriceWaterhouseCoopers.

He graduated from University College London in 2004 in Economics and Statistics (awarded Friends' Scholarship).

Asif Ansari:

A serial technical entrepreneur with a track record of building successful companies in the aerospace, energy, technology and manufacturing sectors. He is recognized for successful commercialization of challenging new, and advanced technologies while rapidly building stakeholders and investors value. Mr. Ansari's pioneering innovations have help create entirely new industries, as well as the development and commercialization of over 25 new class of technical products spanning aerospace, energy and clean-tech sectors. He spearheaded the design of one of the most challenging post-Apollo space projects undertaken; the Lunar Prospector Spacecraft. Mr. Ansari also founded eSolar, a solar thermal startup that reached a record terminal valuation of $1.6 billion in less than two years starting with a four-person team and a $2 million initial investment. Concentrated Solar Thermal Power and Concentrated Photovoltaic technologies including developing 1.5 GW of solar power projects in over 22 countries.

Mr. Ansari served on President Obama's Federal Renewable Energy Advisory Committee. Advised Saudi Government in fulfillment of Vision 2030 goals focusing on developing actionable strategies for achieving technology indigenization. He advises the Kuwaiti Government on technology investments and developing an aggressive, yet actionable plan for diversifying the Kuwaiti economy away from oil.

eSolar Inc., California, USA - Founder and Chief Executive Officer (2003 to 2009)

Founded eSolar and backed by Google, and GE considered as the world leader in solar thermal technologies, and often described as the "Google of Clean-Tech". Raised $300m in record 9 months. Brought the vision and leadership delivering unprecedented growth taking a startup into the global leader in CSP. eSolar's Sun Tower Generating Station named Renewable Project of the Year by Power Engineering magazine.

Morgan Solar, Toronto, Canada - Chief Executive Officer (2009 to 2013)

Morgan Solar is known for its advanced solar technologies and highly disruptive CPV and tracking solutions. Morgan Solar is a portfolio company of Enertech/Kuwait Investment Authority. Raised over $100m and attracted prominent investors including Enertech Holding, a portfolio company of the Kuwait Investment Authority Spain's, Iberdrola, a European utility with one of the worlds largest renewable energy portfolios, as well Enbridge a major Canadian Oil and Gas utility.

Kinetic RES, Dubai, UAE - Founder and Chief Executive Officer (2013 – 2016)

Kinetic RES is an integrated global renewable energy developer; financer and operator focused on delivering economical renewable and sustainable energy solutions for emerging and growth markets. The company has offices in USA, Dubai, Kuwait, Saudi Arabia, Pakistan and West Africa. The company provides an investment conduit into the emerging and growth market power sector for Kuwait Investment Authority, the Sovereign Wealth Fund of Kuwait KIA as well as related GCC-based SWF and equity investment funds. Enertech Holding is one of the major investors in the project pipeline.

Kinetic RES offers complete turnkey utility-scale power solutions based on advanced solar, other renewable and gas-based generation technologies. The company offers complete design, Greenfield development, finance, EPC and O&M services. Kinetic RES invests in Greenfield projects and holds generation assets with a long-term investment horizon. The company has built a global portfolio of renewable energy generation and infrastructure assets and has a 11.5 GW global project pipeline.

Sundam Energy Inc, USA - Founder, Chief Executive Officer (2016 – present)

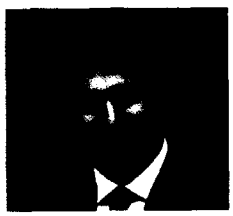
Founded the company to provide affordable rooftop, solar powered electric car charging infrastructure and ground-mount captive solar power solutions. The objective is to provide innovative financial structures in order to deliver energy independence from utilities across the world to commercial, industrial, agricultural and residential consumers.

The company currently has 875 MW of captive power PPA's signed in numerous emerging markets and is working to build out solar power charging infrastructure across the Middle East and South Asia.

Suntrough Energy, California, USA - Founder, Chief Executive Officer (2009 – 2012)

Founded the company to create a paradigm shift in the way power is delivered to the developing world. Introduced the notion of "sustainable energy projects" that focus on developing power plants that utilize indigenous fuels including oil & gas, solar, biomass and hybrids. The company has developed a new class of fully packaged solar thermal hybrid power plants with flexible fuel that operate on heavy fuel oil (HFO), Natural gas, & biomass, and water desalination through multiple effect flash distillation. Company has several high impact solar power projects in West Africa.

Usman Ahsan:



Usman boasts a highly successful career in investment banking which has encompassed some of the pre-eminent transactions involving structured financing in Pakistan. As a part of Syndication and Debt Capital markets at Standard Chartered Bank, Mr. Ahsan actively coordinated and worked with the biggest business groups in Pakistan and was responsible for project financing exceeding the US $ 500 million.

Usman was responsible for some of the most innovative transactions in Pakistan, including structuring the first Sukuk issue, first syndicated term loan secured by the credit card receivables and first private sector non-recourse transaction with no Government off-take. His expertise is in project start ups and executions, financial and investment management and sourcing funding for large scale green field projects. Prior, Mr. Ahsan was involved in the Government sector advisory for the Government of Afghanistan for developing their policy on sale or lease of mining assets.

ASAD KHAN

Asad is working as Director Investment at EnerTech Holding Company since 2013 and is also a Director in EnerTech Quetta Solar and EnerTech Bostan Solar. He has over 22 years of work experience across GCC, Europe and Pakistan covering all major industries like banking, investment banking, energy, real estate, textile, cement, auto & allied, electrical engineering, shipping& logistics, and healthcare.

Previously, Asad was Director Investment Banking with Noor Financial Investment Company Kuwait where he executed many successful deals. Earlier to this he served at Investment & Development Office Government of Rasal Khaimah UAE ass AVP Corporate Finance where he waste am leader in IPO of RAK Properties and did many private equity buy-side & sell-side deals in education, health care and petroleum.

PROJECT BACKGROUND

EnerTech Holding Company and the Government of Balochistan through the Energy Department, signed a Government to Government MOU on 22, June 2016 envisaging a development of 500 MW of Solar PV within the Province of Balochistan to tackle the energy crisis in the province and to contribute to the Prosperity of the people of the Province.

The MOU was a part of a larger Government to Government agreement entered between the Government of Pakistan and State of Kuwait on 11, November 2013 envisaging investment by the State of Kuwait in brother country of Pakistan in energy, infrastructure and healthcare sectors. Under the first phase of the development of the project, EnerTech Holding Company created EnerTech Bostan Solar and applied for and received LOI from Balochistan Power Development Board for 50 MW power project.

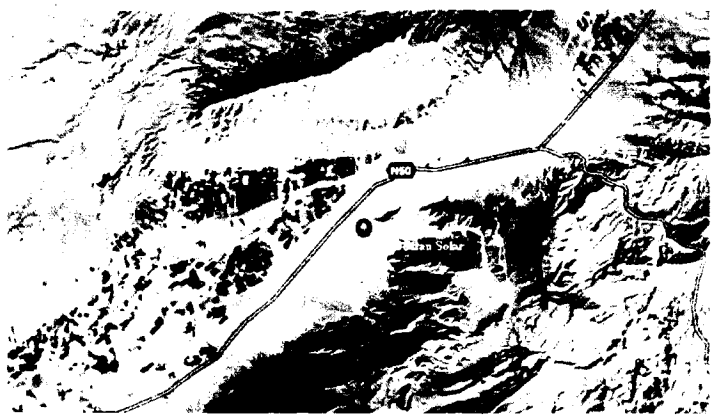
Since the issuance of the LOI in October, 2016, the Applicant conducted all technical studies to assess the feasibility of the Project. These studies included the Solar Resource Assessment, Geo Technical investigation, Topographic study, Initial Environmental Examination and Grid Interconnection Study.

PROJECT SITE

EBSL Project of 50 MW Solar PV Project is located 3 km north of Umerabad towards Khanozai, on the right side of the Kuchlak-Zhob highway (N-50) in MOuza Neeli Tappa Bostan, Tehsil Kharezat, District Pishin. A land of 500 acres has been allocated to the Project Company by the Government of Balochistan. 250 acres of the allocated land is meant for Enertech Bostan Solar, whereas, 250 acres is meant for EnerTech Bostan Solar (a solar pv projects being developed simultaneously by the same parent company). The Project site is a vacant piece of land with sparse vegetation and shrubs. The area is characterized by extreme, harsh, and arid climate.

The logistics for the Project are planned from Karachi using National Highway. The major track from Karachi to the site is a single metalled road. The terrain of the project area is flat and easily accessible through metalled road up to 50 meters ahead to the Project site. Heavy Vehicles and Machinery can easily move onto the track during construction of the project. There is no requirement to establish roads or tracks for movement of traffic. The proposed site located at latitude of 30°452256N and longitude of 67° 100602E.

Site Boundary Layout



The project site coordinates are as listed in Table below: Table 1: Boundary Coordinates

Sr No.	Latitude	Longitude
1	30.468553	67.118524
2	30.460173	67.110318
3	30.454661	67.116144
4	30.461910	67.124735

TOPOGRAPHICAL AND GEOLOGICAL CONDITIONS AT PROJECT SITE

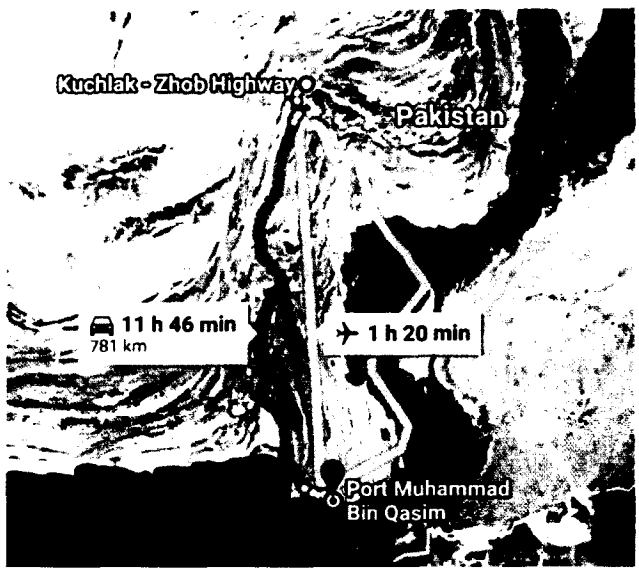
Bostan and its surrounding areas are mountainous. There are also small rock and gravel formations resembling hills along the boundary of the Suleiman Mountains. The site is bounded by Qila Abdullah to the north, Qila Saifullah to the east, Quetta and Ziarat to the south and Afghanistan to the west. The general character of the district is mountainous. The mountains are uniform, with long central ridges from which frequent spurs descend.

The soils are classified as either saline or saline sodic, with pH ranging from 8.2 to 8.4 and 8.8 to 9.6, respectively. The present main source of water supply system in the region is through the use of tubewells with a depth of 300 - 400 ft.

SITE ACCESSIBILITY

The Project is located on Kuchlack-Zhob highway (N50) Bostan. The machinery for the Project will be routed from Port Qasim Karachi, as that is closest to the Project site. The distance of Project site from Port Qasim is 781 km. The proposed route to the Project site is given in the Figure 4.

Figure 4: Port Qasim Karachi to Project Site



TELECOMMUNICATION AT THE PROJECT SITE

PTCL telephone services are not available but mobile services are available on site.

AVAILABILITY OF SEMI-SKILLED AND SKILLED LABOR

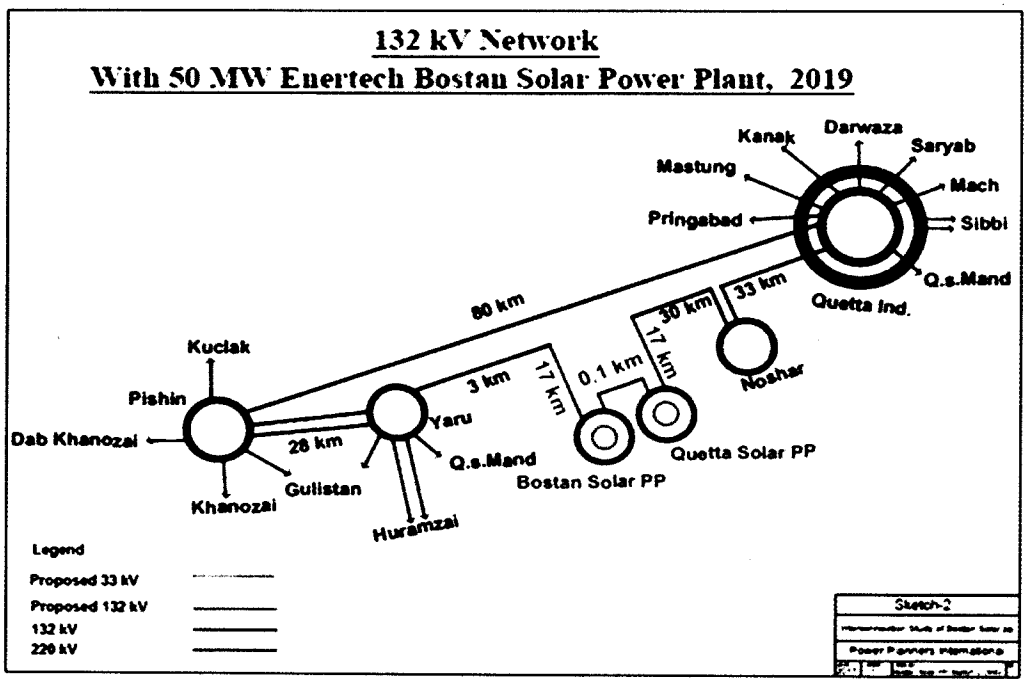
There is a dearth of solar project specific skilled labor in the area, however unskilled and semi-skilled labour is available in the area and the Project will be a meaningful source of employment for individuals.

PROJECT SITE SECURITY

The Applicant is quite cognizant of the fact that security situation in the Balochistan is far from ideal. Therefore, the Applicant has plans to use the infrastructure at Bostan Site in the most efficient manner to provide seamless security at offices, accommodations and the site. Furthermore, the Government of Balochistan will be providing a multi-tier security apparatus around the complex which will involve Police, Levies Force, and Frontier Constabulary.

GRID CONNECTIVITY

The Project would be connected by a of 132kV line connecting to the Yaru and Nohsar Gird Stations.



ANNUAL ENERGY PRODUCTION

Annual Energy Production of the project is 98.3 GWh. The table below show key details relating to power generation from the Project.

Year	*P50 Energy Exported to Grid*
0	
1	98,362
2	97,621
3	97,127
4	96,632
5	96,138
6	95,644
7	95,150
8	94,655
9	94,161
10	93,667
11	93,172
12	92,678
13	92,184
14	91,690
15	91,195
16	90,701
17	90,207
18	89,712
19	89,218
20	88,724
21	88,230
22	87,735
23	87,241
24	86,747
25	86,252

TECHNOLOGY OF PANELS

Canadian Solar is a global energy provider with successful business subsidiaries in 20 countries on 6 continents. Canadian Solar estimates it will manufacture 10.3 GW of solar panels, or about 10% of all solar panels worldwide, by the end of 2018. The Solar pane! selected for the project is Si-Poly Canadian Solar CS3U, 340 W. The details of panel are given in table below.

Specification	Data
Cell Type	Poly-crystalline, half 6 inch cells
Cell Arrangement	144 (24 × 6)
Dimensions	2000 × 992 × 40 mm (78.7 × 39.1 × 1.57 in)
Weight	22.6 kg (49.8 lbs)
Front Cover	3.2 mm tempered glass
Frame Material	Anodized aluminium alloy
J-Box	IP68, 3 diodes
Cable	4.0 mm^2 & 12 AWG ,1250 mm
Connector	T4 series or UTX or MC4 series
Per Pallet	27 pieces
Per container (40' HQ)	594 pieces

TECHNOLOGY OF INVERTERS

Huawei, a leading global ICT and network energy solutions provider, serves more than one-third of the world's population. Its solutions, products and services are used in over 170 countries. With over $45bn invested into R&D over the past decade, Huawei continues to innovate based on customer needs and are committed to enhancing customer experience and delivering maximum value.

Huawei manufactures power supply equipment for solar an d wind power projects. The company's products range from grid-connected inverters, wind power converters, and distributed power supply. Huawei brings the latest digital and internet technology into utility-scale PV power generation.
Their solutions make any PV power plant run more efficiently and through better intelligence. According to IHS Market Report 2017, Huawei was the world's largest inverter supplier. Huawei's strong presence in Pakistan also strengthens the case for their inverters as Huawei can directly provide the servicing and maintenance of the inverters locally. Huawei will supply SUN-90KTL inverters for the project.

-6 MPPTs for versatile adaptions to different layouts
-12 strings intelligent monitoring and fast trouble-shooting
-Power Line Communication (PLC) supported
-Smart I-V Curve Diagnosis supported

It is efficient with:
-Maximum efficiency of 99.0%
-CEC efficiency of 98.5%
-800V output voltage and decrease 75% AC wire loss versus 400V

It is safe with:
-DC AFCI compliant to UL 1699B Type I
-Type II surge arresters for both DC and AC
-Residual Current Monitoring Unit (RCMU) integrated inside

And it is reliable with:
-Natural cooling technology
-Fuse free design
-Protection rating of NEMA Type 4X

DEVELOPMENT IMPACT

The project will not cause any significant lasting and negative environmental or social impacts. The environmental disturbance normally associated with construction activities will be minimized through an EMP, implementation of which will continue during EPC and which includes monitoring arrangements.

As solar PV technology is a clean energy source with no significant impacts on the environment and no Green House Gas emissions after the construction phase, therefore, there will be no need for frequent environmental monitoring once the project is operational. If there will be any unanticipated major negative environmental impact noticed during operation of the project, possible mitigation measures will be taken to reduce the impact.

Sustainable and Cheap Energy:

- Lowest Tariff for new power projects in the country. Levelized cost of less than 6 cents per unit
- Sufficient local energy during day to improve quality of Grid and reduce shortfall
- Investment in Grid up-gradation to be financed by EnerTech
- Dependable Electricity to enhance economic growth

Employment Generation

- Project to employ local skilled and unskilled labour during construction and O&M
- Training of local technical graduates to run power projects
- Internships and training workshops to develop skills in renewable energy

Future Investments

- EnerTech to invest in another 400 MW of projects across Balochistan
- Investment in Solarization of Tubewells for Balochistan
- Encouragement for private investment in energy and industrial sectors
- In Future Balochistan can lead the production of Solar Equipment in Pakistan.

FEASIBILITY STUDY-
50 MWP SOLAR
POWER PLANT

EnerTech Bostan Solar Private Limited
Project company of

شركة انرتك القابضة
EnerTech Holding Company

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LIST OF ABBREVIATIONS

AEDB	Alternative Energy Development Board
COD	Commercial Operations Date
EE	Energy Efficiency
EHS	Environment Health and Safety
EPA	Environment Protection Agency
EMP	Environment Management Plan
ESMC	Environmental and Social Management Cell
EPA	Energy Purchase Agreement
EPC	Engineering Procurement and Construction
EMMP	Environment Monitoring and Management Plan
GCC	Gulf Cooperation Council
GHG	Greenhouse Gas Emissions
GIS	Geographical Information System
GoP	Government of Pakistan
GWh	Gigawatt hour
IA	Implementation Agreement
IEE	Initial Environmental Examination
IFC	International Finance Corporation
IPP	Independent Power Producer
KIA	Kuwait Investment Authority
Km	Kilometers
Kwh	Kilowatt hour

ACKNOWLEDGEMENTS

The management of EnerTech Bostan Solar Private Limited is thankful to the Government of Balochistan Energy Department, the National Energy and Power Regulator, the Alternative Energy Development Board and the Balochistan Power Development Board (BPDB) for their generous support at all stages of project development, and looks forward to their ongoing support for future milestones.

DISCLAIMER NOTICE

The information contained in the report is meant for Approval of Project from the Balochistan Power Development Board (BPDB) and as required, including, without limitation, persons or entities who are employees, consultants, lenders, contractors or sub-contractors, professional advisers or representatives of EnerTech Bostan Solar Limited. Subsequently, Power Planners Private Limited is not responsible for the contents of the report and any references therein, except to the desired purpose of the report. While we have made every attempt to ensure that the information contained in the report has been obtained from reliable and up-to-date sources.

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COMPANY CONTACT INFORMATION

Project Company	**EnerTech Bostan Solar (Private) Limited (EBSL)**
Project Sponsor	EnerTech Holding Company
Address / Telephone	712, Al Hafeez Business Centre, 89/B III, Gulberg, Lahore. +92.423.577.2778-9
Contact Person	Yasser Malik, Chief Executive Officer
Email	info@enertech.com.pk

CONSULTANTS CONTACT INFORMATION

Consultant Name	**Kinetic Renewable Energy Services DMCC**
Website	www.kineticres.com
Contact Person	Asif Ansari, Chairman
Email	asif.ansari@kineticres.com

1. EXECUTIVE SUMMARY

The Government of Pakistan has formulated a policy to standardize and encourage the participation of the private sector in the development and application of renewable energies. A Government organization, the Alternative Energy Development Board (AEDB), has been established to facilitate the implementation of renewable energy projects. Likewise, the provincial government is also addressing this objective within Balochistan, making significant efforts through the Department of Energy and the Balochistan Power Development Board (BPDB).

The Government of Balochistan Department of Energy has issued several Letters of Intent (LOIs) under the policy. The LOI to EnerTech Bostan Solar Private Limited (EBSL) for the development of a 50MW Solar PV Power Project was issued on 26th October, 2016. Land representing a suitable site for the project has been allocated on the Kuchlak-Zhob Highway (N50) in Bostan region of District Pishin, Balochistan.

This document is the complete Feasibility Study of the project including, but not limited to, Technical Feasibility having main components such as Soil Investigations, Transportation and Access, Solar Resource Assessment, Initial Environment Examination, Electrical and Grid Interconnection Studies.

The Project Company intends to apply for cost plus tariff announced by NEPRA under the Alternative and Renewable Energy Policy 2011.

The project will supply 95,081MWh of energy to the Quetta Electric Supply Company in its first year. This will be the first dedicated source of power generation for Balochistan after the Habibullah Coastal Power Plant which was established in 1999.

As the project uses a renewable source of energy (the Sun), it will displace 66,821 metric tons of Carbon every year. This is equivalent to the carbon sequestered by 63,253 acres of forests in one year or 7,518,920 gallons of petrol consumed.

The project will supply electricity to almost 20,000 homes in the regions of Quetta and Pishin. EBSL will also create employment opportunities for locals both during the construction phase and the operations phase of the power plant. **Figure 1** below is a brief of the system specifications:

SYSTEM DESCRIPTION	
AGGREGATE SYSTEM SIZE	50MW (DC)
MODULES	Canadian Solar (CS6U-330P) Poly-Si
No.	151,200
INVERTERS	GPTech S.L (1320WD3-HV650)
No.	30
PRODUCED ENERGY	95,081 MWh/Year
CAPACITY FACTOR	21.70%

THE SPONSOR

The 50MW EBSL project is sponsored by EnerTech Holding Company KSCC, a fully-owned subsidiary of National Technology Enterprises Company (NTEC), which in turn is a fully-owned subsidiary of Kuwait Investment Authority. EnerTech Holding Company is mandated to:

- Build platforms to facilitate the transfer of technology in energy, cleantech and water sectors, to develop technical skills of the country's populace and bring innovation in the use of technology.
- Initiate and take a lead management role in its own green field projects in energy, cleantech, water, environment and renewable energy, to develop the country's economy, create jobs, and strengthen and diversify the national GDP.
- Make strategic Investments in the Energy sector in jurisdictions with which the State of Kuwait enjoys brotherly relations.

STATE OF KUWAIT

الهيئة العامة للإستثمار
KUWAIT INVESTMENT AUTHORITY

Kuwait Investment Authority is an Autonomous Government Body and Sovereign Wealth Fund responsible for the management and administration of the General Reserve Fund (GRF), and the assets of the Future Generation Fund (FGF), as well as any other funds entrusted to it by the Minister of Finance for and on behalf of the State of Kuwait.

الشركة الوطنية لمشاريع التكنولوجيا
National Technology Enterprises Company

National Technology Enterprise Company was established by an act of the Kuwait council of ministers as a fully owned subsidiary of Kuwait Investment Authority (KIA). The company was formed to invest in technology sector to address its core mandate : technology and knowledge transfer

NTEC manages its mandate through five specialized wholly owned subsidiaries:

Global Innovation Company
Human Capital Development Solutions

IMPULSE
Funding Innovation

شركة الرتك القابضة
EnerTech Holding Company

NASCO
ADVISING FOR THE FUTURE

KLSC
الكويتية للعلوم الحياتية
Kuwait Life Sciences

EnerTech's leadership team is globally recognized in the fields of renewable energy technology and project development and finance. EnerTech's portfolio companies have been involved in the development of numerous pioneering solar technologies including Photovoltaic (PV), Concentrated Photovoltaic (CPV) and Concentrated Solar Power (CSP), PV trackers, as well as breakthrough energy storage technologies, and high-dispatch-ability and high-capacity factor solar solutions. In addition, our team has substantial experience working with a variety of solar panels including high efficiency CPV, mono-crystalline, poly-crystalline and thin film panels.

EBSL is focused on delivering customized solutions that minimize the levelized cost of energy (LCOE) and maximize project returns. The Company's CEO is Mr. Yasser Malik, who advises several renewable IPPs and has successfully raised financing for energy projects in Mexico, Pakistan and Africa. He has overseen renewables installations across the entire chain of execution from technical partnerships to fund raising. Before working in renewables, he was responsible for the Strategic Solutions Group covering Central Eastern Europe, the Middle East and Africa ("CEEMEA") at the Bank of America Merrill Lynch.

THE CONSULTANTS

Kinetic Renewable Energy Services DMCC (Kinetic RES) is a Dubai-based company that designs, develops, finances, constructs and operates renewable generation power plants. Kinetic-RES has a 1.5GW Renewable Energy project pipeline at various stages of development with many signed PPAs located in North America, Africa, South Asia and ME. It's poised to become a leading developer in the MENA and GCC regions by deploying innovative and state of the art technologies in the renewable energy realm, effectively shaving costs, improving efficiency of the solar plants and delivering projects in record time. Kinetic RES are the consultants for the Feasibility Study.

Power Planners Pvt. Ltd is the consultant of choice of EnerTech Bostan Solar Private Limited (EBSL) for conducting the Grid Interconnection study of its 50MW Solar Power Project in District Pishin, Balochistan. Power Planners provides consultancy services in the fields of Renewable Energy (RE), Energy Efficiency (EE) and Environment.

The consultant responsible for this assignment is very familiar with renewable energy power projects and has a panel of experts for developing feasibilities of RE-based power projects as per relevant government policies.

Geoservices Engineering Consultants has performed the geotechnical study and the Initial Environmental assessment for the project. Geoservices Engineering Consultants is an organization that offers wide ranging expert services in the field of geotechnical engineering.

The organization possesses the necessary expertise for undertaking diversified civil engineering projects, such as multi-storied buildings, harbours and airfields, railways, dams, bridges, roads and highway, industrial complexes etc. The services offered by Geotechnical Services include planning of geotechnical investigation, drilling, in-site testing, laboratory testing, foundation analysis and design etc. They have conducted studies for over 1GW of power plants, including renewable and conventional power.

2. PROJECT OVERVIEW

PROJECT SIZE

EnerTech Bostan Solar Pvt. Ltd (EQSL) is planning to construct and operate its 50MW solar PV generation station near Quetta, Balochistan. The installed capacity of the project shall be 50MW (DC).

The Project site is located approximately 35km from Quetta City on the Kuchlak-Zhob Highway. EQSL has been allotted 250 acres of land for this Project. The land is vacant with self-grown small shrubs and bushes. There is currently no agricultural activity or human settlement on the Project site.

PROJECT SUMMARY

The total Project Cost, expressed in US Dollars, has been calculated after thorough analysis, evaluation and understanding of the dynamics that affect the development and operation of a solar PV project. A planned Levelized Generation Tariff for the EnerTech Bostan Solar is proposed at US cents 6.0/kWh.

The EPC contractor is yet to be finalized, as under the NEPRA 'Guidelines for Selection of EPC Contractor 2017', the Feasibility Studies need to be approved before the firm bids can be submitted. A summary of the indicative Project Cost is given below:

PROJECT COST	USD ' million
Procurement and Supply of Equipment	37
Construction, Installation and commissioning	8
Project Design Services	0.3
EPC Costs	**45.3**
Project Development Costs	1.25
Insurance During Construction	0.3
Interest during Construction	1.0
Project Security	0.5
Financial Charges	1.5
Total Project Costs	**49.85**

SELECTION OF EPC CONTRACTOR

Under the NEPRA 'Selection of Engineering, Procurement and Construction Contractor Guidelines for Independent Power Producers' 17/05/2017; the shortlisted EPC contractors need to be given the approved Feasibility Studies for them to be able to provide a firm EPC bid. Therefore, EnerTech Bostan Solar cannot provide the final EPC figures and all financial numbers in this section are indicative numbers expressed.

Item	Status	Remarks
Request for Expressions of Interest	Completed	EOI received

RFP for Potential EPCs	Completed	RFP Shared with shortlisted EPC Contractors
Financial and Technical Bids	Pending	To be received from EPC Contractors after Feasibility Study approval from BPDB
Evaluation by Independent consultant	Pending	
EPC Contract Negotiation	Pending	
Finalization of EPC Contractor	Pending	

DETAILS OF PROJECT COST

The EPC Cost includes the cost of, One Hundred Fifty-One Thousand Two Hundred (151,200) PV Modules, thirty (30) PV inverters, trackers, electrical equipment, together with ancillary equipment and other goods, systems and machinery and includes the cost of, inter alia, the erection, testing, completion and commissioning of the equipment and construction of the facility that can fulfill the intended purpose.

The sponsors while ensuring state-of-the-art equipment that can withstand the harsh climatic conditions prevailing at the site also achieved an unprecedented low solar tariff. The efforts made in this regard are evident from the fact that the EPC cost, achieved by EnerTech Bostan Solar (Pvt.) Limited, is significantly lower compared to the EPC costs allowed in previous upfront solar determinations issued by NEPRA till date.

NON-EPC AND PROTECT DEVELOPMENT COST

The "Non-EPC Cost" includes the cost of items that are not part of the EPC Contractor's scope of work pursuant to the EPC Agreement while "Project Development Costs" include the costs incurred for Project development and all costs, fees and expenses incurred or to be incurred for such purpose.

This cost head include, inter alia, costs of feasibility studies, topographical survey of land, geotechnical investigation of land, electric grid interconnection studies; fees of consultants; costs related to the bank guarantee to be furnished to BPDB, costs related to the Purchaser letter of credit to be furnished to the Purchaser pursuant to the provisions of the EPA, various regulatory fees to be paid to NEPRA and other governmental agencies, costs incurred during EnerTech Bostan Solar (Pvt.) Limited's formation and capital enhancement; and costs relating to various permits for the Project, land cost, post financial close technical supervision, administration, audit, accounting and travelling (including boarding lodging) during construction.

This cost head also include staff accommodation (construction of the camping building(s) and permanent housing), certain sections of access road (for transportation of equipment) to the site, fencing around the site, site security and utility connection cost regarding the Project. However please note that the cost estimations provided herein assume that the Project Sponsors will be implementing two solar power projects of 50 MWp each and the resultant savings have been included in the cost estimates to offer the lowest possible tariff for Authority's approval.

SITE SECURITY

EnerTech Bostan Solar (Pvt.) Limited is also responsible for the security of its local and foreign personnel and the EPC contractors' staff. Due to the strategic nature of the project for the Government of Balochistan. EnerTech Bostan Solar is working with the Home Department of the Government of Balochistan to finalize the costs of a comprehensive security plan. The security plan envisages three-tier security for the project:

1. On-site private security
2. Levies Force
3. Frontier Corps/ Army.

PRE-COD INSURANCE COST

Pre-COD Insurance Cost covers the insurance cost of EnerTech Bostan Solar (Pvt.) Limited's assets during construction and the same are incurred prior to COD. These cost estimates have been developed based on the EnerTech Bostan Solar (Pvt.) Limited's determination to obtain Pre-COD insurance at relatively lower rates (0.60% of EPC cost) at the strength of its Sponsors.

EnerTech Bostan Solar (Pvt.) Limited, in view of the practices set by other IPPs in Pakistan and in accordance with the requirements set out by the lenders funding the Project, intends to procure the following insurances during the construction phase of the Project:

- Construction All Risk Insurances ("CAR");
- CAR Delay in Start-up Insurance;
- Terrorism Insurance;
- Marine and Inland Transit Insurance;
- Marine - Delay-In Startup Insurances; and
- Comprehensive General Liability.

FINANCIAL CHARGES

Financial Charges include the costs related to the debt financing of the Project. Such costs include, inter alia, the lenders' up-front fee, arrangement fee and commitment fee (including appraisal fee adjustable against front end fee).

These financial charges are in line with the prevailing market conditions and practices applicable for project financing transactions and as allowed by NEPRA in its other tariff determinations.

INTEREST DURING CONSTRUCTION

The Interest During Construction (the "IDC") has been calculated on a base rate equal to 3 months LIBOR plus a margin in the range of 450 basis points (USD financing), based on the indicative figures received from IFC/ World

bank. EnerTech Bostan Solar (Pvt.) Limited expects that financing will be available at LIBOR plus 450 basis points and has assumed this rate for the development of the Tariff Petition.

Actual IDC, however, shall be subject to change depending on the fluctuations in base rate (i.e. 3-month LIBOR), funding requirement (draw-downs) of the Project during the construction period, changes in Project Cost including changes due to Taxes and Duties, and variations in PKR / USD exchange rate.

Accordingly, if any such taxes become applicable then same are requested to be allowed at the tariff true-up stage.

Basis for IDC Calculations	3-Month
Assumed Base Rate	0.60%
Spread	4.50%
Total Interest Rate	5.10%

IDC, at this stage, is an estimated figure, which is adjustable at COD, based on actual LIBOR, timing and amount of loans drawn down during the Project construction period after financial close.

INFLOW OF FUNDS DURING OPERATING- PERIOD

Under the terms of the EPA to be executed between EnerTech Bostan Solar (Pvt.) Limited and the Purchaser, EnerTech Bostan Solar (Pvt.) Limited shall invoice the Purchaser for the settlement of the Monthly Energy Payment on or after the first day of the month following the month to which the Monthly Energy Payment relates. The Purchaser must make the payment of the same by the thirtieth day following the day of submission of the invoice i.e. thirtieth (30th) day.

The Project Company has assumed that there will be no impact of the following taxes on the Project cashflows (in-line with the terms of other IPPs in Pakistan):

- Sales Tax
- Customs Duty
- Special Excise Duty
- Advance Income Tax
- Federal Excise Duty

COMPARISON WITH NEPRA'S PREVIOUS UPFRONT TARIFFS

The Petitioner respectfully submits hereunder a comparison of proposed levelized tariff and Project costs with NEPRA's previous upfront tariffs.

		3			98.50749
4	98.01495				
5	97.52488				
6	97.03725				
7	96.55206				
8	96.0693				
9	95.58896				
	95.11101				
11	94.63546				
12	94.16228				
	13	93.69147			
	14	93.22301			

Above comparison indicates that the Project cost and EnerTech Bostan Solar (Pvt.) Limited's proposed levelized tariff is substantially lower than the previously allowed project costs and levelized tariffs.

PROJECT FUNDING STRUCTURE (DEBT & EQUITY)

The Project Cost will be funded based on a Debt to Equity ratio of 80 to 20. thereby resulting in the following capital structure for the Project:

	USD in '000
Debt Foreign (100%)	39,88
Equity	9,97
Total Project Cost	49,85

BRIEF ABOUT DEBT AND EQUITY FINANCING

The envisaged Debt to Equity structure of the Project is 80 to 20 implying a total debt requirement of USD 39.88 million (based on a project cost of USD 49.85 million).

The entire debt financing will be funded by International Finance Corporation and World Bank.

Debt amount will be denominated in USD (repayment in USD, interest payments to be indexed to LIBOR).

Based on the current Project cost estimates, the equity required to be injected by the Sponsor amounts to USD 9.97 million. The principal Sponsor, EnerTech Holding Company through their SPV EnerTech Bostan Solar (Pvt) Limited will subscribe for hundred percent (100%) of the equity requirement.

RETURN ON EQUITY

The Tariff Standards prescribed under Rule 17.3(ii) of the Tariff Rules require that the return on investment should be "commensurate with other investments of comparable risk',. In this regard it is submitted that:

NEPRA has allowed seventeen percent (17%) return to hydel projects where the hydrology risk and unforeseen soil conditions are both well mitigated under the Power Purchase Agreement and NEPRA's tariff guidelines which permit a "3 stage" tariff process permitting a reopening of the tariff parameters, whereas resource risk in solar power projects rests with the project companies/ sponsors.

Solar and wind energy projects were allowed IRR based ROE at seventeen percent (17%) in previous upfront tariff determinations by NEPRA. However, in a recent Determination for Wind Power Generation Projects dated 27th January 2017 and "Suo Moto Proceedings for Development of New tariff for Solar PV Power Projects", by NEPRA, a Return on Equity percent (16%) on Internal Rate of Return ("IRR") basis has been allowed to renewable energy Projects.

ROE REQUESTED BY ENERTECH BOSTAN SOLAR (PVT.) LIMITED

The Project Company is proposing the Reference Generation Tariff calculated at, *inter alia*, 15% ROE on IRR basis.

DEBT SERVICING

The capital structure of the Projects is envisaged at 80 to 20 (Debt to Equity). IFC/ World Bank will provide a hundred percent (100%) of the required debt. The door to door tenor of the loan agreed with the lenders is 15 years. The financing will be based on 3-month LIBOR plus assuming a margin of 4.5 percent (4.5%) adjustable on quarterly basis.

TERMS OF FINANCING

The following terms for financing the debt portion of the Project Cost have been agreed and locked, between EnerTech Bostan Solar (Pvt.) Limited and the lenders, through execution of the financing term sheets attached at Annexure G:

Cost Head	Terms
Total Project Value USD M	49.85
Total Value of Debt @ 75% of total project Value USD M	39.88
Assumed Base Rate	3-month LIBOR (0.6%)

Spread	4.50%
Repayment Period	14 years
Grace Period	Up to 12months
Re-Payment Schedule	Quarterly

OPERATIONS COSTS

Under the arrangement the O&M Contractor shall be responsible for provision or procurement and performance of all the works, services, supplies and other activities including management necessary to operate and maintain the Project to ensure energy production is maximized and that the Project is operated and maintained in accordance with the applicable performance standards, agreed environmental-social & monitoring plans and prudent operating practices.

The operations cost of EnerTech Bostan Solar (Pvt.) Limited comprises of the operations and maintenance cost and the cost of the operational insurances to be taken out by EQSL. EQSL estimate O&M cost of USD 13,000 per MW.

Based on the reasons discussed above, EnerTech Bostan Solar (Pvt.) Limited estimates that the cost of carrying out or out-sourcing the entire O&M function of the project is expected to remain same throughout the life of the Project except for the impact of debt financing related costs i.e. monitoring & trustee charges.

The Insurance Cost consists of the insurances required under the Implementation Agreement and the Energy Purchase Agreement coupled with those customarily required for project financing transactions, including all-risk insurance/reinsurance, business interruption insurance, and machinery break-down, natural calamities, sabotage and terrorism. As these risks are an impediment to the smooth and efficient running of the day-to-day affairs of the Project, it is critical that all risks associated with the Project are adequately addressed and all insurable events are catered for in a foolproof manner.

EnerTech Bostan Solar (Pvt.) Limited, in view of the practices set by the other IPPs in Pakistan and in accordance with the requirements set by the lenders, proposes to procure the following insurance during the operational phase of the Project:

- Property Damage and Comprehensive Machinery Insurance (including Business Interruption insurance);
- Third Party Liability;
- Terrorism insurance;
- Group Personal Accident Insurance; and
- Motor Comprehensive Insurance.

The insurance cost has been estimated at 0.25% of the EPC Cost.

PROJECT STATUS AND CALENDAR

Figure 2: Milestones achieved by the Project

Item	Status	Remarks
Site Acquisition	Complete	Land in Pishin, Balochistan

Solar Resource Assessment	Complete	Reliable reference Satellite Data is purchased from Solar GIS and is being used for solar resource assessment
Hiring of Consultants	Complete	
Site Selection and Access Studies	Complete	
Energy Yield Estimates	Complete	
Soil Investigations	Complete	
Electrical and Grid Interconnection Studies	Complete	Submitted to NTDC for approval
Initial Environmental Examination	Complete	NOC from Environment Protection Department Balochistan pending
EPC Selection	On-going	
Submission of Feasibility Study	Complete	
Tariff Determination	Pending	Project Company intends to opt Cost-plus tariff and will submit the application after approval of Technical Feasibility to BPDB, NEPRA.
EPA and IA	Pending	Stage not reached
Financial Close	Pending	Finalizing Terms and Conditions

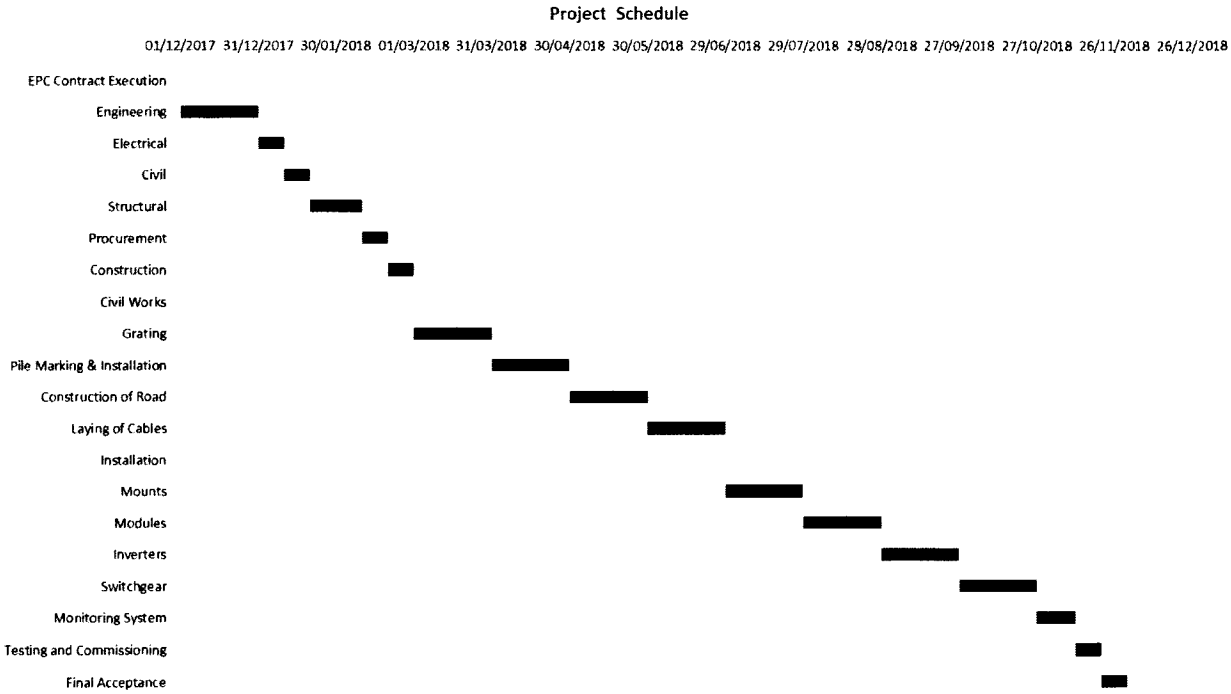
The complete feasibility study is being submitted to BPDB. From here onwards, the Project shall pursue approval of feasibility and all its parts from the stakeholders concerned. In parallel, the Project shall also pursue determination of tariff and signing of EPA/IA.

Figure 3: Project Planned Milestones

ACTIVITY/ MILESTONE	2016		2017				2018			
	3RD QTR	4TH QTR	1ST QTR	2ND QTR	3RD QTR	4TH QTR	1ST QTR	2ND QTR	3RD QTR	4TH QTR
Singing of MOU										
Issuance of LOI										
Hiring of Consultant										
IEE Submission Approval										
Submission of Feasibility Study										
Approval of Feasibility Study										
Approval of Grid Studies										
Tariff Determination										
Signing of EPA										
Signing of IA										
Financial Close										
Project Construction										
Project COD										

PROJECT CONSTRUCTION SCHEDULE

Figure 4: Project Construction Schedule:



PROJECT SITE

The site of the 50MW Solar Power Project is located on the Kuchlak-Zhob Highway (N50) in District Pishin, Balochistan. The Project site lies 35km from the provincial capital of Quetta. Total project area is 250 acres.

The details of the Site are given in **Section 5** of the Feasibility Study. The Transportation and Access Study is attached as **Annex II** of the Feasibility Study.

SELECTION OF EPC CONTRACTOR

EBSL is following NEPRA Guidelines for selection of EPC contractor to ensure competitiveness and transparency. The information on the EPC contractor selection process is given in **Section 6** of the Feasibility Study.

TECHNICAL SPECIFICATION OF THE EQUIPMENT

The technical specifications of the solar plant equipment are given in **Section 7.**

SOLAR RESOURCE ASSESSMENT AND ENERGY ESTIMATES

The information of solar resource assessment is given in **Section 8** of the Feasibility Study.

A complete report on solar resource assessment is attached as **Annexure III** of the Feasibility Study.

The energy production of the Project has been calculated using standard international practices. Simulations are carried out in PVsyst and it was observed that the Project energy generation numbers greater than the energy numbers as assumed by NEPRA in its Determination in the matter of Motion for Leave for Review against Solar PV Upfront Tariff dated 22-1-2015. The detailed methodology and losses considered by the consultant are described in **Section 8.**

GEOLOGICAL CONDITIONS

The information of geological conditions is given in **Section 9** of the Feasibility Study.

CIVIL ENGINEERING DESIGN

The information of civil engineering design is given in **Section 10** of the feasibility study.

A complete Geotechnical investigation report with Topographical description is attached as **Annex IV** of the Feasibility Study.

ELECTRICAL ENGINEERING DESIGN

The information of electrical engineering design is given in **Section 11** of the Feasibility Study.

A complete electrical and grid interconnection study is attached as **Annex VI** of the Feasibility Study.

MECHANICAL ENGINEERING DESIGN

The information of mechanical engineering design is given in **Section 12** of the Feasibility Study.

CONSTRUCTION MANAGEMENT

The information of construction management and schedules is given in **Section 13** of the Feasibility Study.

O&M MANAGEMENT

The information of O&M management is given in **Section 14** of the feasibility study.

ENVIRONMENTAL MANAGEMENT

The information of environmental management is given in **Section 15** of the feasibility study.

A complete Initial Environmental Examination (IEE) report is attached as **Annex V** of the feasibility study.

PROJECT FINANCIAL INFORMATION

The Project Company intends to apply for cost plus tariff to NEPRA covered by the 'National Power Policy 2013' and 'Alternative and Renewable Energy Policy 2011'.

The Project Company accepts and agrees with all the terms and conditions of the above as laid out by NEPRA and shall submit the application for the same soon after approval of the feasibility under the Balochistan Power Generation Policy 2007.

KEY PROJECT FIGURES

Figure 5: Key Project Figures

Item	Value	Remarks
Project Site	Pishin	Leased Land
Project Size	50 MW	
Annual Irradiance	2,100 kWh/m^2	Based on Satellite Data /Solar GIS
Plant Capacity Factor	21.71%	Expected generation numbers based on PVSyst.
Debt to Equity Ratio	80:20	
Debt Facility	International Lenders	
Debt Term	15 years	
Debt Repayment	Quarterly	

3. PROJECT TEAM

ENERTECH BOSTAN SOLAR (PVT.) LTD – PROJECT COMPANY

EnerTech Bostan Solar is a special purpose vehicle (SPV) wholly owned by EnerTech Holding Company KSCC. The purpose of the SPV is to serve as the project development company for the 50MW Solar IPP in Balochistan.

EnerTech Bostan Solar is a portfolio company of EnerTech Holding Company KSCC (EnerTech), a wholly-owned subsidiary of National Technology Enterprises Company (NTEC), which is itself a wholly-owned subsidiary of the Kuwait Investment Authority (KIA), and has offices in Dubai, the US, Kuwait, and Saudi Arabia. EnerTech has a mandate to channel major investment capital, both equity and debt, into renewable energy generation in the GCC from KIA, along with other institutional investors from the region including Saudi Arabia and Abu Dhabi. The primary focus of the platform is in the extended GCC region, as well as investments in the localization of manufacturing and services to serve this platform.

The EnerTech IPP Platform is looking to invest in the development of solar and other renewable energy projects as well as considerable expansion and smart grid upgrades of the transmission and distribution grids that will facilitate the integration of greater amounts of solar energy. EnerTech is building a global portfolio of differentiated return; risk-managed renewable generation projects that deliver long-term (25 year) stable income stream from the sale of electricity to utility companies for its investors. The company is active in a basket of renewable energy technologies including solar, wind, small hydro, biomass and waste-to-energy and associated infrastructure (including solar water desalination and management, energy efficiency, and transmission). EnerTech Holding Company is deeply committed to Pakistan and eager to invest in building up to 500MW of large-scale renewable energy power plants. In the process, it hopes to participate in the upgradation and expansion of the transmission system, incorporate smart grid technology features and establish clean-tech manufacturing to support these projects.

The company aims to further develop and commercialize existing technologies in the region as well as leverage its access to promising emerging energy technologies for investment. EnerTech is working with multilateral development banks, large global renewable energy investors, institutional and private investors as well as sovereign wealth funds. These investors share in the vision that is offered by the EnerTech platform and view the platform as a reliable conduit for capital investments in long-term high-return steady cash flows, as well as access to promising technology investing opportunities.

EXECUTIVE TEAM

Abdullah Al-Mutairi - Chairman

Abdullah Al-Mutairi is the Chairman of EBSL and the Chief Executive Officer of EnerTech Holding Company. EnerTech's venture capital and private equity investments focus on oil and gas (fossil and renewable generation, efficiency and storage), water (desalination, treatment, distribution and conservation), and clean technology (emissions monitoring and control, waste management and recycling and environmental remediation). Previously, Mr. Al-Mutairi served as a senior investment manager for NTEC and headed its energy, water and clean energy division. Prior to NTEC, he served as an investment analyst for the Kuwait Investment Authority. Mr. Al-Mutairi is a member of the Executive Committee and a founding member of the Kuwait Green Building Council (KGBC). He also serves in the Special Projects Committee at the Kuwait Investment Authority.

Yasser Malik – Chief Executive Officer

Yasser advises several renewable IPPs and has successfully raised financing for energy projects in Mexico, Pakistan and Africa. He has overseen renewables installations across the entire chain of execution from technical partnerships to fund raising. Before working in renewables, he was responsible for the Strategic Solutions Group covering Central Eastern Europe, the Middle East and Africa ("CEEMEA") at the Bank of America Merrill Lynch. He was involved in originating, structuring and co-investing in several landmark transactions including British Energy Right-Way Risk. Mr. Malik has also served as Director and Partner heading the Strategy Group at ePlanet Capital, one of the top Venture Capital firms in the world ranked by Forbes. During his time at ePlanet Capital he was instrumental in creating a strategic partnership with Kuwait Finance House and securing OPIC funding. Other work experiences include JP Morgan, PWC, Hewitt Bacon & Woodrow and KPMG based in London.

Usman Ahsan – Chief Operations Officer

Usman boasts a highly successful career in investment banking that has encompassed some of the pre-eminent transactions involving structured financing in Pakistan. As a part of Syndication and Debt Capital markets at Standard Chartered Bank, Mr. Ahsan actively coordinated and worked with the biggest business groups in Pakistan and was responsible for project financing exceeding US$500 million. Usman was responsible for some of the most innovative transactions in Pakistan, including structuring the first Sukuk issue, first syndicated term loan secured by credit card receivables and first private sector non-recourse transaction with no government offtake. His expertise is in project start-ups and executions, financial and investment management and sourcing funding for large scale green field projects. Prior, Mr. Ahsan was involved in the government sector advisory for the Government of Afghanistan to develop their policy on sale or lease of mining assets.

KINETIC RES DMCC – FEASIBILITY STUDY CONSULTANT

Kinetic Renewable Energy Services DMCC (Kinetic Renewables) is a Dubai-based company that designs, develops, finances, constructs and operates renewable generation power plants. Kinetic-RES has a 1.5GW Renewable Energy project pipeline at various stages of development with many signed PPAs located in North America, Africa, South Asia and ME. The company poised to become a leading developer in the MENA and GCC region by deploying innovative and state of the art technologies in the renewable energy realm, effectively shaving costs, improving efficiency of the solar plants and delivering projects in record time.

Kinetic RES is led by Mr. Asif Ansari, who has been a technical entrepreneur for over 20 years and is a lifelong proponent of solar energy. He has founded dozens of successful companies and led the development and commercialization of over 20 technical products in the cleantech and aerospace markets. As the former CEO of Los Angeles-based eSolar, Asif attracted financial backing from Google and led the design of a mass manufactured, modular, and scalable CSP power plant that singularly brought about a resurgence in concentrating solar thermal technologies. Prior to eSolar, he served as EVP in charge of R&D, Engineering and Manufacturing at Energy Innovations, where he led the development of a versatile Fresnel lens-based CPV system.

POWER PLANNERS INTERNATIONAL – ELECTRICAL & GRID STUDIES

PPI (www.powerplannersint.com) performed the electrical and grid interconnection studies of the project. PPI has the honour of undertaking electrical studies of all the renewable power projects in Pakistan. PPI has a team of highly skilled and experienced professionals having worked in WAPDA, Pakistan; and Saudi Electricity Company (SEC or SCECO) in Saudi Arabia in the fields of Power System Analysis, Transmission Planning, Load-Forecasting and Generation Planning. Their professional experience spreads over the whole range of operating voltages viz. 765kV, 500kV, 380kV, 220kV, 132kV, 110kV, 66kV and 33kV.
PPI possesses the technical skills to perform Load Flow, Optimal Power Flow, Short Circuit Analysis, Dynamic and Transient Stability Analysis for a grid system of any size.

The professionals of PPI possess thorough hands-on experience of the latest, state of the art tools of power system analysis including PSS/E of Siemens-PTI, PSCAD/EMTDC of EPRI and Manitoba HVDC Research Centre.

GEOSERVICES ENGINEERING CONSULTANTS – GEO-TECHNICAL INVESTIGATION

Geoservices Engineering Consultants has performed the geotechnical study for the project.

Geoservices Engineering Consultants is an organization that offers wide ranging expert services in the field of geotechnical engineering. The organization has been serving the profession since its inception in 1987.

The organization possesses the necessary expertise to undertake diversified civil engineering projects, such as multi storied buildings, harbours and airfields, railways, dams, bridges, roads and highway, industrial complexes etc. The services offered by the company include planning of geotechnical investigation, drilling, in-site testing, laboratory testing, foundation analysis and design etc. They have conducted studies for over 1GW of power plants, including renewable and conventional power.

4. COUNTRY AND INDUSTRY REVIEW

COUNTRY OVERVIEW

A detailed report on "Pakistan Country Profile and Global Solar PV Industry Status" has been prepared with updated information and statistics for the Pakistan Energy Market, the solar power potential in the country and the importance of harnessing solar energy potential to eradicate the current energy crises of Pakistan. The report also presents Global solar industry updates and statistics for reference. This section provides the summarized information of the "Pakistan Country Profile and Global Solar PV Industry Status" report attached as Annex I.

Pakistan is located on the western stretch of the South Asian Subcontinent with the Arabian Sea to the south, China to the north, India to the east, and Afghanistan and Iran to the west. It covers an area of 796,000km^2 and has a coastal line of 980km. Almost 3/5th of Pakistan's total area is mountains and hills, deserts spreading along the southern coastal areas, and plateau pastures and fertile agricultural land stretching north. The Indus River, which originates from China, traverses 2300km from north to south into the Arabian Sea.

Pakistan has a tropical climate. It is hot and dry in most of its areas, with relatively high average annual temperatures. The southern coastal areas have an average yearly temperature of 26°C. Most areas show temperatures higher than 40°C around noon during June and July. Some parts of Sindh and Balochistan even have temperatures as high as 50°C. The yearly precipitation in Pakistan is less than 250mm, with 1/4th of Pakistan having annual rainfall less than 120mm. Pakistan sees ample rains originating monsoon from the Indian Ocean, which brings both precious rain and abundant energy resources.

Area : 796,096 km Population : 207,715,847 (approximately)

Pakistan's energy requirements are met through Oil, Gas, Hydro Power and Nuclear Power. While Hydro and Nuclear are used only for electricity generation with reference to energy, Oil and Gas are used to supply other areas also. Although Pakistan has one of the largest coal reserves in the world, they remain under-utilized and their share in energy supply is insignificant at the moment.

During fiscal year 2015-16, oil supplies showed an increase of 9.7% while gas supplies decreased by 0.6%, but the overall primary commercial energy supply mix increased by 3.5% as compared to the previous year. The share of each source in primary energy supplies for 2015-2016 was oil: 34.4%, gas: 46.3%, LPG: 0.5%, coal: 5.4%, hydro-electricity: 11.4%, nuclear electricity: 1.8% and renewables: 0.1%.

The power sector in Pakistan is a mix of hydro and thermal units. There are four major power producers in the country, which include

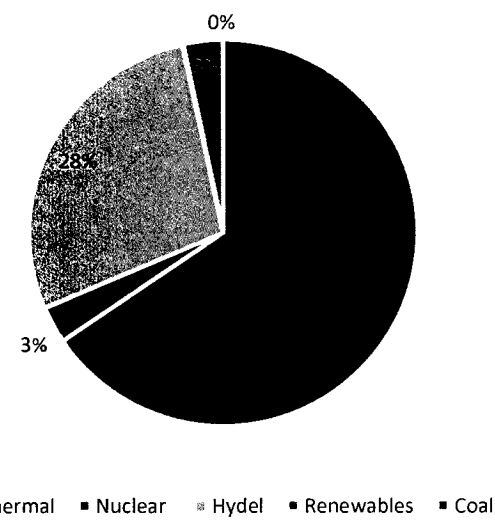
- WAPDA (Water and Power Development Authority) with 11,793MW installed capacity is the largest utility company in Pakistan and provides services to the entire country except Karachi.

- K-Electric with installed capacity of 2,216MW supplies Karachi with electricity.
- Pakistan Atomic Energy Commission (PAEC, www.paec.gov.pk) in assistance with China National Nuclear Company (CNNC) has constructed the Chashma Nuclear Power Plants I & 2 with a total generation capacity of 750MW.
- IPPs (Independent Power Producers) have an installed capacity of 9,071MW (http://www.ppib.gov.pk).

WAPDA and PAEC are government entities, while K-Electric and IPPs operate in the private sector.

During the calendar year 2015-16, the total installed capacities of Thermal, Hydel, Coal, Renewable, and Nuclear are shown in **Figure 6** below;

Installed Generation Capacity (2015-2016)



The total installed capacity of electricity generation as of 30th June during 2015-16 was 25,374MW in the form of thermal, hydro and nuclear power plants.

POWER CRISES AND THE NEED TO INVEST IN THE POWER SECTOR

There is a growing demand for energy in Pakistan because of the increase in population, enhancement in lifestyle, industrial and agricultural growth, and greater transportation needs.

Slow development in Pakistan's energy sector has become a major drain on the economy and is impeding growth, both because of power shortages (which have affected small manufacturing enterprises and services in particular) and because of the budgetary impacts of energy subsidies, which divert much-needed resources from more productive sectors.

The energy sector has become a focus of public policy in recent years and has garnered the attention of international financial institutions, including the IMF. Pressure for reform of the energy sector in general, and of the power generation, transmission and distribution regime in particular, has grown substantially. The government is obliged to carry out tariff adjustments, remove subsidies and ensure a level playing field for all private sector entities active in power generation, in addition to other policy and governance reforms.

Import of gas could be a viable option to overcome the depleting domestic reserves, but gas import has significant issues, mainly the need for substantial capital investment in infrastructure, security difficulties and physical terrain concerns. Moreover, it would increase Pakistan's reliance on imported fuels with associated foreign exchange effects. This must be considered in the context of rising fuel costs for gas and oil-based fuels because of uncertainty over future supply.

Alternatives to further fuel imports for electricity generation are the use of domestic coal, or generation from hydro-electric or other renewable sources, such as wind and solar power.

These options will assist in reducing Pakistan's reliance on imported oil, and consequent vulnerability to changes in global oil prices, which will in turn have a positive effect on the current trade deficit and inflating import bill. As with gas, securing future supplies of coal and hydro-electric power would rely on significant spending on infrastructure. Pakistan has domestic reserves of coal. However, coal currently makes up a very small proportion of total generation, largely the result of most of the reserves being located in one area, the Thar Desert. Exploiting the reserves would require huge and costly upfront investment in local infrastructure (including provision of water supplies), development of mines, housing and related infrastructure, and investment in transmission lines before power plant development could commence. Hydroelectric power already supplies almost 30% of electricity, and numerous sites for future investment exist, but due to their locations, this would also require significant investment in transmission to meet the expected power needs. Moreover, there are varying political stands on hydro-electric power options.

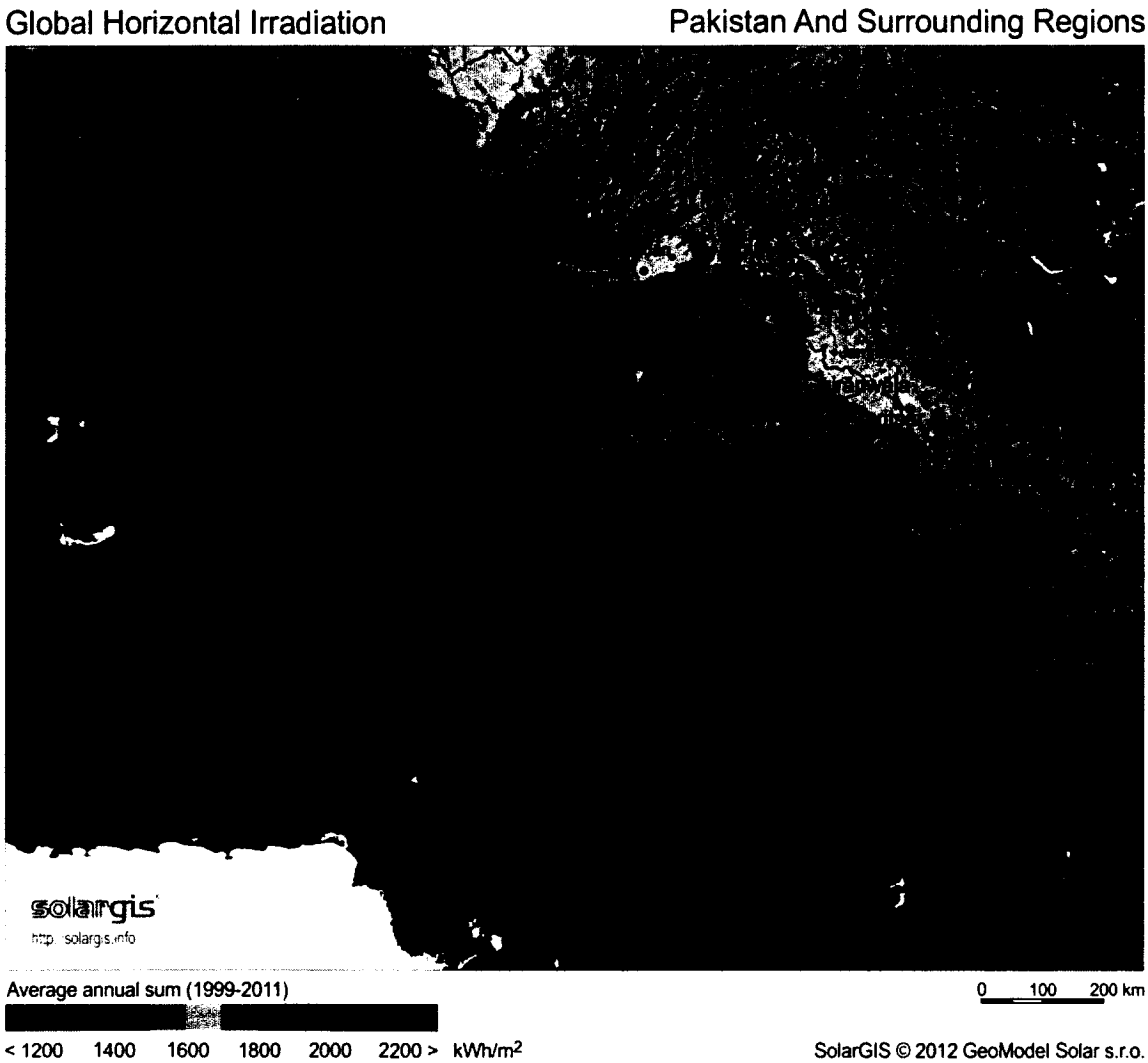
Looking at how the country's future electricity needs might be met in a way that supports the environmental objectives of the Government of Pakistan; solar power generation has the potential of being a strong contributor. The development of solar power generation projects could reduce dependence on fuels for thermal power generation, increase diversity in Pakistan's electricity generation mix, and reduce greenhouse gas (GHG) emissions avoiding thermal power generation.

Solar energy has excellent potential in areas of Pakistan that receive high levels of solar radiation throughout the year. Every year, the country receives an average of about 19 Mega Joules per square meter of solar energy.

Being in the Sun Belt, Pakistan is ideally located to take advantage of solar energy technologies. This energy source is widely distributed and abundantly available in the country. The mean global irradiation falling on horizontal surface is about 200-250 watts per m^2 in a day. This amounts to about 2,500-3,000 of sunshine hours and 1.9-2.3 MWh per m^2 in a year. It has an average daily global insolation of 19 to 20 MJ/m^2 per day with an annual mean sunshine duration of 8 to 8.5 hours (6-7 hours in winters and 10-12 hours in summers), and these values are among the highest in the world. For daily global radiation, up to $23MJ/m^2$, 24 (80%) consecutive days are available in this area for solar energy.

To summarize, the sun shines for 250-300 days per year in Pakistan with average sunshine hours of 8-10 per day. This means that there is tremendous potential for electricity generation by solar power plants in Pakistan.

A quick idea for the potential of solar energy in Pakistan can be obtained from the satellite map of solar radiation released by Solar GIS and World Bank, shown in **Figure 7 below.**



The Government of Pakistan (GoP) is taking measures to ensure energy security and sustainable development in the country. The Government, in its bid to diversify its energy mix, has been giving due attention towards the fast track development of Alternative/Renewable Energy (ARE) resources in the country.

Several supportive measures to promote ARE technologies and to attract private sector investments are being pursued, which include;

- Announcement of upfront tariffs for wind, solar, biomass projects. Upfront Tariff for small/mini hydel projects in process.
- Announcement of Framework for Power Co-generation (Biomass/Bagasse) 2013 for generation of power from sugar mills for supply to national grid.
- Detailed resource assessment of wind, solar and biomass in the country is being carried out through ESMAP (World Bank) assistance.
- Standardized project agreements (EPA/IA) for investors have been developed.
- Grid code has been amended for solar power projects.
- Ensuring availability of grid structure.
- Encouraging local manufacturing.
- Use of solar energy for power generation and water heating in domestic, commercial and industrial sectors is being promoted.

Thirty-one (31) wind power IPPs (1,810MW) holding LOIs issued by AEDB are at various stages of project development, out of which two wind power projects are operational, three are under construction and thirteen projects are in pipeline (680MW capacity).

In Solar energy, thirty-three LOIs for cumulative capacity of approximately 888MW on-grid solar PV power plants have been issued. These Projects are at various stages of development.

PROJECT OVERVIEW AND OBJECTIVES

The EBSL 50MW Solar PV Project is located 35Km from Quetta on the Kuchlak-Zhob Highway, in Bostan, District Pishin. The Project site is land allocated by the Government of Balochistan to EBSL with sparse vegetation and shrubs. The area is characterized by an extreme, harsh and arid climate. The site is considered as an ideal area for the development of a solar power project due to the highest annual irradiance in Pakistan.

The proposed project brings in multi-fold advantages. Not only does it produce clean, pollution free energy, it also has the capacity to provide employment to the people living around the area. As the project uses a renewable source of energy (the Sun), it will displace 66,821 metric tons of Carbon every year. This is equivalent to the carbon sequestered by 63,253 acres of forests in one year or 7,518,920 gallons of petrol consumed. The project will supply electricity to almost 20,000 homes in the regions of Quetta and Pishin. EBSL will also create employment opportunities for locals both during the construction phase and the operations phase of the power plant.

The project also helps the province of Balochistan develop an indigenous energy base and help minimise high transmission and distribution losses owning to long distance transmission of electricity (the last power plant to be built in Balochistan that focused on supplying electricity to the local population was the Habibullah Coastal Power Plant, which was built 18 years ago). The project will supply 95,081MWh of energy to the Quetta Electric Supply Company in its first year. It has the capacity of turning an area, which is vacant barren land, into a clean energy producing hub that will be replicated to install many solar projects in various areas in Balochistan.

EBSL PROJECT IN TERMS OF POLICY FRAMEWORK

The Project is being developed under the Policy for Development of Renewable Energy for Power Generation 2006.

The project has now reached the stage of submitting the Feasibility Study, within 12 months since the issuance of the LOI.

All prerequisites of submitting the feasibility study are completed.

The Project Company intends to apply for the cost-plus tariff and will submit the application for the same soon after submission of this Feasibility Study to BPDB for approval from the Panel of Experts.

Upon determination of tariff, the Project Company shall submit the Performance Guarantee (PG) and seek for issuance of Letter of Support (LOS).

Thereafter, the Project Company shall pursue signing of the EPA/IA and the financial close.

The planned Commercial Operations Date is December, 2018.

5. TECHNICAL FEASIBILITY

PROJECT LOCATION

The 50MW EBSL Project site is near Quetta on the Kuchlak-Zhob Highway (N50) in Bostan, Province of Balochistan, Pakistan.

The project site is 35km from the Provincial capital of Quetta. EBSL was allocated the land by the Government of Balochistan. The land is vacant with self-grown small shrubs and bushes. There is no agricultural activity or human settlement on the Project site.

The land is flat, has easy road access and clear legal title. There is no legal limitation at any portion on the land to set up a solar power plant. The irradiance levels as studied from satellite data are also the best in the country.

The Project site is easily accessible through a paved highway to within 50 meters of the Project site.

The detailed Transportation and Access Study is attached as **Annex II.** The location of the site can be viewed in **Figures 8, 9 and 10** below:


Pishin
Kanozai
EnerTech Quetta Solar
Bostan
Kuchlak
Chashma Achoza
Quetta

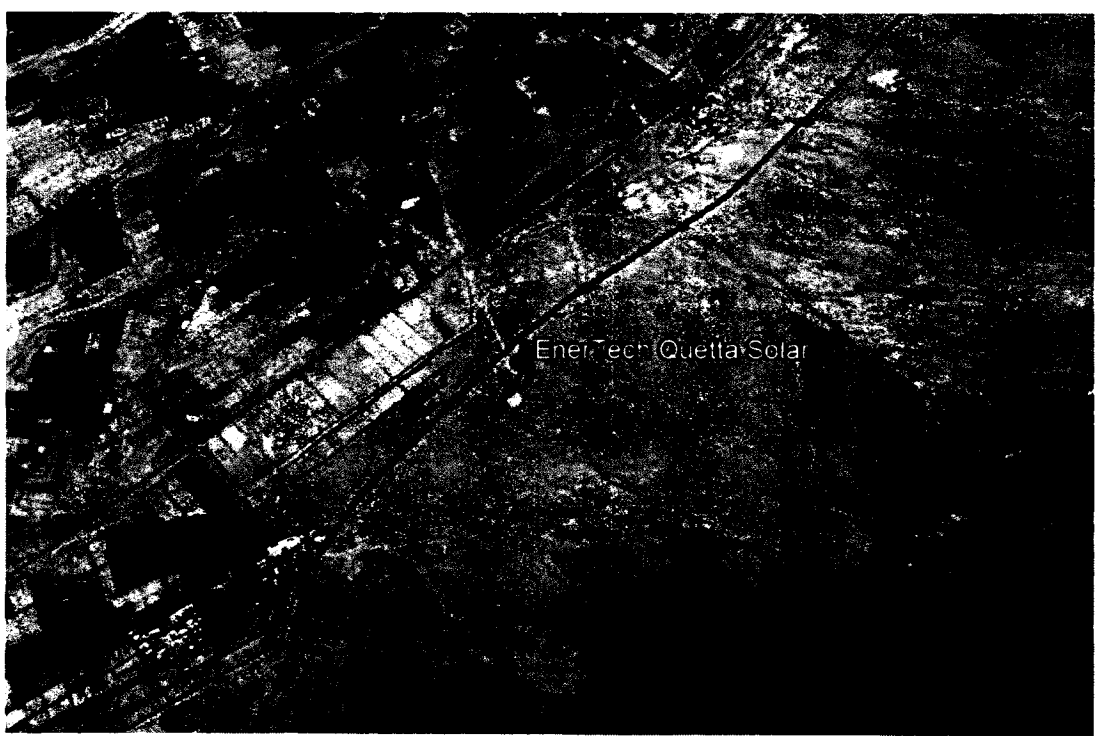
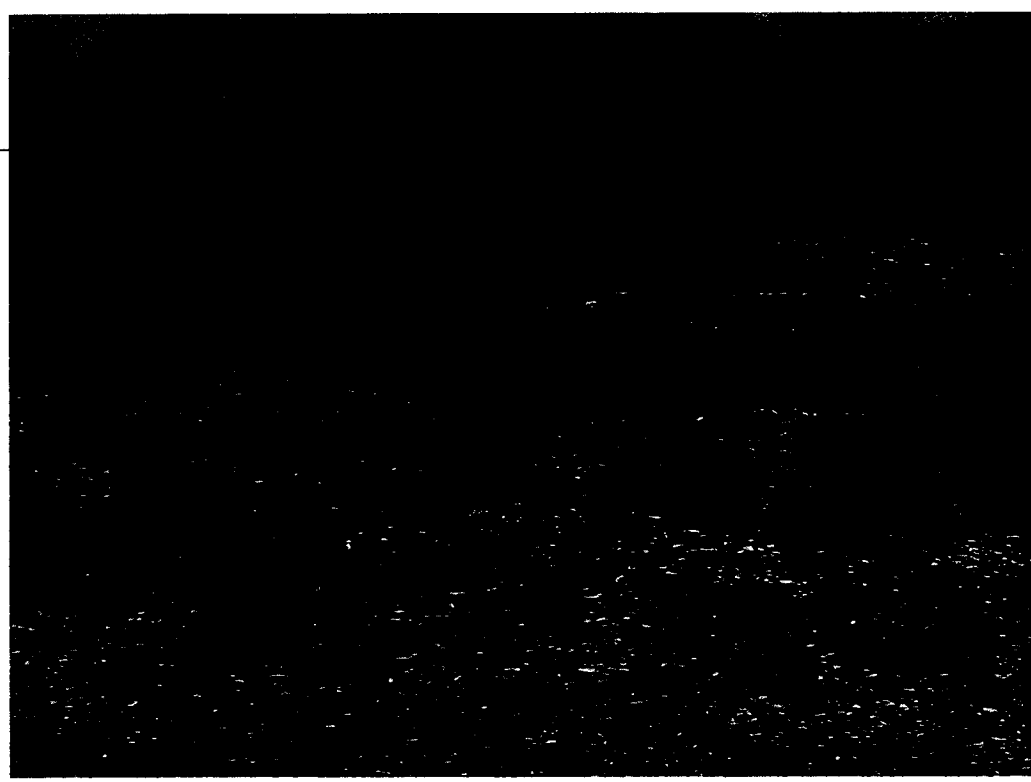
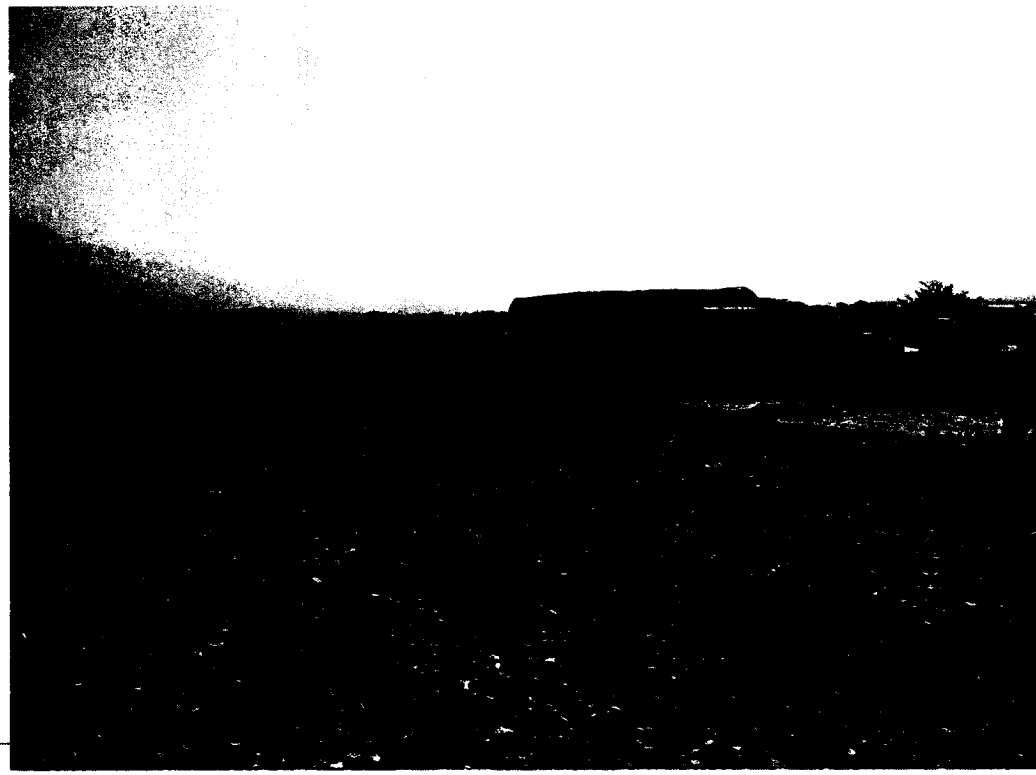

EnerTech Quetta Solar

Figure 11, GPS Coordinates marked for the Project Site:

Sr No.	Latitude	Longitude
1	30.468553	67.118524
2	30.460173	67.110318
3	30.454661	67.116144
4	30.461910	67.124735

The images in **Figures 12 and 13** below show the topography and condition of the Project Area:





TOPOGRAPHY

Bostan and its surrounding areas are mountainous. There are also small rock and gravel formations resembling hills along the boundary of the Suleiman Mountains.

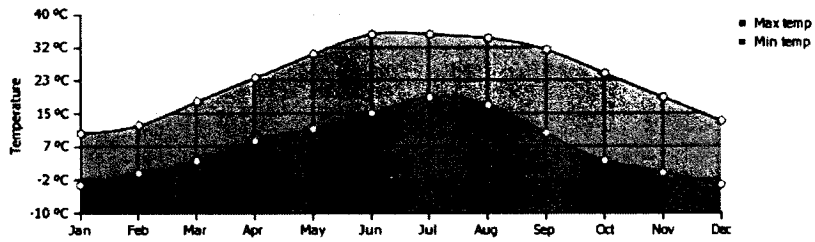
The site is bounded by Qila Abdullah to the north, Qila Saifullah to the east, Quetta and Ziarat to the south and Afghanistan to the west. The general character of the district is mountainous. The mountains are uniform, with long central ridges from which frequent spurs descend.

The soils are classified as either saline or saline sodic, with pH ranging from 8.2 to 8.4 and 8.8 to 9.6, respectively.

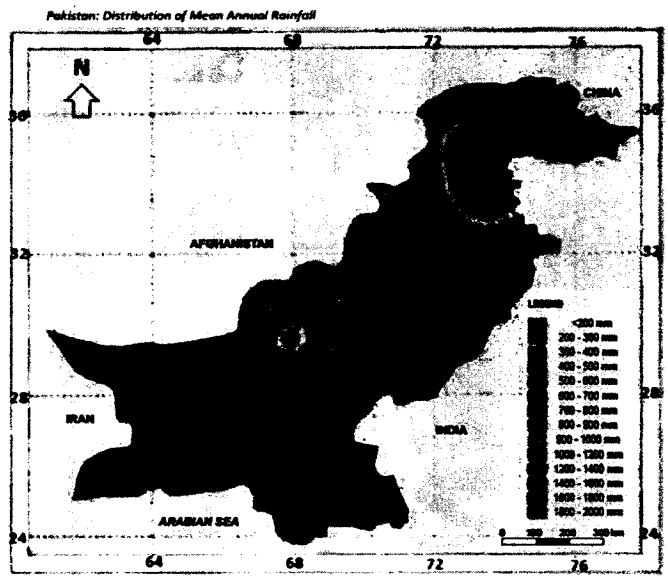
CLIMATOLOGY

Bostan is characterized by extreme environmental conditions with semi-arid climate due to the mountainous boundary on the eastern side. The region does see precipitation in winters due to the approaching western depression. The area is not sandy and the atmosphere is unpolluted and clear throughout the year, resulting in limited diffuse irradiance. Precipitation and rainfall are rare outside of the western depression season. The annual

average temperature is about 22.7°C. However, in summers, the temperature reaches up to 35°C and in winters drop down to -02°C. The annual average and extreme Temperature chart of Bostan is given in **Figure 14** below:



A detailed Temperature analysis has been carried out by getting data from PMD for a period of 10 years (2004-2014) and satellite data from Solar GIS (1999-2015). The analysis is given in Section-6 and Annex III of the Feasibility Report. The rainfall map of Pakistan is provided in **Figure 15** below:



The average monthly precipitation amount for Bostan is given in **Figure 16** below:

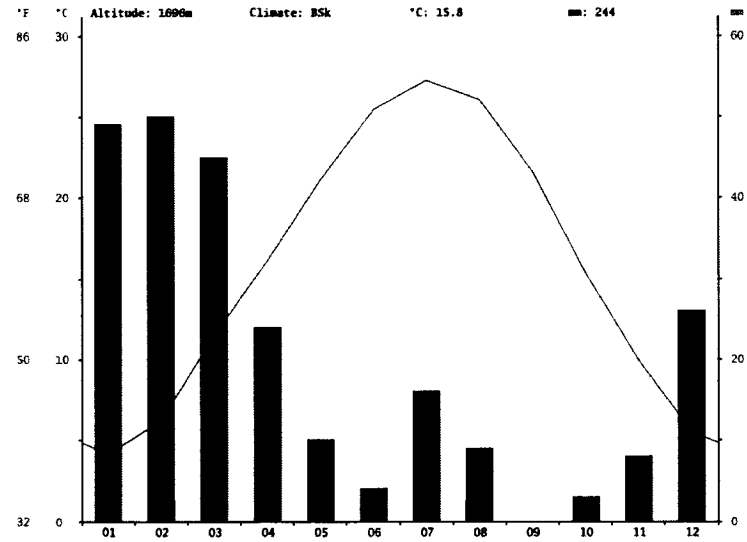
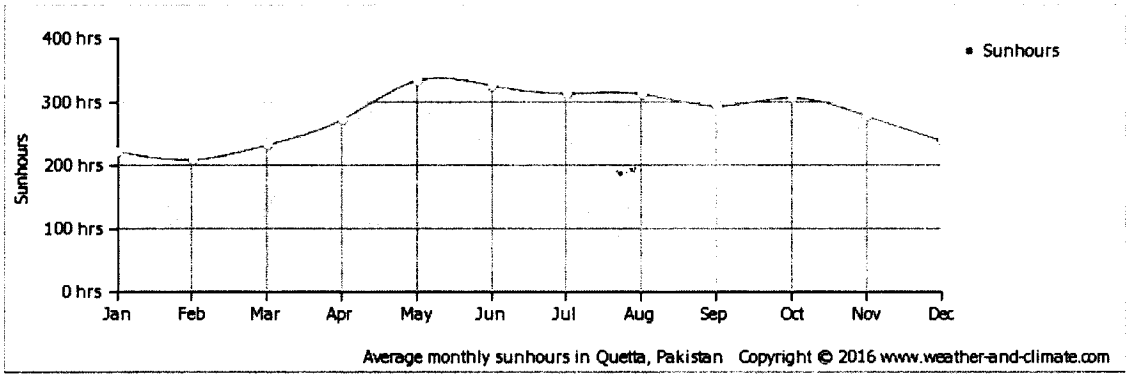


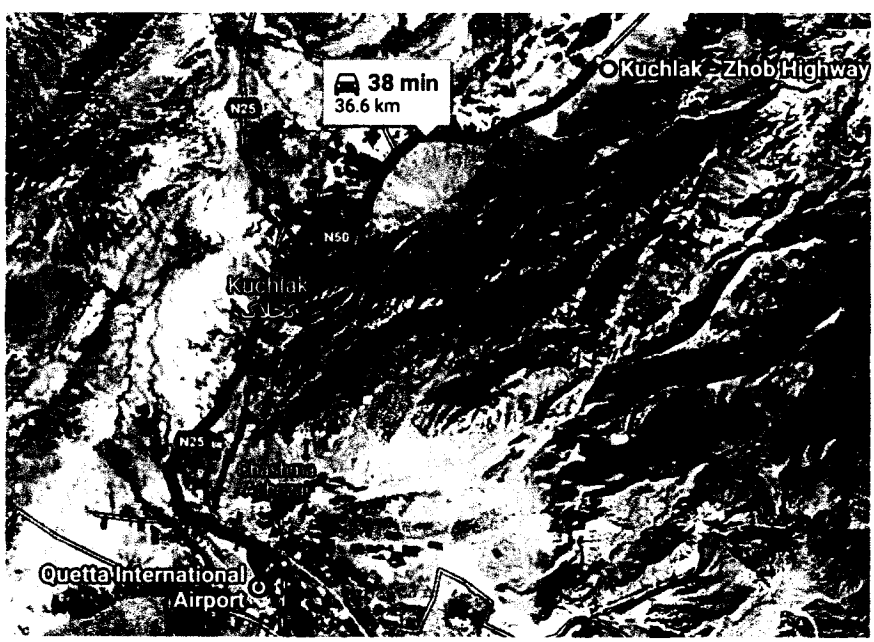
Figure 17: Average Temperature Map of Pakistan (Source NREL):

Monthly total sun hours in Quetta are given in **Figure 18** below; the region receives more than 10 hours of complete sunlight for 6 months of the year:

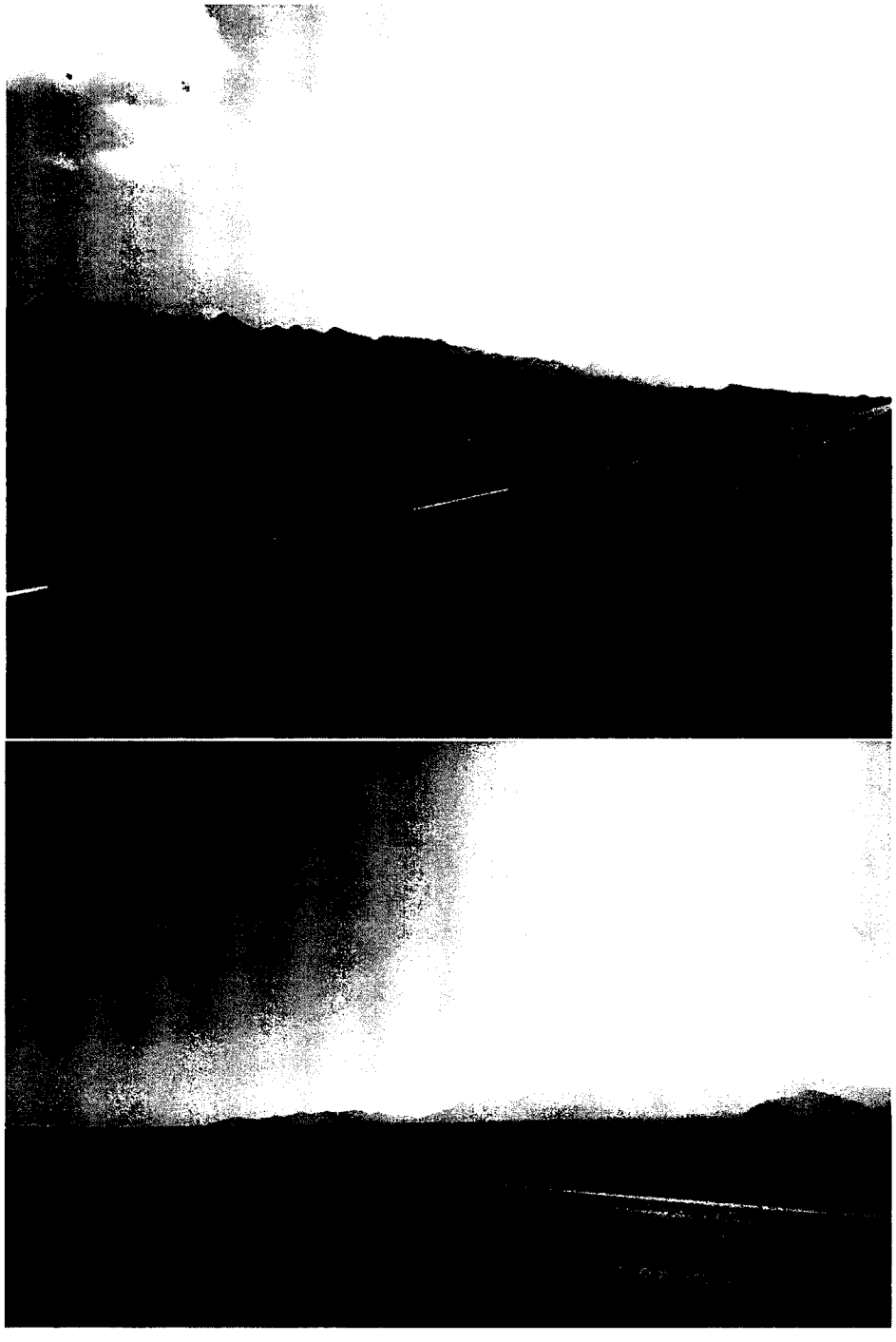


ROAD ACCESS

Quetta district is easily accessible from major cities of Pakistan by air, as Quetta Airport is located at around 3kms from the city center of Quetta. The Project site in Bostan region of Pishin is about 35km north of Quetta. The road from Quetta to the site is the Kuchlak-Zhob highway and is adequate for heavy vehicles and traffic. The view of the route from Quetta to the Project site via the Kuchlak-Zhob Highway is shown in **Figure 19** below. The road access to the project site is marked with a blue line from main city Quetta to the Project site. The detailed Transportation and Access Study is attached as **Annex II.**



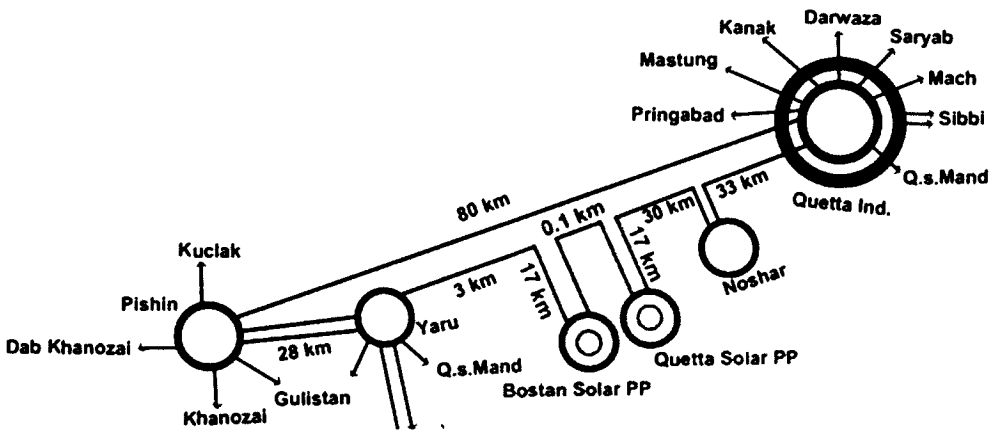
Road access from Quetta to the Project Site is shown in **Figures 20 and 21** below:



LOCATION OF GRID

The Project site is located approximately 17km from the 132kV Grid stations in Yaru and Nohsar belonging to the Quetta Electric Supply Company Limited (QESCO). The most feasible interconnection scheme for EnerTech Bostan Solar and Enertech Quetta Solar Power Plants is by looping in-out of the 132kV Single circuit from Yaru and Nohsar 132kV Grid Station. The looping distance is 17km, whereas the distance between substations of both plants is 0.1km. An Electrical and Grid Interconnection Study has been conducted for the Project, including Power Quality, Load Flow, Short Circuit and Power Evacuation and has been submitted to NTDC for approval. A copy of the Grid Interconnection Study is attached as Annex VI for reference. The view of the Grid interconnection is shown in **Figure 22** below:

132 kV Network
With 50 MW Enertech Bostan Solar Power Plant, 2019



PROJECT SCOPE AND CONFIGURATION

The 50MWp solar PV plant will be constructed and operated on the site. The solar pant will consist of up to 151,200 330Wp solar PV panels, 1,320kWac inverters (arranged in 10 blocks of three inverters each), transformers and associated control instruments and control equipment, and a control room on site. The electricity generated will be directly fed into the Yaru Grid Station of QESCO located less than 17km from the site.

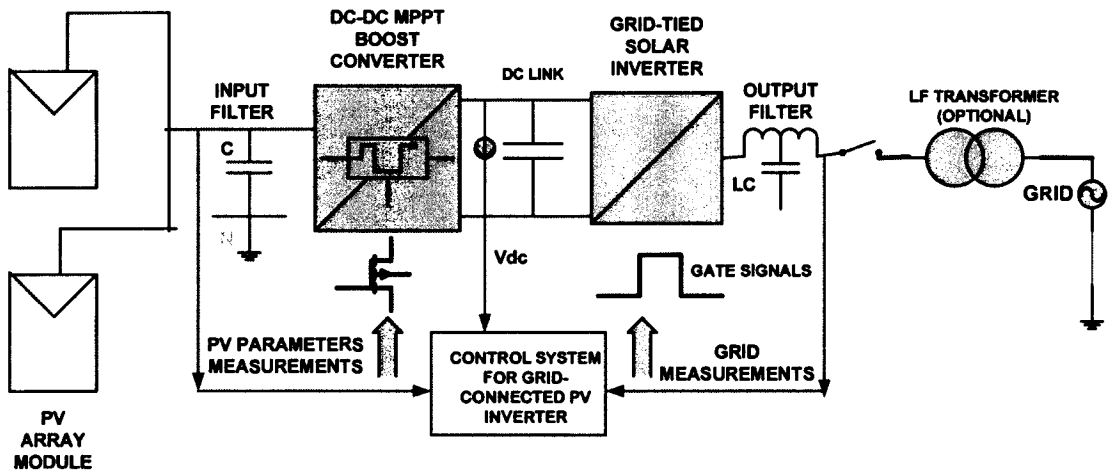
GENERAL WORKING OF PV TECHNOLOGY

Solar power is the conversion of sunlight into electricity, either directly using photovoltaics (PV), or indirectly using concentrated solar power (CSP).

Photovoltaics were initially solely used as a source of electricity for small and medium-sized applications, from the calculator powered by a single solar cell to remote homes powered by an off-grid rooftop PV system. As the cost of solar electricity has fallen, the number of grid-connected solar PV systems has grown into the millions, and utility-scale solar power stations with hundreds of megawatts are being built. Solar PV is rapidly becoming an inexpensive, low-carbon technology to harness renewable energy from the Sun.

The array of a photovoltaic power system, or PV system, produces direct current (DC) power, which fluctuates with the sunlight's intensity. For practical use this usually requires conversion to certain desired voltages or alternating current (AC), using inverters. Multiple solar cells are connected inside modules. Modules are wired together to form arrays, then tied to an inverter, which produces power at the desired voltage, and for AC, the desired frequency/phase.

A schematic view of a general grid connected system is shown in **Figure 23** below:



6. SELECTION OF EPC CONTRACTOR

EnerTech Bostan Solar Pvt. Ltd (EBSL) plans to appoint the main EPC contractor for the 50MW Solar power Project by following the 'Guidelines on Selection of Engineering, Procurement and Construction Contractor', notified by NEPRA on May 19, 2017. These guidelines are applicable to all Power Projects being implemented under the interim power procurement regulations 2005 and a cost-plus tariff that intend to award EPC contracts for the whole or part of the power project.

Following the Selection guidelines will ensure a competitive and transparent process to enable the best EPC price for the project that will enable the most competitive tariff to be offered.

EnerTech will initiate the tendering process with advertisements in multiple local and international media. Appropriate time and information will be provided to the potential bidders to prepare the bids and ensure there is no conflict of interest with the Project Company.

A detailed Request for Proposal (RFP) document will be prepared for the bidders and will include but not be limited to the following:

a) Background information
b) Scope of work
c) Technical specification
d) Prequalification criteria
e) Instruction to bidders
f) Timelines of deliverables
g) Conditions of the contract
h) Penalties and Incentives
i) Evaluation Criteria
j) Reference documents

The pre-qualification process will be run by an independent consultant and shall be based on:

a) Eligibility
b) History of non-performance
c) Litigation history
d) Professional competence of Staff and Equipment
e) Relevant exposure and experience
f) Financial capability

The Bids will include the Technical Proposal and the Financial Proposal. Both proposals will be evaluated separately. The Technical bid will be evaluated by the Independent consultant who will award points based on experience, equipment, staff, construction methodology etc. This will ensure that the technical bid is feasible, deliverable and robust. After the technical scoring, the financial bids will be opened, and the winning bid shall be the bid having the highest combined ranking which shall comprise 40% of the technical score and 60% of the financial score.

Thereafter, the Project company will engage in further price negotiations with the winning bidder.

EVALUATION OF TECHNICAL BID

Figure: 24: Evaluation of Technical Bid

CRITERIA	EVALUATION	SCORE
Contractor Experience	▪ Experience in executing similar projects ▪ Availability of required plant and equipment ▪ Qualified and experienced construction and management personnel	30
Design Experience and capability	▪ Proven design experience with projects of comparable size ▪ Applicable experience of key deign staff	10
Construction and Planning Methods	▪ Project Management plan in place ▪ Clear procedures and interfaces ▪ Technically proven technology ▪ Selection of construction equipment which is balanced, robust and appropriate for ground conditions ▪ RCC construction method ▪ Interfacing of civil works and equipment installations ▪ Comprehensive Project site infrastructure plan ▪ Contingency Planning	20
Electrical and Mechanical Equipment	▪ Plant layout and suitability of equipment ▪ Details of electrical and mechanical equipment ▪ Procurement, delivery and transportation plan ▪ Trainings and O&M Plan	15
Construction Schedule	▪ Realistic planning of facilities and sequencing of works ▪ Realistic scheduling consistent with proposed construction methods ▪ Identification of risks and allocation of float for risks ▪ Proposed means of mitigating delays in case of unforeseen events ▪ Capabilities for mitigation and management of risks to prevent delays and cost increases.	20
Health, Safety and Environment	▪ Corporate commitment to safety and safe working practices ▪ Site health and safety plan ▪ Understanding of key environmental risks	5

EVALUATION OF FINANCIAL BID

Figure 25: Evaluation of Financial Bid

CRITERIA	EVALUATION	SCORE
Bid Price	Lowest bid price will be awarded a score of 70, all other bids will be assigned points on a pro-rata basis.	70
Reasonableness of Pricing	The pricing structure will be reviewed. Points will be awarded on pricing consistent with the technical proposal	5
Financial Strength	Strong balance sheet and ability to provide adequate guarantees	10
Conditions of Contract/ Deliverables	Compliance to the conditions and deliverables specified in the RFP	15

Under the NEPRA 'Selection of Engineering, Procurement and Construction Contractor Guidelines for Independent Power Producers' 17/05/2017; the shortlisted EPC contractors need to be given the approved Feasibility Studies for them to be able to provide a firm EPC bid. Therefore, EnerTech Bostan Solar cannot provide the final EPC figures and all financial numbers in this feasibility are indicative numbers expressed.

Item	Status	Remarks
Request for Expressions of Interest	Completed	EOI received
RFP for Potential EPCs	Completed	RFP Shared with shortlisted EPC Contractors
Financial and Technical Bids	Pending	To be received from EPC Contractors after Feasibility Study approval from BPDB
Evaluation by Independent consultant	Pending	
EPC Contract Negotiation	Pending	
Finalization of EPC Contractor	Pending	

7. TECHNICAL SPECIFICATION OF EQUIPMENT

The proposed 50MW plant anticipates 151,200 solar modules. To streamline the design and construction process, the plant will be divided into up to 10 blocks of approximately 5MW (DC). The use of identical blocks will help reduce the time and cost associated with the construction of the entire project. Each block will have 3x1320kW inverters, and a total of 15,200 PV modules. The modules being used will be 330 Watts each. Each block will be stepped up to 11kV, and then the substation will step up the voltage further to 132kV at the point of evacuation. A 132kV switchyard will be constructed at the site as per utility and national grid code requirements.

The plant will be equipped with a complete monitoring setup needed to seamlessly run the plant for a period of at least 25 years. The monitoring and SCADA system will not only monitor the performance of the plant and gather weather data, but also be used to control inverter power and manage the switchgear in line with grid code requirements.

The general technical specification of the plant equipment is given below.

Figure 26: Technical Specifications of Plant

	PV Modules	
	Type of Module	Polycrystalline Silicon
	Type of Cell	Silicon Solar Cell
	Dimension of each Module	1968 mm x 992 mm x 5.8 mm
	Module Surface Area	1956 mm x 992 mm = 1.94 m^2
	Number of Panel/Modules	up to 151,200
	Total Module Area	up to 293,981 m^2
	Total Land Area Used	250 acres
	Panel's Frame	Aluminium Alloy
	Weight of one Module	27.5kg
	Module Output Warranty	30-year linear output
		0.5% max annual degradation
	Number of Solar Cells in each module	72 cells (6x12)
	Efficiency of module	16.90%
	Environment Protection System	Encapsulation and sealing
	Maximum Power (P_{max})	330 W

	Voltage (vmp)	37.2 V	
	Current <S> P_{max}	8.88 A	
	Open circuit voltage (V_{oc})	45.6 V	
	Short circuit current (I_{sc})	9.45 A	
	Maximum system open circuit voltage	1,000 VDC	
	Temperature coefficient of P_{max}	-0.41%/°C	
	Temperature coefficient of V_{oc}	-0.31%/°C	
	Temperature coefficient of I_{sc}	0.053%/°C	
PV Capacity			
	Total	up to 49,896 kWp	
Technical Specifications of Inverters			
	Capacity of each unit	1320 kVA	
	Inverter Model	1320WD3-HV650	
	Input Operating Voltage Range	936-1500 V	
	Number of Inverters	30	
	Total Power	up to 39,570 kW	
	Efficiency	98.6%	
	Max Allowable Input voltage	1,500 V	
	Max current	1700 A	
	Output electrical system	Nominal AC voltage 650 V	
	Rated Frequency	50 Hz/60 Hz	
	Power Factor	>0.99	
	Environmental Enclosures	Operating Temperature Range	-10°C to 60°C
		Relative Humidity	0-100%
		Audible Noise	<= 55 dB
		Operating Elevation	4,000 m
		Warranty Period	10 years

	Grid Operation Protection	Overvoltage protection
		Anti-Islanding protection
Junction Boxes Installed		
	Number of J/Box units	up to 624
	Input circuits in each box	15
	Max input current for each circuit	15 A
	Max input voltage	1,000 V
	Protection Level	IP65
	Overcurrent protection	Yes
	Output switch	Yes
	Surge protection	Yes
Data Collecting System		
	Weather Data	Pyranometer-Sets (Incline to record irradiation level) [Yes]
		Thermometer - Sets (to record ambient temp) [Yes]
	System Data	DC input voltage and current of each Inverter (Phase, Line) [Yes]
		Total DC power (kW) generated by PV array. [Yes]
		AC output voltage (V) and current (A) of each Inverter (Phase, Total) [Yes]
		Frequency (Hz) [Yes]
		Power Factor (PF) [Yes]
Isolating Transformer		
	Rating	1250 KVA
	Type of Transformer	11 kV Box-type transformer
	Input voltage	315 V
	Output voltage	11 kV
	Efficiency	~98.7%
Outdoor Cubicle Control Room		
	Data record	Continuous logging
	Control room system	Complete data acquisition system
	Control room system detail	Collecting data from all parts of the plant and displaying it to Operator stations

Mounting Structure		
	Structure	Array frames, built to last 25 years
	Tilt of Array Frame	30°
	Array Specification	Designed based on soil, wind, and seismic requirements
Foundation Pillars/Piling		
	Number of Foundations	up to 65,520
	Foundation Structure	Reinforced concrete pile or ground screws

8. SOLAR RESOURCE ASSESSMENT

The detailed report on Solar Resource Assessment is attached as Annex III. The solar irradiance data of ten years has been taken the following sources:

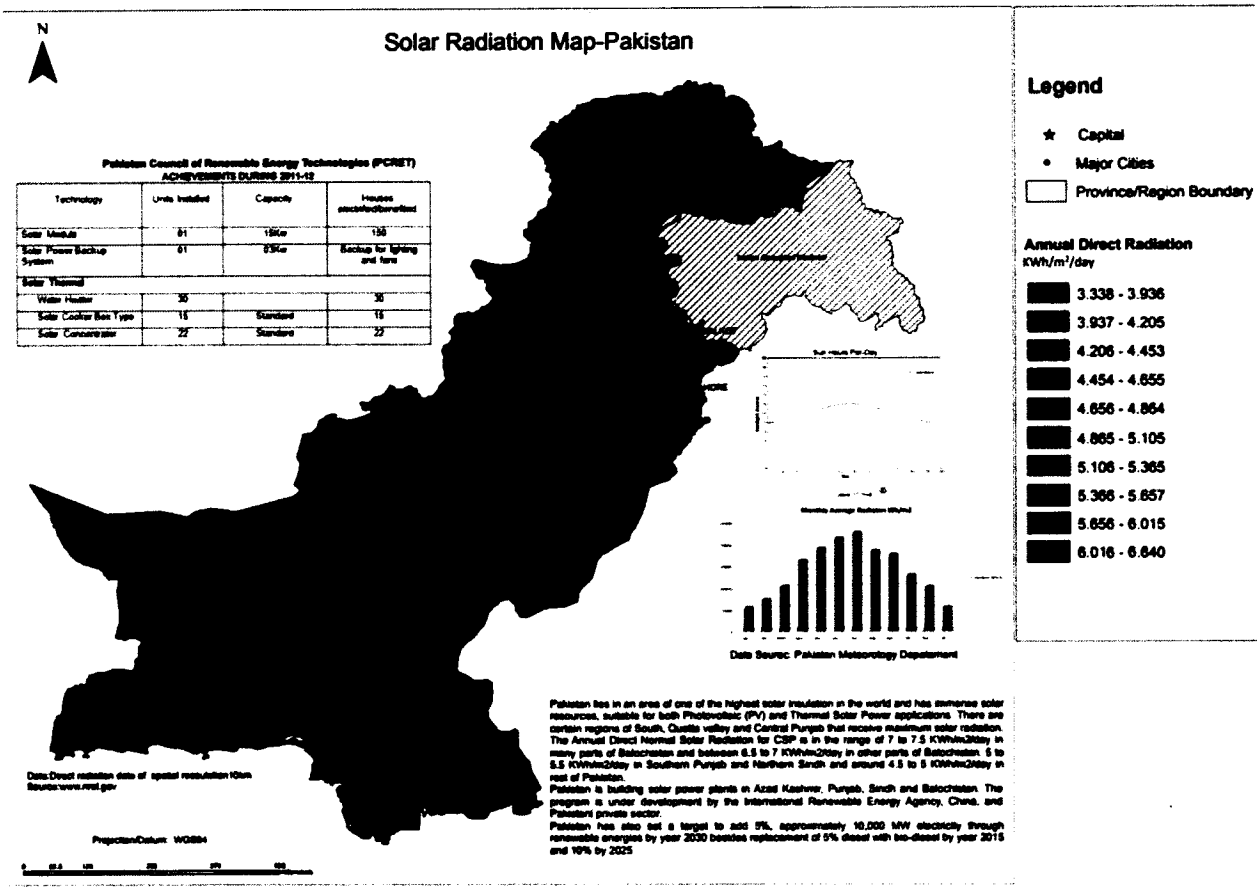
- NASA SSE
- Ten-year data from Meteonorm 7.1
- Solar GIS (January 1991 to July, 2016)

The above referred data sets are considered as the most reliable and accurate data sets with uncertainty of less than or equal to 10% in case of Meteonorm and less than 5% for Solar GIS. Therefore, different data sets are analyzed and compared to conduct a bankable solar resource Assessment for the Project.

As temperature is also the major critical component that can affect the energy production of a solar PV complex, temperature data from PMD has also been taken for the Period of Ten years (2005 to July 2016) to incorporate simulated temperatures at the Project Site into energy production estimates.

The meteorological analyses are carried out using PVsyst, the International Standard for sizing, simulation and data analysis of complete Grid Connected PV Projects.

The Global Horizontal Irradiance map of Pakistan is in **Figure 27** below (Source NREL):


Solar Radiation Map-Pakistan
N
Pakistan Council of Renewable Energy Technologies (PCRET)
ACHIEVEMENTS DURING 2011-12
Technology | Units Installed | Capacity | Houses electrified/benefited
Solar Module | 61 | 15Kw | 150
Solar Power Backup System | 61 | 07Kw | Backup for lighting and fans
Solar Thermal
Water Heater | 30 | | 30
Solar Cooker Box Type | 15 | Standard | 15
Solar Concentrator | 22 | Standard | 22
Legend
Capital
Major Cities
Province/Region Boundary
Annual Direct Radiation
kWh/m²/day
3.338 - 3.936
3.937 - 4.205
4.206 - 4.453
4.454 - 4.655
4.656 - 4.864
4.865 - 5.105
5.106 - 5.365
5.366 - 5.657
5.658 - 6.015
6.016 - 6.640
Data Source: Pakistan Meteorology Department
Pakistan lies in an area of one of the highest solar insolation in the world and has immense solar resources, suitable for both Photovoltaic (PV) and Thermal Solar Power applications. There are certain regions of South, Quetta valley and Central Punjab that receive maximum solar radiation. The Annual Direct Normal Solar Radiation for CSP is in the range of 7 to 7.5 KWh/m2/day in many parts of Balochistan and between 6.5 to 7 KWh/m2/day in other parts of Balochistan. 5 to 5.5 KWh/m2/day in Southern Punjab and Northern Sindh and around 4.5 to 5 KWh/m2/day in rest of Pakistan.
Pakistan is building solar power plants in Azad Kashmir, Punjab, Sindh and Balochistan. The program is under development by the International Renewable Energy Agency, China, and Pakistani private sector.
Pakistan has also set a target to add 5%, approximately 10,000 MW electricity through renewable energies by year 2030 besides replacement of 5% diesel with bio-diesel by year 2015 and 10% by 2025
Projection/Datum: WGS84

MONTHLY AVERAGE IRRADIANCE

The Global Irradiance data are from three different sources including NASA SSE, Meteonorm and Solar GIS was taken and analyzed in detail.

Based on evaluation of different data sets, including NASA, Meteonorm and Solar GIS, the solar global irradiance calculated from the solar GIS data sets can be considered as most reliable and bankable as the solar data of Solar GIS are quality-controlled, validated, integrated and cleaned from the possible gaps.

Uncertainty of the estimate of long-term yearly average of Global Horizontal Irradiation: comparison of SolarGIS calculation used in this report, to other two data sources as shown in **Figure 28** below:

Database	Data Source	Spatial Resolution	Data Period	Primary Time Resolution	GHI (kW/m²)
NASA	Satellite + model	110 km x 110 km	1983-2005	Monthly	1974
Meteonorm	Ground + Satellite	Interpolation	1991 -2010	Monthly	1957
SolarGIS	Satellite	250m	1999 -2015	hourly	2169

The Global Horizontal Irradiance on site as simulated using Solar GIS shows very good potential of solar resource as presented in **Figure 29** below.

Monthly Clearance Index and Annual Global Solar irradiance Solar GIS (1999-July, 2015)

MF2V_39.4_49.9_330x30_EP

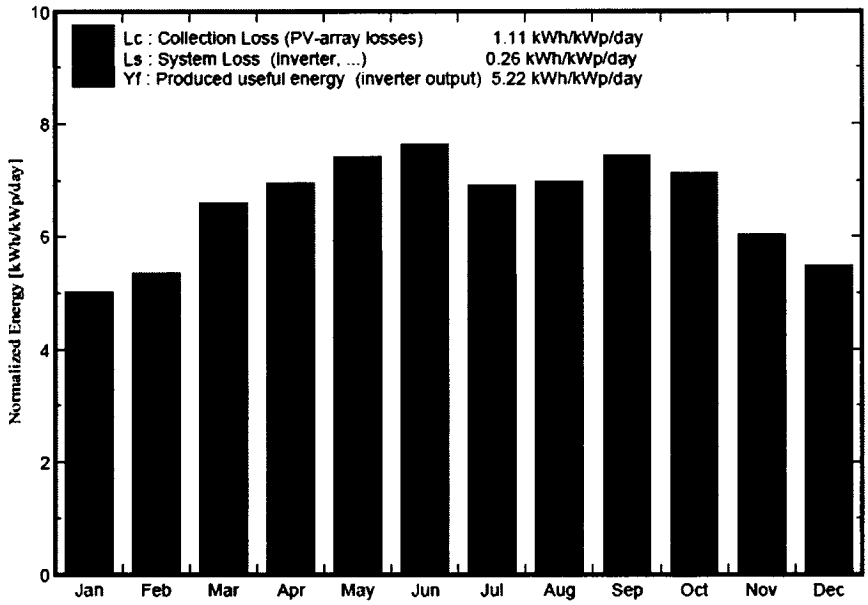
Balances and main results

	GlobHor kWh/m²	T Amb °C	GlobInc kWh/m²	GlobEff kWh/m²	EArray MWh	E_Grid MWh	EffArrR %	EffSysR %
January	111.0	4.40	156.0	144.5	6764	6427	14.74	14.01
February	119.0	6.70	149.4	138.6	6426	6113	14.63	13.91
March	180.0	11.80	204.4	190.1	8672	8266	14.43	13.76
April	203.0	17.40	208.3	192.8	8542	8148	13.95	13.31
May	241.0	21.80	230.0	213.0	9362	8928	13.84	13.20
June	247.0	24.30	229.2	212.1	9287	8859	13.78	13.15
July	227.0	25.30	213.9	196.6	8677	8274	13.80	13.16
August	217.0	24.00	216.3	199.8	8846	8442	13.91	13.28
September	204.0	19.80	223.2	207.9	9032	8614	13.76	13.13
October	178.0	14.50	221.1	207.2	9171	8742	14.11	13.45
November	129.0	9.80	181.1	168.4	7681	7313	14.43	13.74
December	113.0	6.40	170.2	156.6	7314	6957	14.61	13.90
Year	2169.0	15.53	2403.2	2227.7	99775	95081	14.12	13.46

Legends:			
GlobHor	Horizontal global irradiation	EArray	Effective energy at the output of the array
T Amb	Ambient Temperature	E_Grid	Energy injected into grid
GlobInc	Global incident in coll. plane	EffArrR	Effic. Eout array / rough area
GlobEff	Effective Global, corr. for IAM and shadings	EffSysR	Effic. Eout system / rough area

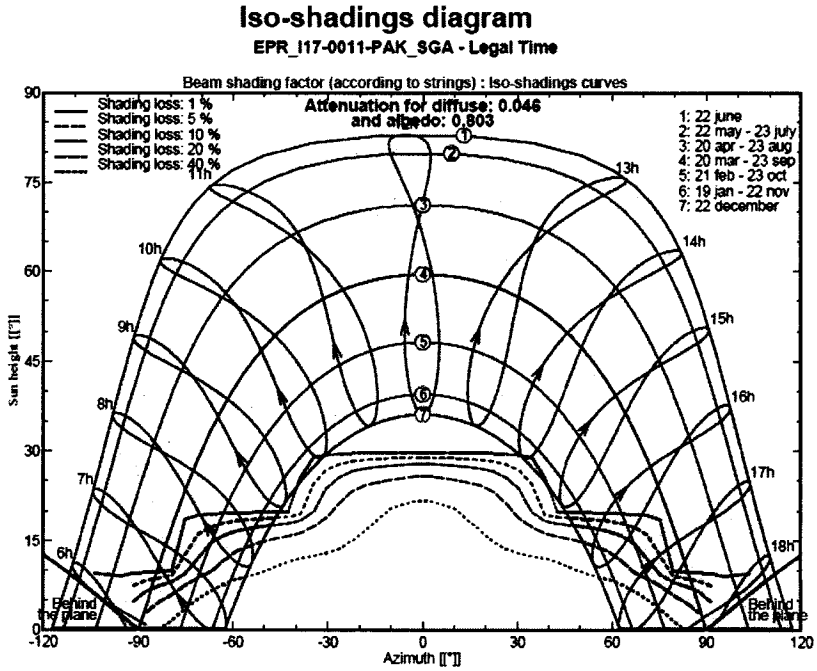
The clearance index of the Solar GIS dataset was high as compared to NASA Data and Meteonorm datasets. Solar GIS has been considered the most accurate data source because it has been validated at 200+ locations globally. According to several researchers, uncertainty (at P90 confidence interval) of SolarGIS annual estimate of Global Horizontal Irradiation is approx. ±5% in the Quetta region. Therefore, the results obtained from Solar GIS are only presented here in **Figure 30** for reference. The detailed Solar Resource Assessment Report is attached as Annex III.

Normalized productions (per installed kWp): Nominal power 49896 kWp



SUN ALTITUDE AND AZIMUTH ANGLE

The sun altitude and its path during various time spans of the day and during various days of the year are presented in **Figure 31** below.



South is designated as 0° the azimuth angle at noon, at horizon towards the east in morning is -90°, and +90°when the sun is at horizon towards west in the evening. As the sun moves across the sky throughout the day from the east in the morning to the west in the afternoon, it traces an arc across the southern half of the sky for observers in the Northern Hemisphere. For this reason, it is optimal to install south-facing fixed modules to obtain the maximum amount of direct light exposure throughout the day.

TEMPERATURE ANALYSIS

Temperature data is based on a dataset obtained from the Pakistan Metrological Department (PMD). The nearest ground measurement station of PMD is in Quetta, which is around 35km from the Project Site in Bostan.

The maximum and minimum temperature data from Year 1946 to Year 2015 was taken from PMD and analyzed.

Temperature trends for the past 70 years are presented in **Figure 32** below.

QUETTA (During 1946-2015)			
Month	Temperature (°C) Highest Maximum (dd/yyyy)	Lowest Minimum (dd/yyyy)	Monthly Heaviest Rainfall in mm
January	23.6 *(28/1987)*	-18.3 *(08/1970)*	178.0 *(1982)*
February	26.7 *(26/1953)*	-16.7 *(01/1970)*	189.2 *(1982)*
March	31.1 *(19/2010)*	-8.3 *(12/1973)*	232.4 *(1982)*
April	35.5 *(26/2015)*	-3.9 *(02/1965)*	158.7 *(1992)*
May	39.4 *(11/2000)*	-0.3 *(03/1989)*	39.9 *(1963)*
June	41.5 *(**/2005)**	5.0 *(01/1958)*	61.0 *(2007)*
July	42.0 *(10/1998)*	8.9 *(07/1955)*	163.6 *(1956)*
August	40.6 *(09/1970)*	3.3 *(23/1949)*	173.0 *(1983)*
September	38.3 *(01/1970)*	-0.6 *(30/1962)*	62.0 *(1994)*
October	34.0 *(01/1998)*	-8.3 *29/1949)*	68.8 *(1982)*
November	36.0 *(03/1998)*	-13.3 *(30/1962)*	72.0 *(2006)*
December	25.5 *(05/2015)*	-18.3 *(21/1950)*	162.0 *(1982)*
Annual	42.0 *(10/07/1998)*	-18.3 *(08/01/1970)*	949.8 *(1982)*

It was observed from analysis that maximum annual average temperature in the area was 32.98°C in the past ten years. However, from the analysis of daily maximum values, the maximum temperature recorded in the area during the past 70 years was 42°C.

ANNUAL ENERGY PRODUCTION

The Energy production of the Project is calculated through simulation in PVsyst utilizing the specifications of our chosen equipment. Various simulations were carried out using the hourly dataset of Solar GIS and Monthly Datasets of Meteonorm. The finding of the energy Yield Estimations are close to the Annual Energy production numbers as assumed by NEPRA vide its Determination of the Authority in the matter of Motion for Leave for

Review against Solar PV Upfront Tariff dated 22-1-2015. Therefore, the Project Company accepts the production numbers as considered by NEPRA of south region projects.

The Energy Production of the plant is calculated based on standard international practices. A description of the losses mechanism of the PV system is presented in this section. The described losses outline the significant, non-negligible losses that could pose risks if the plant is not designed properly:

Albedo

Albedo is the relation of energy falling on a body and the energy reflected by its surface to the PV array. It describes the reflectivity of the local environment. An average albedo value of 0.2 is regularly assumed for grassland/flat areas; 0.2 also represents the default setting of PVsyst. An albedo value for urban situation varies from 0.14-0.22 whereas for the grassland area varies from 0.15-0.25. We utilized the PVsyst default assumption for the presented yield estimation for the Project.

Soiling

The soiling factor is a measure of the dimming effect on module due to dust or other precipitation on the module surface. As the site is prone to dust due to proximity to dry mountains, the soiling factor is therefore assumed at 3.0% over the year and is utilized here to describe the soiling effect for the site conditions in Bostan.

Horizon

The horizon analysis measures the effect on reduction of global solar irradiation at the site due to far shading effect. Based on the site location, it is assumed that there are no far shading objects, hence, the losses due to horizon effect is assumed to be 0.5%.

Near Shading

Near shading are partial shadings that affect only a part of the PV field. This partial shading could be because of closer row-to-row alignment, surface geometry, external shading objects such as trees, buildings, poles etc.

In the case of the EnerTech project site, since the site is flat, large enough to accommodate adequate row spacing, and has no baseline slopes in any direction, the near shading effect is assumed as zero.

Component and Design-related Losses

The following table shortly describes other design and equipment related losses that are being considered.

SYSTEM PART	DESCRIPTION
Losses due to Environment	
IAM factor	The incidence effect (IAM-Incidence Angle Modifier) corresponds to the weakening of the irradiation reaching the PV cell's surface, with respect to irradiation under normal incidence.
Losses due to module characteristics	
Loss due to irradiance level	Deviation of actual irradiation to STC irradiation, i.e. changes of the model efficiency with changing irradiance
Loss due to temperature	Thermal behaviour of the field - which strongly influences the electrical performances - is determined by a thermal balance between ambient temperature and cell's heating up due to incident irradiation
Mismatching losses at MPP	Losses due to "mismatch" are related to the fact that the real modules in the array do not rigorously have identical I/V characteristics
Module Quality Loss	Deviation of the average effective modules power by respect to manufacturer specifications
Losses due to cabling	
DC cabling losses at STC AC cabling losses	**Cabling losses from module inverter Cabling losses from inverter -> metering point**
Losses due to electricity conversion	
Inverter losses	Inverter losses during the DC to AC conversion
Transformer losses	Losses due to the LV/MV transformer

The Consultant assumed the following losses percentage during energy simulations;

Losses Percentage Consideration

Figure 33, Loss Percentage Consideration:

Horizon	**0.5%**
Near Shading	**-2.0%**
IAM factor on global	**-2.9%**
Soiling Losses	**-3.0%**
Losses due to irradiance level	**-0.3%**
Losses due to Temperature	**-5.9%**
Mismatching Losses at MPP	**-1.0%**
Module Quality Loss	**0.4%**
AC cabling loss at STC	**-1.1%**
Inverter Losses	**-1.5%**
Transformer Losses	**-1.2%**
Technical Availability	**99%**

MICROSITING OF SOLAR ARRAYS

The final micrositing shall be selected by the engineering teams of EBSL and the EPC contractor in consultation with the lender's consulting engineer. For the calculations, the micrositing was developed considering the following criteria:

- No shading should be observed on any solar panel at any time during any month of year.
- Siting layout should have good aesthetics.
- Layout should support facing arrays towards the equator for the maximum solar irradiance.
- Layout should have symmetry.
- All arrays should be easily accessible.
- Movement of trucks should be possible for easy transportation of materials within the plant.
- Boundaries of the plant should be secured.
- There should be adequate fencing around the plant for security purposes.
- Restricted areas must be taken into consideration before siting.
- Wiring requirement should be minimized through efficient layout techniques.

Layout should support using a simplified electrical layout to the maximum extent. Micrositing is assumed to be general consideration that is subject to change at the final design stage.

9. GEOLOGICAL CONDITIONS

In order to collect detailed regional geological information, the Project Company hired professional services of Geoservices Engineering Consultants to conduct field exploration, including the drilling of multiple bore holes at the Site. The average drilling depth is 6 feet.

The scope of work was to drill the boreholes, undertake field tests, collect samples, perform laboratory tests and compile results along with pertinent recommendations.

The objective was to identify soil conditions and develop recommendations for the detailed designing of civil works for the Project.

The following tests were performed in the laboratory on representative soil samples:

- Grain size analysis
- Atterberg limits
- Moisture content
- Unconfined compression
- Bulk density
- Sulphate content

It is recommended in the study that the building structures be supported on strip footings placed at a 3ft depth below the existing ground level. The solar panels will be supported on ground anchors.

The allowable bearing capacity of ground anchors having nominal length of 1,400mm shall be adopted as about 9.5kN.

Sulphate content in subsoil has been found to be negligible. It is, therefore, recommended that ordinary Portland cement be used in the foundation concrete.

The complete Geotechnical Investigation Report of the Project Site is attached as Annex IV.

10. CIVIL ENGINEERING DESIGN

The civil engineering design mainly includes following structures:

- Foundation of Solar Arrays
- Foundation of substation and grid interconnection apparatus, i.e. transformer, switchgear.
- Civil Works for construction of office building at site.
- Site Drainage
- Roads
- Security wall

The civil works are included in the scope of the EPC contract. The detailed design activity of the civil works shall be carried out by the EPC contractor prior to start of construction. This sequence is in accordance with international and Pakistani power sector best practices.

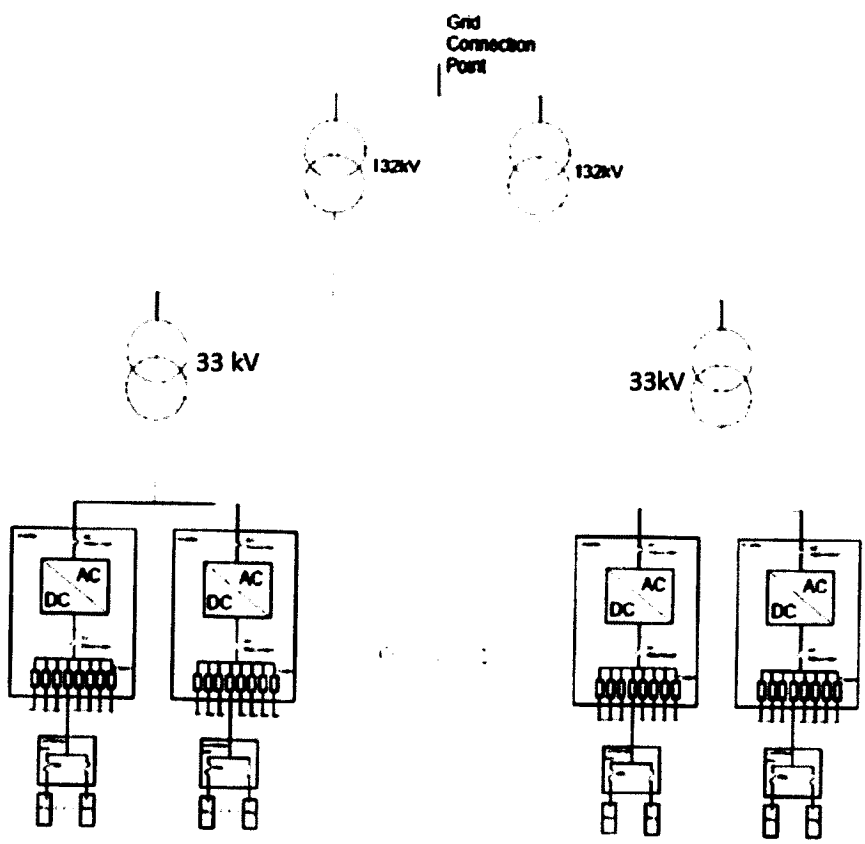
11. ELECTRICAL ENGINEERING DESIGN

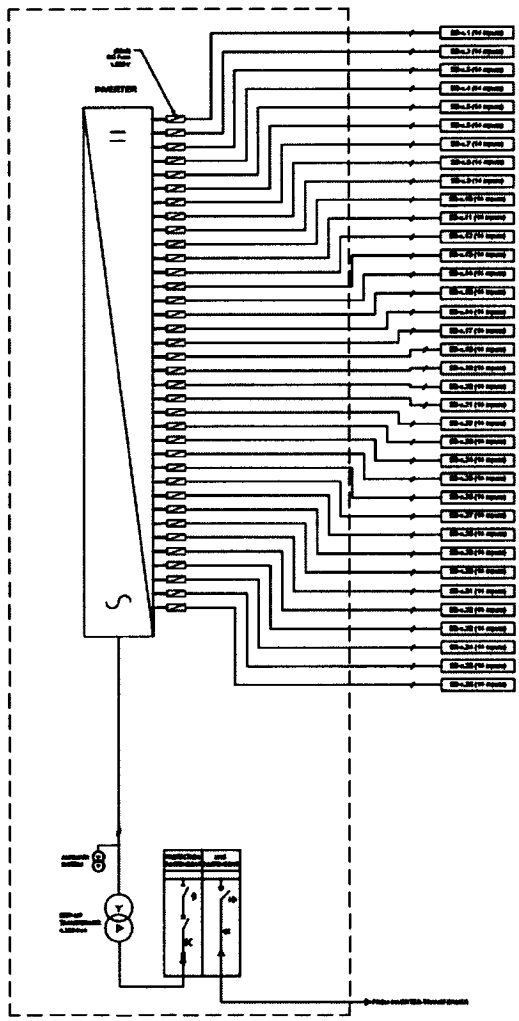
The detailed report on Electrical and Grid Interconnection Studies performed by Power Planners International (PPI) is attached as Annex VI.

The detailed design of the electrical works shall be carried out by the EPC contractor prior to start of construction. This sequence is in accordance with best practices in the solar and utility industries.

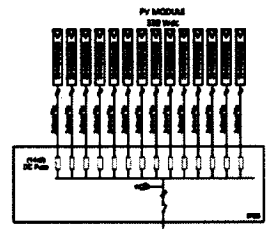
SINGLE LINE DIAGRAM

A brief overview of the plant interconnection is given in **Figure 34** below:





A ELECTRICAL WIRING DIAGRAM (DC).



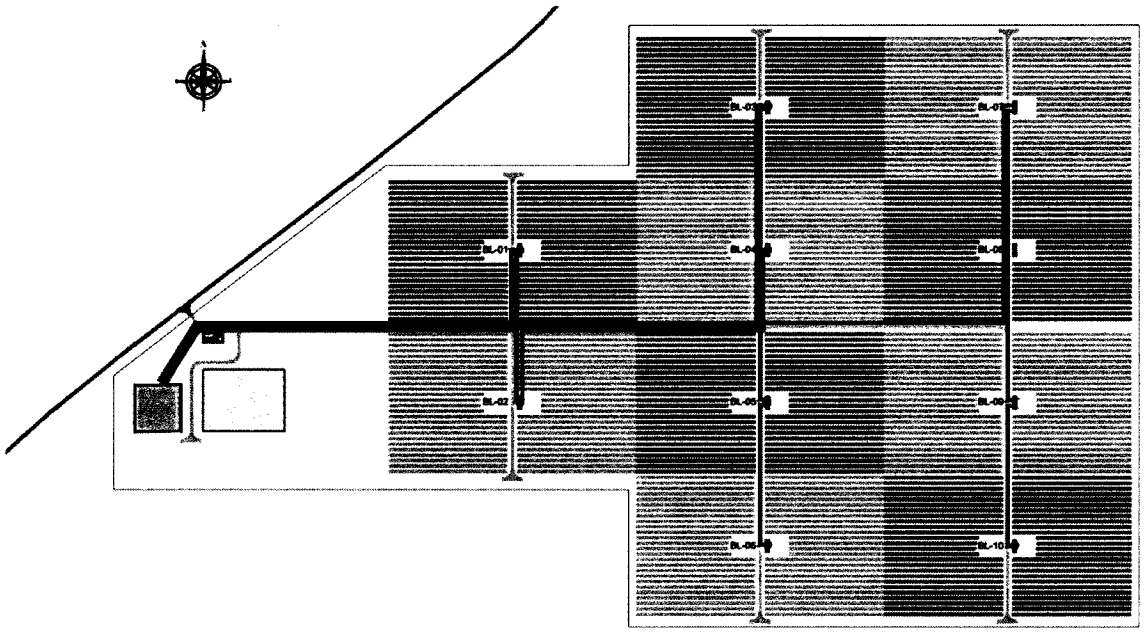
B STRING BOX (14 inputs)

INVERTER		
GPTECH WDS-HV650		
Apparent Power (@50°C)	(kVA)	2500
Min. Input Current (@MPO)	(A)	1386
Number of DC Inputs		28
MPP Voltage Range:		
Min.	(V)	600
Max.	(V)	1300
Min Input Voltage	(V)	1000
PV MODULE		
CANADIAN CSIU 330		
Peak Power Watts	(P_{max})	330 Wp
Maximum Operating Voltage	(V_{mp})	37.20 V
Maximum Operating Current	(I_{mp})	8.88 A
Open Circuit Voltage	(V_{oc})	45.60 V
Short Circuit Current	(I_{sc})	9.40 A
Module Efficiency		16.97 %
Values at Standard Test Conditions (STC) (AM 1.5, Irradiance 1000W/m², Cell Temperature 25°C)		

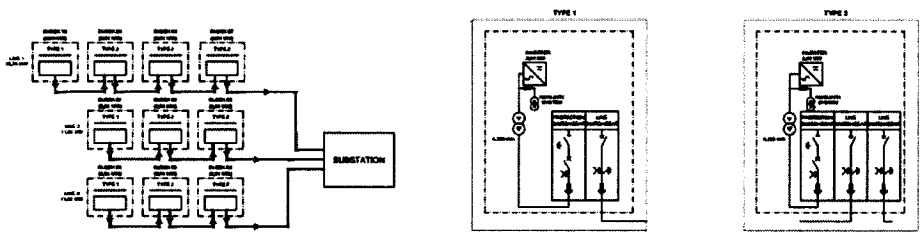
Each Inverter Block = 3x1320 kV inverter.

INTERCONNECTION OF PV MODULES AND FORMATION OF ARRAYS

Figure 35, Formation of PV Arrays:



A GENERAL LAYOUT

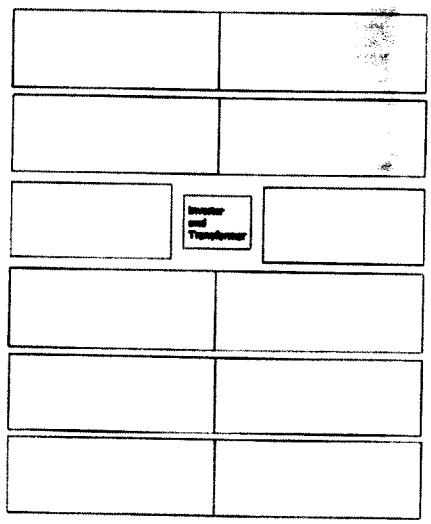


For the purpose of feasibility, the interconnection of PV modules and formation of arrays is explained as follows:

- The "PV Layout" consists of total 10 "Blocks" plus surplus area for control room and substation.

Each of the 10 Blocks consists of 15,120 solar arrays. Each array has 330watt solar panels. As shown in Annexure III 'Solar Resource Assessment', there are 3 Inverters arranged in each block. i.e. 3x1320Kva inverters (each block 3960Kva). The model to be used for the inverters is GPTech-1320WD3-HV650.

Layout of One PV Array Block is shown in **Figure 36** below:



The North-South distance between two arrays is restricted to minimum 1.5 times the height of array to avoid shadows. Other spacing is for ease of maintenance. The final PV interconnection design shall depend upon the module capacity, design of mechanical assemblies and detailed engineering design.

As shown in Annexure III 'Solar Resource Assessment', the Inverters are arranged in blocks of 3. i.e. 3x1320Kva inverters (each block 3960Kva). The model to be used for the inverters is GPTech-1320WD3-HV650.

12. MECHANICAL ENGINEERING DESIGN

The primary component of mechanical engineering design is in the Steel/Aluminum Structures to support the Solar Arrays.

There are several standardized products for fixed-tilt solar array structures. EBSL will either utilize a standard product for sale in the marketplace that comes with performance record and warranties that are acceptable to its finance partners, or will facilitate the contract manufacture of an accepted design that meets the same project finance acceptance standards.

The mechanical works (fabrication and installation) are included in the scope of the EPC contract. Final selection and the detailed design activity of the mechanical works shall be carried out by the EPC contractor prior to financial close.

13. CONSTRUCTION MANAGEMENT

Like many power projects in Pakistan, the structure of the EPC contract shall be on a "turnkey" basis. Everything shall be managed from the one platform (one window) of the EPC contractor. The partners of the EPC contractor shall be underneath that platform through "joint and several arrangements" such that the guarantees and warranties mechanism does not deviate from the basic concept and international practices. In this way, the role of the Project Company shall be to supervise and monitor everything.

The arrangement of the EPC contract shall be back-to-back with the requirements of the Energy Purchase Agreement (EPA).

The Project personnel supervise construction activities from the start of the project. The EBSL team will monitor construction schedules, owner's engineers and the EPC contractor to complete the project frame and in-line with Health Safety and Environmental (HSE) guidelines.

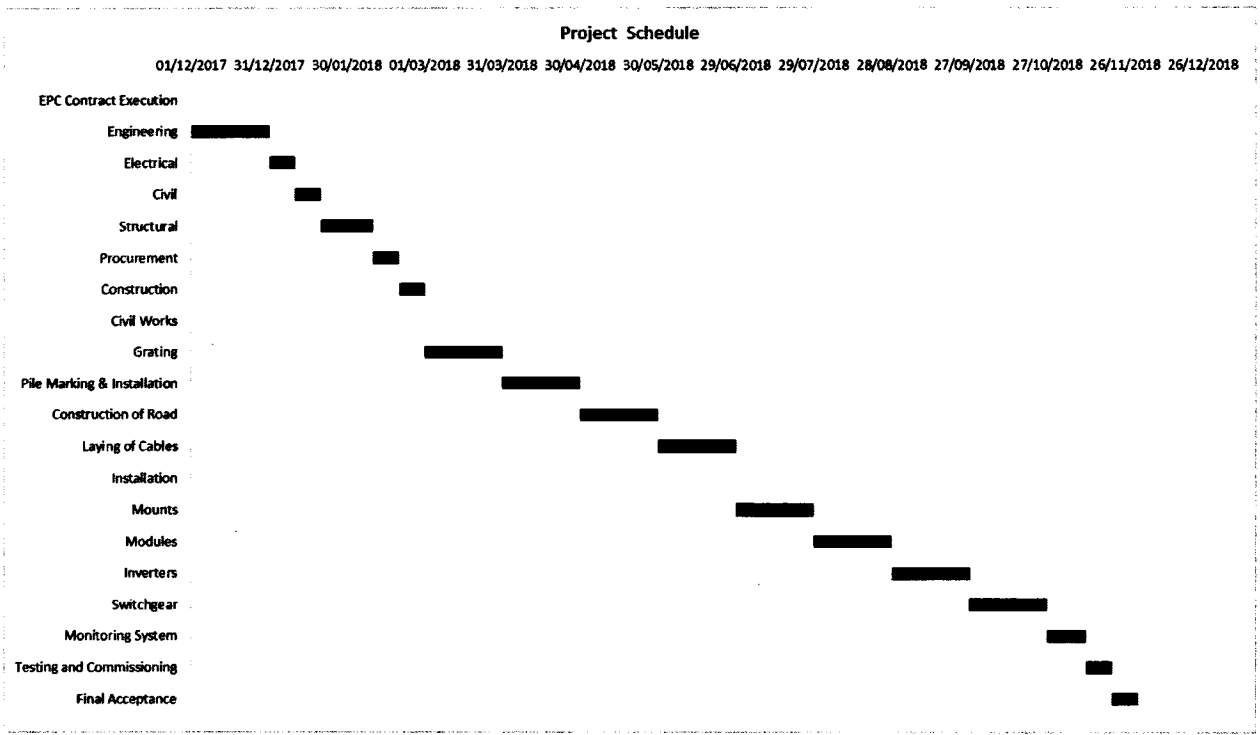
The Project Company shall prepare a Construction Management Master Plan, which shall consider all relevant aspects. The master plan shall be regularly reviewed, updated and shared with all project stakeholders.

To properly manage all the above operations correctly, EBSL shall have the services of a professional consultant or a consulting company to act as a "Construction Supervisor" which shall monitor the quality and progress of all contractors and give approvals of milestones.

PROJECT SCHEDULING

The project construction shall take an estimated 12 months from the date of financial close till the COD.

Figure 37, Project Schedule:



14. O&M MANAGEMENT

Maintenance at regular intervals will ensure high yields throughout the life cycle of the power plant. The Project Company (EBSL) will look after the monitoring and control system of the plant. EBSL's O&M protocols include different maintenance routines which cover the following measures:

- Cleaning of modules
- Routine visual check of all combiner boxes installed in the generator field
- Routine check for proper functioning of fault detection and fault indication routines
- Routine check of all current measurement points
- Random extraction of string current samples (current measurement)
- Measurement precision check and sensor calibration checks
- Deliberate destruction of sample fuses to obtain remaining service life duration of installed fuses
- Data logger: visual check of UPS backup function; cleaning
- Data logger: replacement of batteries of DC UPS unit
- Check and calibration of ambient condition sensors installed in the generator field (e.g., pyranometers, irradiation sensors based on reference cells, weather stations
- Maintenance of spares needed to quickly replace faulty components and suffer minimal downtime

ALARM MANAGEMENT WITH INTEGRATED ERROR LOG

EBSL's power plant performance monitoring systems accelerate reaction times to outages coupled with enhanced fault diagnosis, to increase the plant's availability. Data accumulated can be used for trending analysis for systematic and efficient operation and maintenance. With selectable error conditions, error states and limits for automatic monitoring will take the system topology and site conditions (e.g. string allocation, shading or inverter mode) into account. The system allows monitoring of performance of the complete PV system as well as individual inverters, strings and other components.

A service log (called a data historian) provides chronological records for the operation and maintenance of the PV system. For traceability, O&M personnel will link the centrally maintained log, together with operator notes, to service incidents such as alarms, together with details of specific equipment. The service log provides a simple and indispensable tool in helping you meet the necessary record-keeping requirements for certification according to ISO 9001 and ISO 14001.

STORAGE AND ARCHIVING OF ALL MEASURED DATA ACQUIRED OVER THE PLANT'S ENTIRE OPERATIONAL LIFE

The data monitoring system provides full access to all historical data over the entire life of the plant. This allows sophisticated analysis for aging effects in the PV plant such as the early detection of module degradation that might be needed for warranty purposes. Flexible tables and diagrams are available to assist in analysis and visualization. The state of the plant can be depicted at any time in all views.

15. INITIAL ENVIRONMENTAL EXAMINATION

The Initial Environment Examination (IEE) has been carried out as per Pakistan Environmental Protection Act, 1997 according to the requirements of Environment Protection Agency, Balochistan. The IEE report has been submitted to the Environment Protection Department (EPD) Balochistan.

The report is attached as Annex V. The summary of the report is presented here.

STUDY METHODOLOGY

The study was conducted using standard methodology prescribed by national and international agencies. The IEE comprises baseline data on existing conditions on physical and biological environment, and social environment together with the anticipated environmental impacts and proposed mitigation measures. Detailed assessment of the social and biological environment of the area was conducted through field surveys for a distance up to 10km radius of the project site, however, the influence zone of the environmental impacts is considered as 5km.

Data was also collected through secondary sources such as published literature and internet resources to support the findings of the field survey.

The present document reports the finding of the Initial Environmental Examination (IEE) carried out to identify potential environmental issues associates with the project and ensures appropriate mitigation measures to cope with those issues.

The IEE report incorporates the following elements:

- Relevant Project Information
- Project Alternatives
- Baseline Environmental Conditions
- Possible Impacts
- Mitigation Measures
- Environment Management Plan

Statutory Requirements

The report fulfils the following regulatory requirements

- Guidelines published by Pakistan Environmental Protection Agency (Pak-EPA),
- Asian Development Bank Polices and Guidelines,
- Performance Standards of IFC and World Bank group,
- The best practices followed at international level.

PROJECT OVERVIEW

EnerTech Bostan Solar Pvt. Ltd (EBSL) is planning to set up the 50MW solar PV power project in the Bostan region of District Pishin near Quetta.

The Project site is located approximately 35km from Quetta City. EBSL has been allocated land of 250 acres by the Government of Balochistan. The land is vacant with few self-grown small shrubs and bushes. There is no agricultural activity or human settlement on the Project site.

The town of Bostan and its associated village settlements are located within a 5km radius from the Project site. The Project site is easily accessible by the Kuchlak-Zhob highway (N-50).

DESCRIPTION OF ENVIRONMENT

The detailed environmental and social survey was conducted by GeoServices Engineering Consultants and was started on 8th August, 2017. A survey was conducted to assess the baseline information on the environment and socio-economic features of the area.

The Primary information on environmental baseline conditions was assessed by visual observation, information from local stakeholders including villagers, NGOs working in the area and union council representatives. Secondary data was gathered from internet sources, available literature documents and information on the project area. Detailed assessment of the social and biological environment of the area was conducted through field survey for a distance covering a 10km radius of the project site, however the influence zone of the environmental impacts is considered as 5km.

The project site of EBSL is in Bostan, District Pishin. The Project site location and access is provided in detail in Section 3.

The project area is a semi-arid mountainous area with sparse vegetation and self-grown small shrubs (5 feet height) and no few trees. The Project area is lying vacant and there is no agricultural activity or human settlement on the Project site.

Based on topography, Bostan and its surrounding areas are classified as mountainous. Bostan is characterized by extreme environmental conditions with arid and semi-arid climate due to the Suleiman Range boundary on the eastern side.

Agricultural activities were seen in the village settlements that were visited during the survey. The literacy rate in the villages around the Project site is around 45 percent, considering people who received an education up to secondary level, although very few people in the area are graduates. People with secondary-level or higher are engaged in the teaching profession and as government servants.

Most of the remaining people living in these villages are either farmers or laborers working in Pishin and Quetta on daily wages. Some are dependent on livestock development and keep camels, goats, buffaloes and cows for meat and milk production. The overall socioeconomic condition of the people living in the area is moderate to low income.

Education facilities up to secondary level are available in Bostan near the Project site for both boys and girls. People usually travel to Quetta for higher education facilities. There is no hospital facility in the nearby villages. Although basic healthcare facilities are available, people typically go to Quetta to visit a hospital.

Quetta is connected to the major cities of the country by air as well as through National Highway roads and railways.

The area in and around the project site up to 5km has no industrial development. Due to strong winds throughout the year, sand rises with hot air to form dust clouds and haze that can affect the air quality of the area. There are no external factors like traffic, industry or any kind of pollution in the area.

The project site is in a quiet area with no significant noise being heard. The area of the Project site is lying vacant with no minor or major noise activities in the surroundings. According to the seismic map of Pakistan, the project site falls under the category of "moderate active" zone.

STAKEHOLDER CONSULTATION

Stakeholder consultation was carried out as part of the IEE study. The main objectives of the consultations were to apprise stakeholders about the proposed project activities; obtain their views, concerns and recommendations; and address/incorporate them in the project design, thus enhancing the environmental and social performance of the project.

IMPACT ASSESSMENT AND MITIGATION

During the IEE, the project potential social and environmental impacts were identified. Each identified impact was then characterized with respect to its nature, reversibility, geographical extent, consequence-severity and likelihood. Based upon this characterization, the impacts were then assessed to be of high, medium or low significance. The key potential environmental and social issues identified during the study included contamination of soil and water, safety hazards, damage to infrastructure, air quality deterioration, noise emissions, threat to wildlife and habitat modification. Similar impacts during the plant operation were identified; these included soil and water contamination, safety hazards, species mortality, habitat modification, noise and vibration. The IEE has recommended appropriate mitigation measures to address the above concerns, and to keep the residual impacts within acceptable limits.

ENVIRONMENTAL MANAGEMENT PLAN

An Environmental Management Plan (EMP) had been developed to provide an implementation mechanism for the mitigation measures mentioned above and has been updated considering the EPA decision circumstances. The EMP provides the organizational structure for the environmental and social management system during the project, and defines the roles and responsibilities of project players. The EMP includes a mitigation plan, a monitoring plan, the communication and documentation requirements, and training needs, in the context of the environmental and social management of the Project.

WATER CONSUMPTION

During the construction phase the site will require both Potable and raw water. The potable water will be used by the workers on site. And the Raw water will be used for the civil works.

Construction Phase (9 months)		
Potable Water	9,938	m3
Raw Water	1,770	m3

O&M		
Cleaning	1,486	m3/year
Potable	300	m3/year

EnerTech will utilize two sources for their water needs. The underground water and water tankers. EnerTech seek to ensure that our project puts the least amount of stress on the water table. The water table in the region is at 400 ft. We plan to operate a small one cusec tube well that will be run for 4 hours a day (any excess water will be stored). The balance amount will be sourced from water tankers. Enertech has already assumed a price per litre for the water delivery to site by the water tankers a part of its project and operational cost.

FINDINGS AND RECOMMENDATION

The project will not cause any significant lasting and negative environmental or social impacts. The environmental disturbance normally associated with construction activities will be minimized through an EMP, implementation of which will continue during EPC and which includes monitoring arrangements. As solar PV technology is a clean energy source with no significant impacts on the environment and no GHG gas emissions after the construction phase, therefore, there will be no need for frequent environmental monitoring once the project is operational. If there will be any unanticipated major negative environmental impact noticed during operation of the project, possible mitigation measures will be taken to reduce the impact.

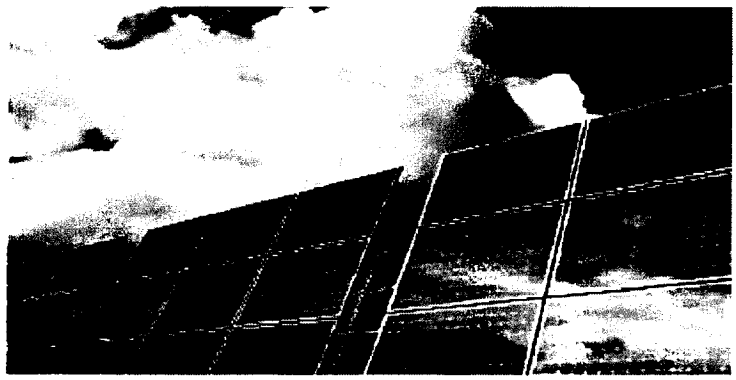
It is concluded that the project will be a positive development in the area and improve the socioeconomic conditions of the area through generation of employment opportunities and opening of ways for the development of this area. There are no negative environmental impacts of the project, rather it is a green energy project and contributes to the environmental sustainability of the area. The project will also help to promote renewable energy in Pakistan and help to meet the increasing energy supply demand of the country.

Report No. PPI-253.2-Final/17

INTERCONNECTION STUDY

For

50 MW Enertech Bostan Solar Power Plant
Near Quetta, Baluchistan



Draft Report
(October 2017)

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Executive Summary

- The data received from the client for 50 MW Enertech Bostan Solar Power Plant is validated and the study objective, approach and methodology have been described. The maximum net AC output of this plant would be 39.57 MW.
- The Solar Power Plant data as provided by the client has been used and is attached in Appendix – B.
- The expected COD of Enertech Bostan Solar Power Plant is 31st December 2018. Another 50 MW Solar PP, referred to as Enertech Quetta Solar, will also start operating on the same date. The nearest substations of QESCO to these solar plants are Nohsar 132kV and Yaru 132 kV.
- Given the location of Enertech Bostan Solar Power Plant, the most feasible interconnection scheme for Enertech Bostan Solar and Enertech Quetta Solar Power Plants is by looping in-out of 132 kV Single circuit from Yaru and Nohsar 132kV Grid Station. The looping distance is 17 km whereas the distance between substations of both plants is 0.1 km. The conductor used would be Rail with a thermal capacity of 202 MVA. The complete circuit is shown in Appendix – B.
- The above proposed interconnection scheme has been tested for steady state, short circuit and transient stability conditions through detailed technical studies after the commissioning of Solar Power Plants.
- Detailed load flow studies have been carried out for the peak load conditions of Summer 2019 for the proposed scheme under normal and N-1 contingency conditions to meet the reliability criteria.
- Steady state analysis by load flow for all the scenarios described above reveals that the proposed scheme is adequate to evacuate the maximum power of 39.57 MW of the plant under normal and contingency conditions.
- The short circuit analysis has been carried out to calculate maximum fault levels at the Enertech Bostan Solar Power Plant 132 kV, and the substations of 132 kV in its vicinity. We find that the fault currents for the proposed scheme are much less than the rated short circuit capacities of switchgear installed at these substations. There are no violations of exceeding the rating of the equipment due to contribution of fault current from Enertech Bostan Solar Power Plant.

- The maximum short circuit level of 132 kV bus bar of Enertech Bostan Solar Power Plant is 5.68 kA and 5.60 kA (for the year 2019) for 3-phase and 1-phase faults, respectively. Therefore, industry standard switchgear of the short circuit rating of 40 kA would be fine to be installed at 132 kV switchyard of Enertech Bostan Solar Power Plant as per NTDC requirement taking care of any future generation additions and system reinforcements in its electrical vicinity.
- The dynamic stability analysis of proposed scheme of interconnection has been carried out. The stability check for the worst case of three phase fault right on the 132 kV bus bar of the Solar power plant substation followed by the final trip of 132/33 kV transformer from this substation, has been performed for fault clearing of 5 cycles (100 ms). The system is found strong enough to stay stable and recovered with fast damping. The proposed scheme successfully passed the dynamic stability checks for near and far faults.
- The proposed scheme of interconnection has no technical constraints or problems, it fulfills all the criteria of reliability and stability under steady state load flow, contingency load flows, short circuit currents, dynamic/transient conditions and power quality; and is therefore recommended to be adopted.

Report Contents

1. Introduction

1.1 Background

Enertech Pakistan Pvt. Limited is developing two separate Photovoltaic (PV) based Solar Farms near Bostan, Baluchistan. The site of proposed project is located near Bostan in the concession area of Bostan Electric Supply Company (QESCO). The maximum net AC output of both solar plants namely Enertech Bostan Solar and Enertech Quetta Solar would be 39.57 MW each. Both project will start commercial operation on 31st December 2018. The electricity generated from this project would be supplied to the QESCO network through the network developed for evacuation of power.

1.2 Objectives

The overall objective of the Study is to evolve an interconnection scheme between Enertech Bostan Solar Power Project and QESCO network, for stable and reliable evacuation of the electrical power generated from this plant, fulfilling N-1 reliability criteria. The specific objectives are:

- To develop scheme of interconnections at 132 kV for which right of way (ROW) and space at the terminal substations would be available.
- To determine the performance of interconnection scheme during steady state conditions of system, normal and N-1 contingency, through load-flow analysis.
- To check if the contribution of fault current from this new plant increases the fault levels at the adjoining substations at 132 kV voltage levels to be within the rating of equipment of these substations, and also determine the short circuit ratings of the proposed equipment of the substation at the Enertech Bostan Solar Power Plant.
- To check if the interconnection withstands dynamic stability criteria of post fault recovery with good damping after 3-phase faults on the system.

1.3 Planning Criteria

The planning criteria as per Grid Code required to be fulfilled by the proposed interconnection is as follows:

Steady State:

Voltage	± 5 %, Normal Operating Condition
	± 10 %, Contingency Conditions
Frequency	50 Hz, Continuous, ± 1% variation steady state
	49.4 - 50.5 Hz, Short Time
Power Factor	± 0.95 (as per Grid Code Addendum No. 2 for Solar Power Plants)

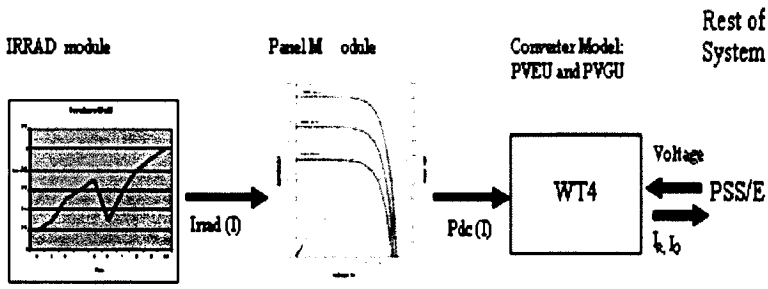
Dynamic/Transient:

- The system should revert back to normal condition after dying out of transients without losing synchronism with good damping. For the systems of 132 kV and above the total normal fault clearing time from the instant of initiation of fault current to the complete interruption of current, including the relay time and breaker interruption time to isolate the faulted element, is equal to 100 ms (5 cycles).
- In case of failure of primary protection (stuck breaker case), the total fault clearing time from the instant of initiation of fault current to the complete interruption of current to isolate the faulted element, including the primary protection plus the backup protection to operate and isolate the fault, is equal to 180 ms (9 cycles) for 132 kV and higher voltage levels.

2. Assumptions of Data

2.1 Solar Power Plant data

The Solar Power plant has been modeled according to the following block diagram



The way this works is that the irradiance profile from the sun is used as an input to the panel module which then calculates the DC power at that value of the irradiance. This value is then input to the electrical model of the solar power plant (inverter module) which then goes on to calculate the AC power supplied by the solar power plant.

Steady State data:

Maximum Net AC Output of Solar PP to Grid = 39.57 MW

Dynamic Data:

Converter time constant for IQcmd seconds = 0.02 s

Converter time constant for IQcmd seconds = 0.02 s

Voltage sensor for LVACR time constants = 0.02 s

Voltage sensor time constant = 1.1 s

2.2 Network data

The 132 kV networks available for interconnection to Enertech Bostan Solar Power Plant are as shown in Sketches 1 and 2 in Appendix-B. The lengths of the nearby circuits are also mentioned in the sketches.

The Solar Power Plant data as provided by the client has been used and it is attached in Appendix - B. The latest load forecast and the generation expansion plan provided by NTDC has been used as shown in Appendix A.

3. Study Approach and Methodology

3.1 Understanding of the Problem

The 39.57 MW (Net AC Output) Solar Power Plant by Enertech Bostan Solar, is going to be a photovoltaic (PV) based solar project in Baluchistan embedded in the 132 kV distribution network of QESCO. It would run almost all the months of the year though with some variation in its output due to variation in the strength of light in winter and in rainy season.

The existing nearest QESCO grid stations are Yaru and Nohsar 132 kV Substations. The 132 kV network of QESCO in the electrical vicinity of Enertech Bostan Solar PP and Enertech Bostan Solar PP has significant load demand; therefore a considerable portion of the power from these solar power plants will be utilized in meeting this load demand on substations including Yaru, Nohsar, Pishin, Khanozai and Bostan Industrial etc.

The adequacy of QESCO network of 132 kV in and around the proposed site of Enertech Bostan Solar Power Plant would be investigated in this study for absorbing and transmitting this power fulfilling the reliability criteria.

3.2 Approach to the problem

The consultant has applied the following approaches to the problem:

- A base case network model has been prepared for the peak load case of Summer 2019, after COD of Solar Power Plants, comprising all 500 kV, 220 kV and 132 kV system, envisaging the load forecast, the generation additions and transmission expansions for that year particularly in QESCO.
- The expected COD of the project is in 31st December 2018. In view of planned COD of Enertech Bostan Solar Power Plant, the above proposed interconnection scheme has been tested for steady state conditions through detailed load flow studies for Peak summer 2019 in this report.
- Performed technical system studies for peak load conditions to confirm technical feasibility of the interconnections. The scheme has been subjected to standard analysis like load flow, short circuit and transient stability studies to

check the strength of the plant and the proposed interconnection scheme under disturbed conditions.

- Determine the relevant equipment for the proposed technically feasible scheme.
- Recommend the technically most feasible scheme of interconnection.

4. Development of Scheme of Interconnection

4.1 The Proposed Network for Enertech Bostan Solar Power Plant

The nearest existing QESCO interconnection facility at the time of commissioning of Enertech Bostan Solar Power Project is Yaru 132 kV and Nohsar 132 kV Substations. Given the location of Enertech Bostan Solar power plant, the most feasible interconnection scheme for Enertech Bostan Solar and Enertech Quetta Solar Plants is by looping in-out of 132 kV Single circuit from Yaru to Nohsar 132kV Grid Station. The looping distance is 17 km whereas the distance between substations of each power plant is 0.1 km. The conductor used would be Rail with a thermal capacity of 202 MVA. The complete circuit is shown in Appendix – B.

We have modeled the scenario of the Peak Load Case of summer 2019 to assess the scenario when there would be maximum stress on the system. An additional 50 MW (39.57 MW Net AC Power) from Quetta Solar Power Plant has been modeled in the Peak Load Case of Summer 2019.

4.2 The Scheme of Interconnection of Enertech Bostan Solar Power Plant

Given the location of Enertech Bostan Solar power plant, the most feasible interconnection scheme for Enertech Bostan Solar and Enertech Quetta Solar Plants is by looping in-out of 132 kV Single circuit from Yaru to Nohsar 132kV Grid Station. The looping distance is 17 km whereas the distance between substations of each power plant is 0.1 km. The conductor used would be Rail with a thermal capacity of 202 MVA. The complete circuit is shown in Appendix – B.

5. Detailed Load Flow Studies

5.1 Modeling of Solar Power Plant in the Load Flow

Representation of all the individual inverters in a large Solar Power Plant is inappropriate in most grid impact studies. There is a provision in the model structure of PSS/E to allow single equivalent collector model to represent multiple collectors. For grid system impact studies, simulations are typically performed with the irradiance sufficient to produce the rated output on all the inverters. Though simulations of bulk system dynamics using a single inverter equivalent are adequate for most planning studies.

5.2 Reactive Power Requirements

Enertech Bostan Solar power plant factor is used as mentioned in the data sheet provided attached in Appendix-B. Part of this reactive power will be consumed by the step-up transformers and the rest may be consumed in collector cables of the solar plant. However, some reactive power might reach the bus bar of solar plant substation. That means each inverter is self sufficient to meet VAR absorption requirement of its step-up transformer with some contribution of VARs to the Solar Plant MV network.

The Grid Code Addendum No.2 requires to meet the criteria of ± 0.95 power factor at the point of interconnection with the NTDC/QESCO grid at 132 kV (point of common coupling). Therefore, Enertech Bostan Solar with its maximum AC output of 39.57 MW generating capacity is required to pump around 13 MVARs to the grid at maximum AC power output of 39.57 MW to fulfill the criteria. The VAR generating capability of the inverters will not be able to fully meet this VAR demand of the system because of VAR loss in step-up transformers, collector cables and the transformers at the Solar Plant substation.

In order to meet the Grid Code criteria, we need to install reactive power compensation equipment. For a Solar Power Plant delivering 39.57 MW Net AC output, we need to have around 13 MVAR at 132kV bus bar after farm losses. Hence a switched shunt capacitor bank (20 MVAR) with contactors and PLC (Programmable Logic Controller) is proposed at 33kV bus bar of the Solar PP.

5.3 Base Case Peak Summer 2019, Without Solar Power Plant

A base case has been developed for the peak load of Summer 2019, using the network data of QESCO and NTDC. Peak Load Demand of QESCO for FY 2019-20 is **2102 MW**. There is very limited generation in the QESCO network. Moreover the commissioning of Reactive Compensation Devices at major feed stations is also delayed by a couple of years. To ensure a stable system, **361 MW** load has been shed in the QESCO area. The load in the PSSE case comes out to be **1741 MW.**

The results of load flow for this base case are plotted in Exhibit 0.0 of Appendix-C. The system plotted in this Exhibit shows 132 kV network in the vicinity of Enertech Bostan Solar Power Plant including the substations of Nohsar, Yaru, Pishin and other substations.

The load flow results show that the power flows on all circuits are within their specified normal current carrying rating. The voltages are also within the permissible limits.

For N-1 contingency conditions we have performed the following cases:

Exhibit 0.1	Nohsar to Yaru 132kV Single Circuit Out
Exhibit 0.2	Quettain to Nohsar 132kV Single Circuit Out
Exhibit 0.3	Pishin to Yaru 132kV Single Circuit Out
Exhibit 0.4	Yaru to Huramzai 132kV Single Circuit Out
Exhibit 0.5	Khanozai to Pishin 132 kV Single Circuit Out

We see that the power flows on all circuits remain within their ratings. Thus, we find that there are no capacity constraints in terms of MW or MVA flow in the 132 kV network available in the vicinity of Enertech Bostan Solar Power Plant for its connectivity under normal conditions and the N-1 contingency conditions considered.

5.4 Load Flow with Enertech Bostan Solar Power Plant, Peak Load Case Summer 2019

We have considered the scenario of Summer 2019 so that we can judge the maximum impact of the project on the system when the load of the system would be at its maximum. After the introduction of Enertech Quetta Solar Power Plant and Enertech Bostan Solar PP into the system, the amount of load shedding required to maintain a

steady state supply of power is reduced. In this scenario, **260 MW** load has been shed out of QESCO's peak load. The load in the PSSE case comes out to be **1842 MW.**

The results of load flow with Enertech Bostan Solar Power Plant interconnected as per proposed scheme are shown for each case. The power flows on the circuits under normal conditions are seen well within the rated capacities. Also, the voltages on the bus bars are within the permissible operating range of ± 5 % off the nominal

We find no capacity constraints on the 132 kV circuits under normal conditions i.e. without any outages of circuits.

N-1 contingency analysis has been carried out and the plotted results are attached in Appendix – C as follows:

Exhibit 1.1	Bostan Solar 132/33 kV Single Transformer Out
Exhibit 1.2	Quetta Solar to Bostan Solar 132kV Single Circuit Out
Exhibit 1.3	Bostan Solar to Yaru 132kV Single Circuit Out
Exhibit 1.4	Quetta Solar To Nohsar 132kV Single Circuit Out
Exhibit 1.5	Quettain to Nohsar 132kV Single Circuit Out
Exhibit 1.6	Pishin to Yaru 132 kV Single Circuit Out
Exhibit 1.7	Yaru to Huramzai 132 kV Single Circuit Out
Exhibit 1.8	Khanozai to Pishin 132 kV Single Circuit Out

In all the above contingency cases, we find that in the event of outage of any circuit, the intact circuits remain within the rated capacity. Also, the bus bar voltages are well within the rated limits in all the contingency events. Thus, there are no constraints in this scheme in the contingency conditions mentioned above.

5.5 Load Flow with Enertech Bostan Solar Power Plant, Peak Load Case Summer 2021

Detailed load flow studies have also been carried out for an extended term spot year of 2021. All the future reinforcements that were proposed till 2021 are modeled in the case.

Load flow studies have been carried out with all the additional power generation and the associated additional transmission schemes. Complete scheme is shown in

Appendix-C. The results of load flow with Enertech Bostan Solar Power Plant interconnected as per proposed scheme are shown for each case. The power flows on the circuits under normal conditions, with the above mentioned line openings, are seen well within the rated capacities and the voltages on the bus bars are also within the permissible operating range of ± 5 % off the nominal.

To fulfill N-1 criteria of Grid Code, one-line-out contingency studies have also been carried out. Their results are shown plotted in Appendix-C as follows:

Exhibit 2.1	Bostan Solar 132/33 kV Single Transformer Out
Exhibit 2.2	Quetta Solar to Bostan Solar 132 kV Single Circuit Out
Exhibit 2.3	Bostan Solar to Yaru 132 kV Single Circuit Out
Exhibit 2.4	Quetta Solar to Nohsar 132 kV Single Circuit Out
Exhibit 2.5	Quettain to Nohsar 132 kV Single Circuit Out
Exhibit 2.6	Pishin to Yaru 132 kV Single Circuit Out
Exhibit 2.7	Yaru to Huramzai 132 kV Single Circuit Out
Exhibit 2.8	Khanozai to Pishin 132 kV Single Circuit Out

In all the above contingency cases, we find that in the event of outage of any circuit, the intact circuits remain within the rated capacity. Also, the bus bar voltages are well within the rated limits in all the contingency events. Thus, there are no constraints in this scheme in the contingency conditions mentioned above.

5.6 Analysis of Voltage Profile and Transmission Line Losses

a) Voltage Profile

The voltage profile on the buses near Quetta and Bostan Solar PP was analyzed. The voltages on the bus bars in the vicinity of solar power plants have been shown in Table 5.1 for comparison. These voltages are also shown in Exhibit 0.0 (without Quetta and Bostan SPP) and Exhibit 1.0 (with Quetta and Bostan SPP).

Table – 5.1

Bus Bars	Volatge (kV)	
	Without Quetta and Bostan SPP	With Quetta and Bostan SPP
Nohsar 132 kV	131.5	133.2

Yaru 132 kV	130.8	132.4
QuettaIn 132 kV	133.4	133.3
Pishin 132 kV	131.0	132.0
Huramzai 132 kV	129.4	131.1

It can be seen that the overall voltage profile of the area improves after the introduction of Quetta and Bostan Solar PP into the system.

b) Transmission Line Losses

The transmission line losses were evaluated for normal case of peak load summer 2019 from Bostan solar PP to the point of interconnection. The Exhibit 1.0 of Appendix - C was used to calculate transmission line loss as a percentage of the flow.

% Power Loss from Quetta Solar towards Nohsar = (5.8250 – 5.8197) / 5.8250

= **0.091%**

% Power Loss from Bostan Solar towards Yaru = (73.0482 – 72.6448) / 73.0482

= **0.55 %**

It can be seen that the transmission loss of the transmission line from Power plant to the point of interconnections is less than 1%.

5.7 Conclusion of Load Flow Analysis

From the analysis discussed above, we conclude that the proposed interconnection scheme of connecting Enertech Bostan Solar power plant ensures reliability and availability under all events of contingencies i.e. planned or forced outages studied in this report for the base year of 2019.

6. Short Circuit Analysis

6.1 Methodology and Assumptions

The methodology of IEC 909 has been applied in all short circuit analysis in this report for which provision is available in the PSS/E software used for these studies.

The maximum fault currents have been calculated with the following assumptions under IEC 909:

- Set tap ratios to unity
- Set line charging to zero
- Set shunts to zero in positive sequence
- Desired voltage magnitude at bus bars set equal to 1.10 P.U. i.e. 10 % higher than nominal, which is the maximum permissible voltage under contingency condition.

For evaluation of maximum short circuit levels, we have assumed contribution in the fault currents from all the installed generation capacity of hydel, thermal and nuclear plants in the system in the year 2019 i.e. all the generating units have been assumed on-bar in fault calculation's simulations.

6.2 Maximum Fault Current Calculations without Enertech Bostan Solar power plant – Year 2019

In order to assess the short circuit strength of the network of 132 kV without the Enertech Bostan Solar power plant for the grid of QESCO in the vicinity of the site of the Plant at Enertech Bostan Solar power plant, fault currents have been calculated for balanced three-phase and unbalanced single-phase short circuit conditions. These levels will not only give us the idea of the fault levels without Enertech Bostan Solar power plant and later on how much the contribution of fault current from the Solar Power Plant may add to the existing levels, but also we get a feel of the strength of the proposed node to connect this Power Plant depending on its relative short circuit strength.

The results are attached in Appendix – D.

The short circuit levels have been represented graphically on the bus bar of 132 kV which are shown in the Exhibit 3.0 attached in Appendix-D.

Both 3-phase and 1-phase fault currents are indicated in the Exhibit which are given in polar coordinates i.e. the magnitude and the angle of the current. The total fault currents are shown below the bus bar.

The tabular output of the short circuit calculations is also attached in Appendix-D for the 132 kV bus bars of our interest i.e. 132 kV circuits lying close to Enertech Bostan Solar power plant. The tabular output is the detailed output showing the contribution to the fault current from the adjoining sources i.e. the lines connected to that bus. The phase currents, the sequence currents and the sequence impedances are shown in detail for each faulted bus bar.

The total maximum fault currents for 3-phase and 1-phase short circuit at these substations are summarized in Table 6.1. We see that the maximum fault currents do not exceed the short circuit ratings of the equipment at these 132 kV substations which normally are 20 kA, 25 kA or 31.5 kA.

Table - 6.1
Maximum Short Circuit Levels without Bostan Solar
Summer 2019

Substation	3-Phase fault current, kA	1-Phase fault current, kA
Nohsar 132 kV	**6.29**	**3.57**
Gulistan 132 kV	**4.11**	**2.40**
Khanozai 132 kV	**6.45**	**3.73**
Maizai Addah 132 kV	**5.14**	**2.96**
Pishin 132 kV	**8.37**	**4.61**
Yaru 132 kV	**7.79**	**4.30**
Huramzai 132 kV	**5.40**	**3.09**
Alizai 132 kV	**4.25**	**2.48**
Q. Abdulla 132 kV	**4.38**	**2.54**
Quetta Industrial 132 kV	**11.71**	**6.74**
Kuclak 132 kV	**7.51**	**3.96**
Q.S Mand 132 kV	**9.76**	**5.03**

Habib-P 132 kV	**9.29**	**8.48**
Sorrange 132 kV	**7.65**	**4.30**

6.3 Maximum Fault Current Calculations with Enertech Bostan Solar power plant interconnected – Year 2019

Fault currents have been calculated for the electrical interconnection of proposed scheme. Three-phase and single-phase faults have been applied at the 132 kV bus bars of Enertech Bostan Solar power plant and other bus bars of the 132 kV substations in the electrical vicinity of Enertech Bostan Solar power plant. The graphic results are indicated in Exhibit 3.1.

The tabulated results of short circuit analysis showing all the fault current contributions with short circuit impedances on 132 kV bars of the network in the electrical vicinity of Enertech Bostan Solar power plant are placed in Appendix-D. Brief summary of fault currents at significant bus bar of 132 kV are tabulated in Table 6.2.

We find that even after the interconnection of Enertech Bostan Solar power plant these fault levels are much below the rated short circuit values of the equipment installed on these substations. The maximum short circuit level of 132 kV bus bar of Enertech Bostan Solar power plant is 5.68 kA and 5.60 kA for 3-phase and 1-phase faults respectively.

Table - 6.2

Maximum Short Circuit Levels with Bostan Solar
Summer 2019

Substation	3-Phase fault current, kA	1-Phase fault current, kA
Bostan MV 33 kV	**11.67**	**13.59**
Bostan Solar 132 kV	**5.68**	**5.60**
Quetta Solar 132 kV	**5.68**	**5.60**
Nohsar 132 kV	**5.65**	**3.99**
Gulistan 132 kV	**4.09**	**2.75**
Khanozai 132 kV	**6.43**	**4.13**
Maizai Addah 132 kV	**5.11**	**3.43**

Pishin 132 kV	**8.29**	**5.76**
Yaru 132 kV	**7.58**	**5.75**
Huramzai 132 kV	**5.32**	**3.75**
Alizai 132 kV	**4.22**	**2.89**
Q. Abdulla 132 kV	**4.35**	**2.96**
Quetta Industrial 132 kV	**11.69**	**7.99**
Kuclak 132 kV	**7.48**	**4.71**
Q.S Mand 132 kV	**9.72**	**6.25**
Habib-P 132 kV	**9.24**	**8.45**
Sorrange 132 kV	**7.65**	**5.01**
Bostan MV 33 kV	**11.67**	**13.59**

6.4 Maximum Fault Current Calculations with Enertech Bostan Solar Power Plant Interconnected – Year 2021

The maximum Fault currents have been calculated for the electrical interconnection of proposed scheme for the future scenario of 2021. The graphic results are indicated in Exhibit 3.2.

The tabulated results of short circuit analysis showing all the fault current contributions with short circuit impedances on 132 kV bars of the network in the electrical vicinity of Enertech Bostan Solar Power Plant are placed in Appendix-D. Brief summary of fault currents at significant bus bar of 132 kV are tabulated in Table 6.3.

The maximum short circuit level of 132 kV bus bar of Enertech Bostan Solar power plant is 5.87 kA and 6.01 kA for 3-phase and 1-phase faults respectively.

Table - 6.3

Maximum Short Circuit Levels Year 2021 with Bostan Solar

Substation	3-Phase fault current, kA	1-Phase fault current, kA
Bostan MV 33 kV	**11.91**	**14.01**
Bostan Solar 132 kV	**5.87**	**6.01**

Quetta Solar 132 kV	**5.87**	**6.00**
Nohsar 132 kV	**5.81**	**4.31**
Gulistan 132 kV	**4.24**	**3.05**
Khanozai 132 kV	**7.18**	**4.96**
Maizai Addah 132 kV	**5.33**	**3.93**
Pishin 132 kV	**8.80**	**7.26**
Yaru 132 kV	**7.93**	**7.02**
Huramzai 132 kV	**5.53**	**4.29**
Alizai 132 kV	**4.36**	**3.21**
Q. Abdulla 132 kV	**4.50**	**3.31**
Quetta Industrial 132 kV	**12.13**	**9.62**
Kuclak 132 kV	**7.78**	**6.27**
Q.S Mand 132 kV	**10.12**	**9.87**
Habib-P 132 kV	**9.60**	**9.87**
Sorrange 132 kV	**7.90**	**6.41**

6.6 Conclusion of Short Circuit Analysis

The short circuit analysis results show that for the proposed scheme of interconnection of Enertech Bostan Solar power plant, we don't find any problem of violations of short circuit ratings of the already installed equipment on the 132 kV equipment of substations in the vicinity of the Solar Power Plant by fault current contributions from this plant due to three-phase faults as well as single phase faults.

The maximum short circuit level of 132 kV bus bar of Enertech Bostan Solar power plant is 5.68 kA and 5.60 kA for 3-phase and 1-phase faults, respectively, for the year 2019. Therefore, industry standard switchgear of the short circuit rating of 40 kA would be fine to be installed at 132 kV switchyard of Enertech Bostan Solar power plant as per NTDC requirement taking care of any future generation additions and system reinforcements in its electrical vicinity.

7. Transient Stability Analysis

7.1 Assumptions & Methodology

7.1.1 Stability Models

The assumptions about the generator and its parameters are the same as mentioned in Ch.2 of this report.

We have employed the generic stability models available in the PSS/E model library for dynamic modelling of the PV-Solar power generator, its electrical model and the panel as follows;

Generator	PVGU1
Electrical Model	PVEU1
Solar Panel Model	PANELU1

We have done studies with the inverter which has reactive support capability and LVRT Capabilities as per the data provided by the client.

7.1.2 System Conditions

We have used the system conditions of Summer 2019 because this will allow the maximum impact of Enertech Bostan Solar power plant to be judged.

All the power plants of WAPDA/NTDC from Tarbela to HUBCO have been dynamically represented in the simulation model.

7.1.3 Presentation of Results

The plotted results of the simulations runs are placed in Appendix - E. Each simulation is run for its first one second for the steady state conditions of the system prior to fault or disturbance. This is to establish the pre fault/disturbance conditions of the network under study were smooth and steady. Post fault recovery has been monitored for nine seconds. Usually all the transients due to non-linearity die out within 2-3 seconds after disturbance is cleared in the system.

7.1.4 Worst Fault Cases

Three phase faults are considered as the worst disturbance in the system. We have considered 3-phase fault in the closest vicinity of the Solar Power Plant i.e. right at the 132 kV bus bar of the solar power plant substation, cleared in 5 cycles, for 132 kV i.e. 100 ms, followed by permanent trip of a 132/33 kV transformer.

7.2 Transient Stability Simulations' Results (Summer 2019)

7.2.1 Fault at 132 kV Bostan Solar power plant

We applied three-phase fault on the Bostan Solar power plant 132 kV bus bar, cleared fault in 5 cycles (100 ms) followed by trip of 132/33 kV transformer. We monitored different quantities for one second pre-fault and nine seconds after clearance of fault (post-fault) conditions and plotted the results attached in Appendix – E and are discussed as follows;

Fig. 1.1 Bus Voltages

The bus voltage of 132 kV bus bars of Bostan Solar, Nohsar, Yaru, Huramzai, Quetta Solar, Quetta Industrial is plotted. The results show quick recovery of the voltages after clearing of fault.

Fig. 1.2 Frequency

We see the system frequency recovers back to normal quickly after fault clearance.

Fig. 1.3 MW/MVAR Output of Solar Power Plant

The pre-fault output of Bostan Solar power plant was 39.57 MW and it gets back to the same output quickly after fast damping of the oscillations in its output. Similarly, MVAR output acquires equilibrium at a same value.

Fig. 1.4 MW/MVAR Output at Adjacent Plant (Quetta Solar PP)

The pre-fault output of Quetta Solar was 39.57 MW and it gets back to the same output quickly after fast damping of the oscillations in its output. Similarly, MVAR output acquires equilibrium at a same value.

Fig. 1.5 MW /MVAR flow on 132/33 kV Bostan Solar Transformer

Followed by clearing of fault, the trip of 132/33 kV transformer of Bostan Solar causes the entire output of Bostan Solar to flow through the other 132/33 kV transformer of Bostan Solar. We plotted the flows of MW and MVAR on this intact transformer and see that the power flows on this circuit attains to steady state level with power swings damping down fast.

Fig. 1.6 Voltage Sensor for LVACR

The value for LVACR is restored to its pre-fault value after the fault clears.

Fig. 1.7 Rotor Angles

The rotor angles of the generators of UCH-1 220 kV, UCH-2 220 kV, Engro Energy 200 kV, Guddu New 500 kV and Guddu 220 kV are plotted relative to machines at Hub

500 kV. The results show that the rotor angles get back after the first swing and damp down quickly. The system is strongly stable and very strong in damping the post fault oscillations.

7.2.2 Fault at 132 kV Bostan Solar power plant- Stuck Breaker

We applied Single-phase fault on the Bostan Solar power plant 132 kV bus bar, cleared fault in 9 cycles (180 ms) followed by trip of 132/33 kV transformer. We monitored different quantities for one second pre-fault and nine seconds after clearance of fault (post-fault) conditions and plotted the results attached in Appendix – E and are discussed as follows;

Fig. 2.1 Bus Voltages

The bus voltage of 132 kV bus bars of Bostan Solar, Nohsar, Yaru, Huramzai, Quetta Solar, Quetta Industrial is plotted. The results show quick recovery of the voltages after clearing of fault.

Fig. 2.2 Frequency

We see the system frequency recovers back to normal quickly after fault clearance.

Fig. 2.3 MW/MVAR Output of Solar Power Plant

The pre-fault output of Bostan Solar power plant was 39.57 MW and it gets back to the same output quickly after fast damping of the oscillations in its output. Similarly, MVAR output acquires equilibrium at a same value.

Fig. 2.4 MW/MVAR Output at Adjacent Plant (Quetta Solar PP)

The pre-fault output of Quetta Energy Solar was 39.57 MW and it gets back to the same output quickly after fast damping of the oscillations in its output. Similarly, MVAR output acquires equilibrium at a same value.

Fig. 2.5 MW /MVAR flow on 132/33 kV Bostan Solar Transformer

Followed by clearing of fault, the trip of 132/33 kV transformer of Bostan Solar causes the entire output of Bostan Solar to flow through the other 132/33 kV transformer of Bostan Solar. We plotted the flows of MW and MVAR on this intact transformer and see that the power flows on this circuit attains to steady state level with power swings damping down fast.

Fig. 2.6 Voltage Sensor for LVACR

The value for LVACR is restored to its pre-fault value after the fault clears.

Fig. 2.7 Rotor Angles

The rotor angles of the generators of UCH-1 220 kV, UCH-2 220 kV, Engro Energy 200 kV, Guddu New 500 kV and Guddu 220 kV are plotted relative to machines at Hub 500 kV. The results show that the rotor angles get back after the first swing and damp down quickly. The system is strongly stable and very strong in damping the post fault oscillations.

7.2.3 Fault at 132 kV Nohsar

We applied three-phase fault on the Nohsar 132 kV bus bar, cleared fault in 5 cycles (100 ms) followed by trip of 132 kV circuit between Nohsar and Quetta Solar. We monitored different quantities for one second pre-fault and nine seconds after clearance of fault (post-fault) conditions and plotted the results attached in Appendix – E and are discussed as follows;

Fig. 1.1 Bus Voltages

The bus voltage of 132 kV bus bars of Bostan Solar, Nohsar, Yaru, Huramzai, Quetta Solar, Quetta Industrial is plotted. The results show quick recovery of the voltages after clearing of fault.

Fig. 1.2 Frequency

We see the system frequency recovers back to normal quickly after fault clearance.

Fig. 1.3 MW/MVAR Output of Solar Power Plant

The pre-fault output of Bostan Solar power plant was 39.57 MW and it gets back to the same output quickly after fast damping of the oscillations in its output. Similarly, MVAR output acquires equilibrium at a same value.

Fig. 1.4 MW/MVAR Output at Adjacent Plant (Quetta Solar PP)

The pre-fault output of Quetta Energy Solar was 39.57 MW and it gets back to the same output quickly after fast damping of the oscillations in its output. Similarly, MVAR output acquires equilibrium at a same value.

Fig. 1.5 MW /MVAR flow on 132 kV Circuit from Bostan Solar to Quetta Solar

Followed by clearing of fault, the trip of 132 kV Circuit from Nohsar to Quetta Solar causes the entire output to flow through the other intact 132kV circuits. We plotted the flows of MW and MVAR on the intact circuit between Bostan Solar and Quetta Solar and see that the power flows on this circuit attains to steady state level with power swings damping down fast.

Fig. 1.6 Voltage Sensor for LVACR

The value for LVACR is restored to its pre-fault value after the fault clears.

Fig. 1.7 Rotor Angles

The rotor angles of the generators of UCH-1 220 kV, UCH-2 220 kV, Engro Energy 200 kV, Guddu New 500 kV and Guddu 220 kV are plotted relative to machines at Hub 500 kV. The results show that the rotor angles get back after the first swing and damp down quickly. The system is strongly stable and very strong in damping the post fault oscillations.

7.3 Conclusion of Dynamic Stability Analysis

The results of dynamic stability show that the system is very strong and stable for the proposed scheme for the severest possible faults near to and far of the Solar Power Plant of Bostan Solar. Therefore, there is no problem of dynamic stability for interconnection of this Solar Power Plant; it fulfils all the criteria of transient stability. The reactive support from the inverter also helps the system stability.

8. Conclusions

- Interconnection Study for 50 MW Enertech Bostan Solar PP is carried out. Given the location of Enertech Bostan Solar Power Plant, the most feasible interconnection scheme for Enertech Bostan Solar and Enertech Quetta Solar Power Plants is by looping in-out of 132 kV Single circuit from Yaru and Nohsar 132kV Grid Station. The looping distance is 17 km whereas the distance between substations of both plants is 0.1 km. The conductor used would be Rail with a thermal capacity of 202 MVA. The complete circuit is shown in Appendix – B.
- The above proposed interconnection scheme has been tested for steady state, short circuit and transient stability conditions through detailed technical studies after the commissioning of Solar Power Plants.
- Detailed load flow studies have been carried out for the peak load conditions of Summer 2019 for the proposed scheme under normal and N-1 contingency conditions to meet the reliability criteria.
- Steady state analysis by load flow for all the scenarios described above reveals that the proposed scheme is adequate to evacuate the maximum power of 39.57 MW of the plant under normal and contingency conditions.
- The short circuit analysis has been carried out to calculate maximum fault levels at the Enertech Bostan Solar Power Plant 132 kV, and the substations of 132 kV in its vicinity. We find that the fault currents for the proposed scheme are much less than the rated short circuit capacities of switchgear installed at these substations. There are no violations of exceeding the rating of the equipment due to contribution of fault current from Enertech Bostan Solar Power Plant.
- The maximum short circuit level of 132 kV bus bar of Enertech Bostan Solar Power Plant is 5.68 kA and 5.60 kA (for the year 2019) for 3-phase and 1-phase faults, respectively. Therefore, industry standard switchgear of the short circuit rating of 40 kA would be fine to be installed at 132 kV switchyard of Enertech Bostan Solar Power Plant as per NTDC requirement taking care of any future generation additions and system reinforcements in its electrical vicinity.
- The dynamic stability analysis of proposed scheme of interconnection has been carried out. The stability check for the worst case of three phase fault right on the 132 kV bus bar of the Solar power plant substation followed by the final trip of

132/33 kV transformer from this substation, has been performed for fault clearing of 5 cycles (100 ms). The system is found strong enough to stay stable and recovered with fast damping. The proposed scheme successfully passed the dynamic stability checks for near and far faults.

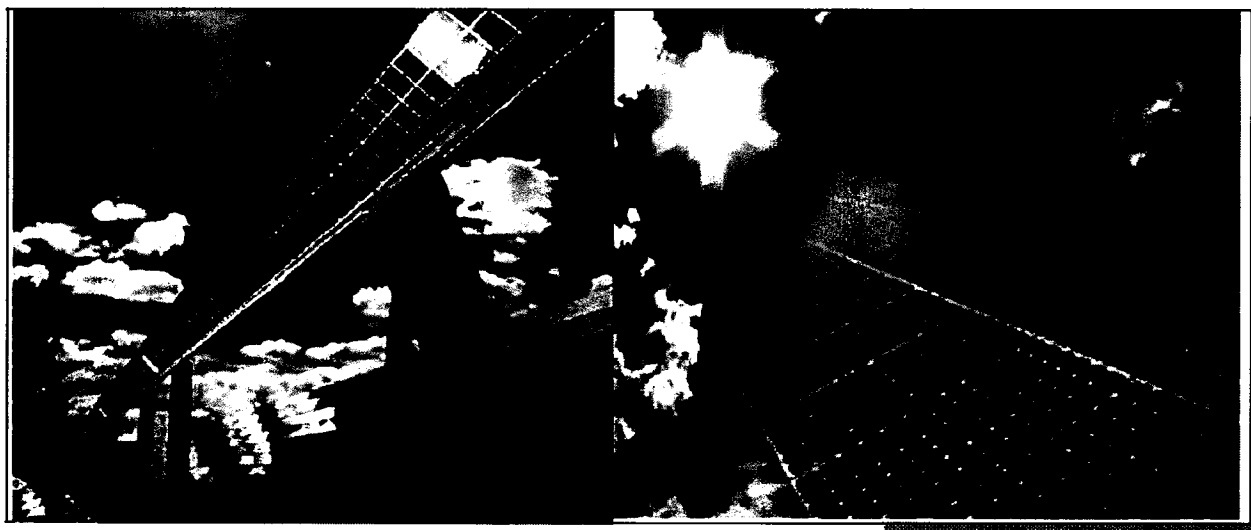
- The proposed scheme of interconnection has no technical constraints or problems, it fulfills all the criteria of reliability and stability under steady state load flow, contingency load flows, short circuit currents, dynamic/transient conditions and power quality; and is therefore recommended to be adopted.

INITIAL ENVIRONMENTAL EXAMINATION (IEE) STUDY REPORT For

50 MW EnerTech Bostan Solar Pvt Limited

at

Moza Neeli Tappa Bostan Quetta



BOSTAN,PISHIN DISTRICT

SEPTEMBER 2017

Initial Environmental Examination (IEE)

Project Number: 54166
September 2017

PAK: MOZA NEELI TAPPA SOLAR POWER PROJECT

Project Proponent: Ener-Tech Holding Company Kuwait,

Prepared by Geological and Environmental Management Services (GEMS)

In Association with:

Geoservices Engineering Consultants (GEC)

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Initial Environmental Examination (IEE)

Project Number: 54166
September 2017

EXECUTIVE SUMMARY

INTRODUCTION

Ener Tech holding company Kuwait has been engaged ***Geological & Environmental Management Services (GEMS)*** in associations with ***Geoservices Engineering Consultants (GEC)*** to prepare an Initial Environmental Examination (IEE) study for a 50 MW solar power project located in Moza Neeli Tesil Karezat Sub Tehsil Bostan, Pishin District, near Kuchlak Zhob main highway in Quetta Capital city of the Balouchistan, Pakistan. As part of this IEE study, an inspection visit was conducted with the assistance of Mr. Atif Saqib Geologist of Geo-services, Maqbool Anwar Rakhshani Ex Deputy commissioner, Muhammad Mati-Ullah Tehsildar, Muhammad Ummer lecturer and local Patwari land revenue department for evaluation of site conditions for technical and environmental study.

Based on the site visit information, publicly available information and from ***GEMS*** and ***GEC,*** s past experience in conducting similar projects, ***GEMS*** and ***GEC*** has prepared this study report on Initial Environment Examination (IEE).

This report describes the various features of Initial Environment Examination of the project site in line with local and international standards. ***GEMS*** and ***GEC*** have also provided recommendations in this report to ensure sustainable development of the project.

The total area concerned piece of state land measuring a 500 Acres, situated in Three (03) KM North of Umarabad towards Khanozoi Right side of Kuchalak-Zhob (N-50) National Highway in Moza Neeli Tappa Bostan Tehsil Karzat. The leased land is situated in the vicinities of latitude 30.45231 longitudes 67.10151 is allotted on the lease basis in favor of Secretary, Government of Balouchistan Energy Department Quetta. This lease land Agreement made on 27th day of July 2017 between the government of Balouchstan, Board of Revenue through Deputy Commissioner/Collector Pishin and Secretary Energy Department through his representative Ashfaq Ahmed (Director Electricity North Energy Department) for following terms and conditions:

- This lease will be initially for a period of (3) years extend able for another period.
- The lease shall not assign, sublet mortgage or transfer in any manner the leased land or any part thereof without the express permission of the Government.
- The lease shall utilize the land for any other purpose except with the prior permission of the board of revenue Balochistan.

Project at a Glance

S. No	Particulars	Descriptions
1.	Project site	Village-Moza Neeli Tappa
2.	Tehsil	Karezat
3.	District Name	Pishin
4.	Name of the Province	Balochistan
5.	Latitude:	30.45231 N
6.	Longitude:	67.10151 E
7.	Road Accessibility:	Asphalt Main highway road is attached to the Site. Motor able Asphalt road is 20m away from the site.
8.	Nearest airport:	50 KM
9.	Nearest Town:	Bostan
10.	Nearest City:	Umarabad
11.	Land available:	500 Acre.
12.	Water Requirement:	Tubwells
13.	Daily Global Solar Irradiance	5.65 kWh/m^2
14.	Daily Diffuse Solar Irradiance	2.01 kWh/m^2
15.	Annual Global Solar Irradiance	2063 kWh/m^2
16.	Annual Diffuse Solar Irradiance Land availability Type of system	732 kWh/m^2 375 Acre Fixed tilt (20 degree)
17.	Type of PV modules	Thin Film
18.	Proposed capacity	50 MW
19.	Capacity of each module proposed	90 Wp / any other compatible size
20.	Model of solar PV module	FS-377
21.	Total number of PV Modules	534000
22.	Inverter Model	Power One PVI 500 TL
23.	Annual electricity supplied to grid	7,38,04,200.0 kWh
24.	Plant load factor (%)-First Year	21.06 %
25.	Project Cost	$ 49 million

Benefits due to Proposed Project

The proposed Project brings in multi fold advantages. Not only does it produce clean, pollution free energy, it also has the capacity to provide employment to the people living in and around that area. It has

the capacity of turning Quetta which is a harsh, barren land into a clean energy producing hub which will be emulated by the other Districts of Pakistan.

OBJECTIVE OF THE IEE STUDY

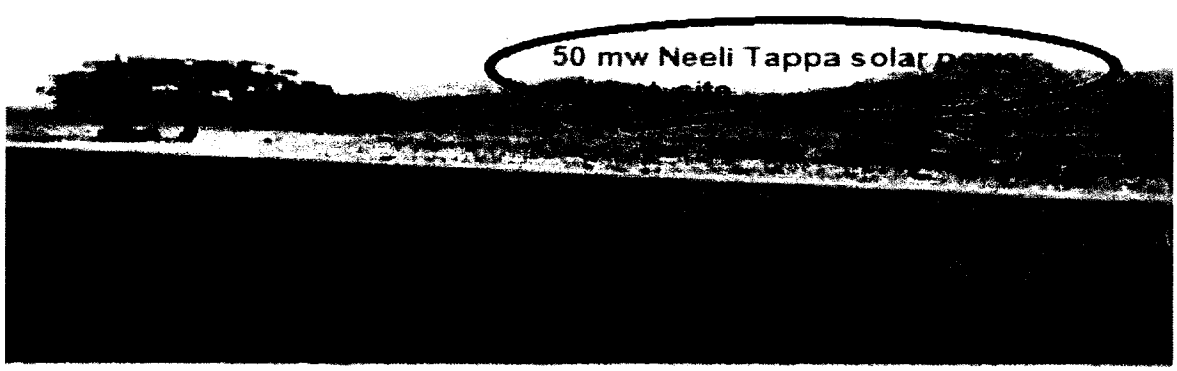
The objective of Initial Environmental Examination (IEE) is to prepare a document based on anticipated Environmental Impact due to setting up of 50 MW Solar Power Project and to applicable local and national regulations.

The proposal is for PV based solar power project and there are no potentially significant adverse and irreversible social and environmental impacts. Therefore, according to the findings of the environmental and social impact assessment study conducted with respect to the establishment of the Project and a review of the broad Equator Principles of the project due to limited adverse social or environmental impacts and these are limited to site-specific, largely reversible and readily addressed through mitigation measures.

PROJECT DESCRIPTION

INTRODUCTION

The plot size for the proposed project site is approximately 450 to 500 acres. The site is located at approximately 50 KM, north-west of Quetta city. The route to access the project site from Quetta starts towards Khanozoi Right side of Kuchalak-Zhob (N-50) National Highway in Moza Neeli Tappa Bostan Tehsil Karezat. Along Kuchalak-Zhob (N-50) National Highway, a town called "Neeli Tappa Town" at approximately 5.1 KM from Bostan. Access to the site is available from this town main highway N 50 National Highway.



Panoramic view of Project Site

PROJECT STATUS

KEY FEATURES OF SITE

- Following are key features of proposed 50MW Solar Power Project:
- The location falls under the 'Hot and Dry' climatic zone of the area and comprises extreme weather conditions of the hot desert.
- The project location comprises well accessibility as the motorable asphalt road is 20m away from the site.
- There are no shading elements like mountains, large sand dunes, trees available on the site. The entire area is shadow free.
- NHA road is located on 20m from the selected project location.
- Nearest Airport is Quetta which is about 50 km from the projected location.
- Nearest City to the site is 10 km.
- Bostan station is the nearest railway station from the location.
- Soil condition at the site is hard sandy and surface is almost flat; hence limited and work is needed to make land flat as per the requirements of solar PV power plant.
- Yaru Ariel is the nearest grid substation for power evacuation.

PROJECT JUSTIFICATION

Pakistan's major electricity sources are a thermal and hydro generation, meeting approximately 70% and 28% (respectively) of the country's annual electricity demand. The primary thermal generation fuels employed are furnace oil and gas. While both are produced domestically, demand already outstrips supply by a considerable amount. Oil import is a significant burden on the national exchequer and the increasing import bill continues to exert further pressure on the foreign exchange reserves. Electricity mix of Pakistan (2013-2014) is presented.

LEGAL POLICIES & INSTITUTIONAL FRAMEWORK

This chapter describes the relevant: national and international policies; legal and administrative framework;

Institutional setup, in respect of the environmental and social assessment of the proposed Project.

Several laws exist in Pakistan containing a number of clauses concerning the protection of the environment. However, the first legislation on environmental protection was issued in 1983.

The Pakistan Environment Protection Ordinance, 1983 was the first legislation promulgated for the protection of the environment. Pakistan Environment Protection Agency was established in 1984. No significant environmental policy, guidelines, and regulations were made till the early 1990s. The National Conservation Strategy was developed and approved by the federal cabinet in 1992. Provincial Environment Protection Agencies were also established in 1992-93. National Environmental Quality

Standards (NEQS) were established in 1993. Detailed environmental guidelines were issued in 1996. The National Assembly and the Senate conferred Pakistan Environment Protection Act in 1997.

NATIONAL ENVIRONMENTAL LAWS

There are several laws in Pakistan which contain provisions relating to the protection of the environment. However, the enactment of comprehensive legislation on the environment, in the form of an act of parliament, is a relatively new phenomenon. Most of the existing laws on environmental and social issues have been enforced over an extended period, and are context specific. The laws relevant to development projects are briefly reviewed below.

POLICY GUIDELINES (www.epa.gov.pk)

National Conservation Strategy

The National Conservation Strategy (NCS) is the primary policy document of the Government of Pakistan (GOP) on national environmental issues of the country. The Strategy approved by the Federal Cabinet in March 1992 was also recognized by International Financial Institutions, principally the World Bank. The NCS had identified 14 core areas including conservation of biodiversity, pollution prevention and abatement, soil and water conservation and preservation of cultural heritage. It had also recommended immediate attention to the stated core areas in order to preserve the environment of Pakistan.

A mid-term review of the NCS in 2000 concluded that achievements under the NCS were primarily awareness raising and institutional building rather than meaningful improvement of the environment and natural resources and that the NCS was neither designed nor adequately focused as a national sustainable development strategy (GOP, November 2002). Thus, the need for a more focused National Environmental Action Plan (NEAP) was formulated and approved by the Pakistan Environmental Protection Council in 2001 to practically improve the national environment with emphasis on poverty reduction, and economic as well as sustainable development.

NEAP now constitutes the national environmental agenda and its core objective is to initiate actions that would safeguard public health, promote sustainable livelihoods and enhance the quality of life of the people of Pakistan.

The GOP and United Nations Development Programme (UNDP) have jointly initiated an umbrella support program called the NEAP-Support Programme that was signed in October 2001 and implemented in 2002. The development objective supported by NEAP-Support Programme is environmental sustainability and poverty reduction in the context of economic growth. The objectives of the new policy have total 171 guidelines on sectoral and cross-sectoral issues. The objectives of new policy include assurance of Sustainable development and safeguard of the natural wealth of country. The following are the approved Sectorial Guidelines:

- Water Supply and Management

- Air Quality and Noise
- Waste Management
- Forestry
- Biodiversity and Protected Areas
- Climate Change and Ozone Depletion
- Energy Efficiency and Renewable
- Agriculture and Livestock
- Multilateral Environmental Agreements
- Biodiversity Action Plan

The key to protection of the biological heritage of Pakistan lies in the involvement of local people and in the support provided by competent institutions for conservation and sustainable use. The Government of Pakistan has recognized the importance of these measures in the preparation of National Conservation Strategy and in becoming a signatory to and ratifying, the Convention on Biological Diversity (CBD) in 1994. Developing the Biodiversity Action Plan for Pakistan, 2000 has been the most significant direct steps towards addressing the biodiversity loss. This law is applicable for all the project and covers the core 14 points of NCS to sustain the environment for the betterment of future generation.

The Biodiversity Action Plan

The Biodiversity Action Plan (BAP), which has been designed to complement the NCS and the proposed provincial conservation strategies, identifies the causes of biodiversity loss in Pakistan and suggests a series of proposals for action to conserve biodiversity in the country.

The Pakistan Environment Protection Act, 1997 is the key legislation empowering the government to frame regulations for the protection of the environment. Detailed rules, regulations, and guidelines required to enforce the Environment Protection Act are still in various stages of development.

ENVIRONMENT INSTITUTIONS AND ADMINISTRATION

The Constitution of Pakistan distributes the legislative powers between the federal and the provincial governments through Federal and Concurrent Lists. The Federal list depicts the areas and subjects on which the Federal government has exclusive powers. The second, concurrent list contains areas and subjects on which both Federal and Provincial governments can enact laws.

The Ministry of Climate Change, Local Government, and Rural Development is responsible for environmental issues at the federal level. The NCS unit within the Ministry ensures implementation of the National Conservation Strategy.

The Pakistan Environment Protection Agency at the federal level is responsible for administering the provisions of the Environment Protection Act. It is responsible to ensure compliance with the NEQS, develop monitoring and evaluation systems and initiate legislation when necessary.

The provincial Environment Protection Agencies are responsible for environmental planning and development, approval of Initial Environmental Examination (IEE) and Environmental Impact Assessments (EIA) of new projects at the provincial level.

LAWS, REGULATIONS, AND GUIDELINES

Pakistan Environment Protection Act, 1997 is the basic law that empowers the Government of Pakistan to develop policies and guidelines for the protection of the country's natural environment. A brief description of the laws is given below;

PAKISTAN ENVIRONMENTAL PROTECTION ACT, 1997

The PEPA, 1997 is the basic legislative tool empowering the government to frame regulations for the protection of the environment. The act is applicable to a broad range of issues and extends to air, water, soil, marine, and noise pollution, as well as to the handling of hazardous wastes.

The key features of the law that have a direct bearing on the proposed project relate to the requirement for an initial environmental examination (IEE) and EIA for development projects. Section 12(1) requires that: "No proponent of a project shall commence construction or operation unless he has filed with the Federal Agency an initial environmental examination or, where the project is likely to cause an adverse environmental effect, an environmental impact assessment, and has obtained from the Federal Agency approval in respect thereof." The Pak-EPA has delegated the power of review and approval of environmental assessments to the provincial environmental protection agencies.

PAKISTAN ENVIRONMENT PROTECTION AGENCY REVIEW OF IEE AND EIA REGULATION, 2000

The Pakistan Environment Protection Agency Review of IEE and EIA Regulations provide the necessary details for preparation, submission, and review of the IEE and EIA. Categorization of projects of IEE and EIA is one of the main components of the Regulations.

The IEE-EIA Regulations, 2000 also provide the necessary details on the preparation, submission, and review of IEE and EIAs.

The following is a brief step-wise description of the approval process:

A project is categorized as requiring an IEE or EIA using the two schedules attached to the Regulations.

An EIA or IEE is conducted as per the requirement and following the Pak-EPA guidelines.

The EIA or IEE is submitted to the concerned EPA—provincial EPAs if the project is located in the provinces or the Pak-EPA if it is located in Islamabad.

A fee, depending on the cost of the project and the type of the report, is submitted along with the document.

The submittal is also accompanied by an application in the format prescribed in Schedule IV of the Regulations.

The EPA conducts a preliminary scrutiny and replies within 10 days of the submittal of a report, a) confirming completeness, or b) asking for additional information, if needed, or c) returning the report requiring additional studies, if necessary.

The EPA is required to make every effort to complete the IEE and EIA review process within 45 and 90 days, respectively, of the issue of confirmation of completeness.

If the EPAs accord their approval subject to a certain condition, then before commencing construction of the project, the proponent is required to submit an undertaking accepting the conditions as per mentioned in Schedule VII.

Before commencing operation of the project, the proponent is required to obtain from the EPA a written confirmation of compliance with the approval conditions and requirements of the EIA.

An Environment Management Plan (EMP) is to be submitted with a request for obtaining confirmation of compliance.

The EPAs are required to issue a confirmation of compliance within 15 days of the receipt of the request and complete documentation.

The EIA approval is valid for three years from the date of the accord.

A monitoring report is to be submitted to the EPA after completion of construction, followed by annual monitoring reports during operation.

PUNJAB ENVIRONMENT PROTECTION AGENCY REVIEW OF IEE AND EIA REGULATION, 2016

The PEPA review of IEE and EIA regulations, 2016 (the 'Regulations'), prepared by the PEPA under the powers conferred by section of Punjab Environmental Protection Act, 2012 provide the necessary details on the preparation, submission, and review of the IEE, EIA and environmental checklist of the project

These regulations classify projects on the basis of the expected degree of severity of environmental impacts and list them in three separate schedules. Schedule-I lists projects that may not have significant environmental impacts and require an IEE. Schedule-II lists projects of potentially significant environmental impacts requiring preparation of an EIA. Schedule-III list projects of screening and requiring preparation of environmental checklist. The Regulations also require under the schedule-II solar energy projects if falls under any sensitive, protected area and under the Clause I: that all projects located in environmentally sensitive areas require preparation of an EIA. PEPA (Review of IEE /EIA regulations) 2016 has been provided in the report.

POLICY FOR DEVELOPMENT OF POWER GENERATION PROJECTS, 2006

The Alternative Energy Development Board was established as an autonomous body attached to the Cabinet Division on 12th May 2003. The AEDB was established to act as a central agency for the development, promotion, and facilitation of renewable energy technologies; the formulation of plans and policies; and the development of a technological base for manufacturing of renewable energy equipment in Pakistan. In February 2006, the administrative control of the AEDB was shifted from the Cabinet Division to the Ministry of Water & Power. The AEDB has developed the national policy for promoting renewable energy sources in the medium and long term, which is known as the Policy for Development of Renewable Energy for Power Generation, 2006 (Power Policy). AEDB is also responsible for procuring land leases from the Revenue department for solar and wind farm projects.

EXISTING ENVIRONMENTAL & SOCIAL CONDITION

GENERAL

Quetta is the provincial capital and largest city of Baluchistan, Pakistan It has a population of 1,001,205 according to the 2017 census. The city is known as the fruit garden of Pakistan, due to the numerous fruit orchards in and around it, and the large variety of fruits and dry fruits produced there. The immediate area has long been one of pastures and mountains, with varied plants and animals relative to the dry plains to the west. Quetta is at an average elevation of 1,680 meters (5,510 feet) above sea level, making it Pakistan's only high-altitude major city. Located in northwestern Baluchistan near the Pakistan-Afghanistan border, Quetta is a trade and communication center between the two countries. The city lies on the Bolan Pass route which was once one of the major gateways from Central Asia to South Asia. Quetta played an

important role militarily for the Pakistani Armed Forces in the intermittent Afghanistan conflict.

STUDY AREA:

An area of 2 km around the project can be considered as influence zone and hence it has been taken as a study area to understand even set in the vicinity of the proposed project. However, as the environmental setting is arrived based on secondary data, all available data has been used for the purpose of Environmental understanding.

DATA SOURCE:

SOIL

The soils of the Arid Zone are generally sandy to sandy-loam in texture. The consistency and depth vary according to the topographical features. The low-lying loams are heavier and may have a hard pan of clay, calcium carbonate ($CaCO_3$) or gypsum. The pH varies between 7 and 9.5. The soils improve in fertility from west and northwest to east and northeast. Desert soils are Regosols of windblown sand and sandy fluviatile deposits, derived from the disintegration of rock in the subjacent areas and blown in from the coastal region and the Indus Valley.

LAND USE

The proposed project area is Government wasteland. There are few shrub thickets near the project site. There are no settlements near the project site. Within the 2 Km survey area, there are some houses, some temporary huts and agricultural fields as shown there. The soil is sandy which is porously comprising of more of gravel and less silt and clay content. There are some sand dunes in the small area. Overall the area is plain with a gentle slope.

ENVIRONMENTAL AND SOCIAL IMPACTS AND MITIGATION MEASURES

The proposed project may have an impact on the environment during construction & operation phases. During the construction phase, the impacts may be regarded as temporary or short-term; while long term impacts may be observed during the operation stage. Spatially the impacts have been assessed over the study area of 2 km radius of the project site.

The project has overall positive impacts by providing a competitive, cost-effective, pollution free reliable mode of Solar PV power. It will certainly meet the ever increasing Demand of Power and to bridge the Gap between Demand and Supply of Power.

ENVIRONMENTAL & SOCIAL MANAGEMENT PLAN

INTRODUCTION

Environmental & Social Management Plan is an implementation plan to mitigate and offset the potential adverse environmental & social impacts of the project and enhance the positive impacts. Based on the environmental baseline conditions, planned project activities and impacts assessed earlier, this section enumerates the set of measures to be adopted to minimize the adverse impacts. The process of implementing mitigation and compensatory measures, execution, agencies responsible for their implementation and indicative costs is discussed in this chapter.

The project has overall positive impacts by providing a competitive, cost-effective, pollution free reliable mode of Solar PV power. It will certainly meet the ever increasing Demand of Power and to bridge the Gap between Demand and Supply of Power.

ENVIRONMENTAL & SOCIAL MANAGEMENT PROCESS

The ESMP has been designed within the framework of the requirement under Pakistan legislation and ADB's SPS on environmental and socio-economic aspects.

The mitigation measures to be adopted for the implementation of the proposed project include the following:

- Environmental Management Plan;
- Rainwater Harvesting
- Clean Development Mechanism;
- Occupational Health and Safety;
- Labor Working Conditions;
- Construction Labor Management;
- Environmental Action and Monitoring Plan;
- Community Development Plan;
- Public Consultation and Information Disclosure Plan;
- Grievance Redressal Mechanism;
- Disaster Management Plan

CONSULTATION, PARTICIPATION, AND DISCLOSURE

INTRODUCTION

The need for public consultation and disclosure arises from the universal belief that transparency and accountability are fundamental to fulfilling any development mandate and in strengthening public involvement in the decision making process.

For all Categories, "A" and "B" projects the project proponent or third party experts must have consulted with project affected communities in a structured and culturally appropriate manner. The public consultation should involve affected communities; the process must ensure their free, prior and informed consultation (FPIC) and facilitate their informed participation.

CONCLUSION AND RECOMMENDATION

Impacts are manageable and can be managed cost effectively - Environmental impacts are likely to result from the proposed transmission system development. Careful mitigation and monitoring, specific selection criteria and review/assessment procedures for subprojects have been specified to ensure that minimal impacts take place. The detailed design would ensure inclusion of any such environmental impacts that could not be specified or identified at this stage are taken into account and mitigated where necessary. Those impacts can be reduced through the use of mitigation measures such as a correction in work practices at the construction sites, or through the careful selection of sites and access routes.

The proposed project will have a number of positive impacts and negative impacts to the existing environment as follows:

Significantly improvement in the economic activities in the surrounding areas due to the generation of direct and indirect employment opportunities.

There is the negligible removal of trees for the transmission line, which is the main positive impact to the proposed project area. Compensatory afforestation will take place where tree removal is unavoidable.

Environment pollution due to cut and fill operations, transportation of construction materials, disposal of debris, nuisance from dust, noise, vehicle fumes, black smoke, vibration are the short term negative impacts due to the proposed project.

Based on the environmental and social assessment and surveys conducted for the Project, the potential adverse environmental impacts can be mitigated to an acceptable level by adequate implementation of the mitigation measures identified in the EMP. Adequate provisions are being made in the Project to cover the environmental mitigation and monitoring requirements, and their associated costs. Adequate provisions are being made by the owner of the project to cover the environmental mitigation and monitoring requirements, and their associated costs.

CONCLUSIONS

An environment and social analysis have been carried out looking at various criteria such as topology, air, noise, water resources and water quality, ecology, demography of the area, climate and natural habitat, community, and employee health and safety etc. The impact analysis found that due to careful consideration of environmental and social aspects during route and site selection by the proponent, no major adverse impacts are expected. There is no adverse impact on the migration of habitat, any natural existing land resources, and effect in the regular life of people. The environment and social impact associated with transmission line project is limited to the extent of the construction phase and can be mitigated through a set of recommended measures and adequate provision for the environment and social impacts which cover monitoring, measuring and mitigation.

EMP has been prepared. Most impacts are expected to occur during the construction phase and are considered to be of a temporary nature. The transmission corridor was carefully selected after undergoing an options assessment. This enabled the right of way alignment to bypass villages and important water supplies and resources. The main project impacts are associated with clearing of shrub vegetation, waste management and excavation and movement of soils.

From this perspective, the project is expected to have a small "environmental footprint". No endangered or protected species of flora or fauna are reported at any of the subproject sites. Adequate provisions have been made for the environmental mitigation and monitoring of predicted impacts, along with their associated costs.

CHAPTER 1

INTRODUCTION

M/S Ener Tech holding company Kuwait solar power Pvt Ltd. incorporated under the Companies Act, in Pakistan. ETC Solar Power is a well-capitalized, listed group company, established to develop, construct and operate power projects, domestically. The feasibility study of the 50 mw Ener -Tech Bostan Solar Pvt Ltd. project is in progress and will complete soon.

The sponsors of M/S ETC Kuwait Pvt Ltd is very competent and motivated person actively involved to reduce the energy crises in Province. The sponsors belong to Quetta and are land lords since 5 decades. The chairman of the board Malik Yasir and Asad Khan has a broad vision to boost up the clean energy projects with limited emissions of the greenhouse gasses (GHG) in the atmosphere.

1.2 PROJECT STATUS

KEY FEATURES OF SITE

Following are key features of proposed 50MW Solar Power Project:

- The location falls under the 'Hot and Dry' climatic zone of the area and comprises extreme weather conditions of the hot desert.
- The project location comprises well accessibility as the motor-able asphalt road is 20m away from the site.
- There are no shading elements like mountains, large sand dunes, trees available on the site. The entire area is shadow free.
- NHA Highway is located on 20m from the selected project location.
- Nearest Airport is Quetta which is about 50 km from the projected location.
- Nearest City to the site is 10 km.
- Bostan Station is the nearest railway station from the location.
- Soil condition at the site is hard sandy and surface is almost flat; hence limited and work is needed to make land flat as per the requirements of solar PV power plant.
- Yaru-Arrel is the nearest grid substation for power evacuation.

1.3 PROJECT JUSTIFICATION

Pakistan's major electricity sources are a thermal and hydro generation, meeting approximately 70% and 28% (respectively) of the country's annual electricity demand. The primary thermal generation fuels employed are furnace oil and gas. While both are produced domestically, demand already outstrips supply by a considerable amount. Oil import is a significant burden on the national exchequer and the increasing import bill continues to exert further pressure on the foreign exchange reserves. Electricity mix of Pakistan (2013-2014) is presented in Figure 1.1

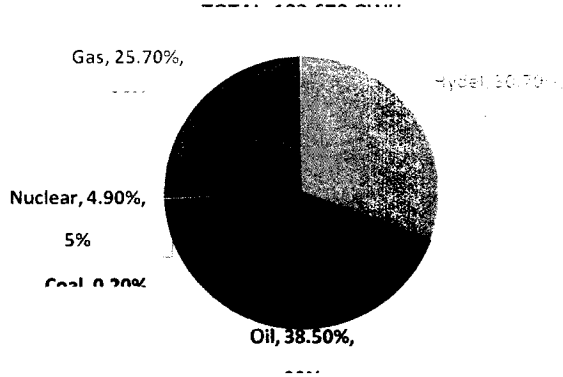


Figure 1.1: Electricity Mix of Pakistan by Source[1]

Import of gas could be seen as a viable option to overcome the depleting domestic reserves. However, gas import has significant issues, mainly the need for substantial capital investment in infrastructure, security difficulties and physical terrain concerns. Moreover, it would increase Pakistan's reliance on imported fuels with associated foreign exchange burdens. This must be considered in the context of rising fuel costs for gas and oil-based fuels as a result of uncertainty over future supply.

Alternatives to further fuel imports for electricity generation are the production of domestic coal, generation from hydroelectric power, or other renewable sources, such as the wind and solar power. These options will assist in reducing Pakistan's reliance on imported oil and protect against resulting vulnerability to changes in global oil prices, which will in turn also have a positive effect on the current trade deficit and inflating import bill.

As with gas, securing future supplies of domestic coal and hydroelectric power would require significant spending on infrastructure. While Pakistan has domestic reserves of coal, it currently makes up a very small proportion of the country's total power generation. This is due, in part, to the fact that most of the reserves are located in the remote Thar Desert region. Exploiting the coal reserves would require significant upfront investment in local infrastructure (including the provision of water supplies), development of mines, housing, and related infrastructure, and investment in transmission lines, as a pre-requisite to any power plant development. Hydro-electric power already supplies almost 30% of the domestic

[1] Energy Year Book of Pakistan 2014

The electricity that is generated and numerous sites for future investment exist. However, due to their locations, this would also require significant investment in transmission and other infrastructure. Moreover, there are various political issues relating to the development of hydroelectric and coal generation power plants, which remain to be resolved.

In light of the prevailing circumstances at how the country's future electricity needs might be in a way that supports the environmental objectives of the Government of Pakistan; solar power generation appears to be a viable and environmentally friendly alternative for meeting Pakistan's urgent electricity demands. The development of solar power generation projects could reduce dependence on oil based thermal power generation, increase diversity in Pakistan's electricity generation mix, and reduce greenhouse gas (GHG) emissions, all of which will contribute towards projecting a positive image of Pakistan within the international community.

1.4 PROSPECTS OF SOLAR ENERGY IN PAKISTAN

Solar energy has excellent potential in areas of Pakistan that receive high levels of solar radiation throughout the year. Every day, for example, the country receives an average of about 19 Mega Joules per square meter of solar energy.

Pakistan is in the Sun Belt is ideally located to take advantage of solar energy technologies. This energy source is widely distributed and abundantly available in the country. The mean global irradiation falling on a horizontal surface is about 200-250 watt per sqm in a day. This amounts to about 2500-3000 sun shine hours and 1.9 - 2.3 MWh per sqm in a year. It has an average daily global insulation of 19 to 20 MJ/sqm per day with an annual mean sunshine duration of 8 to 8.5 hours (6-7hrs in cold and 10-12 hrs in hot season) and these values are among the highest in the world. For daily global radiation, up to 23MJ/m2, 24 (80%) consecutive days are available in this area for solar energy. Such conditions are ideal for solar thermal applications.

To summarize, the sun shines for 250-300 days per years in Pakistan with an average sun shine hours of 8-10 per day. This gives a huge amount of energy to be used for electricity generation by solar thermal power plants.

A quick idea for the potential of solar energy in Pakistan can be obtained from the satellite map of solar radiation released by National Renewable Energy Lab (NREL) of the USA shown in Figure 2-2.

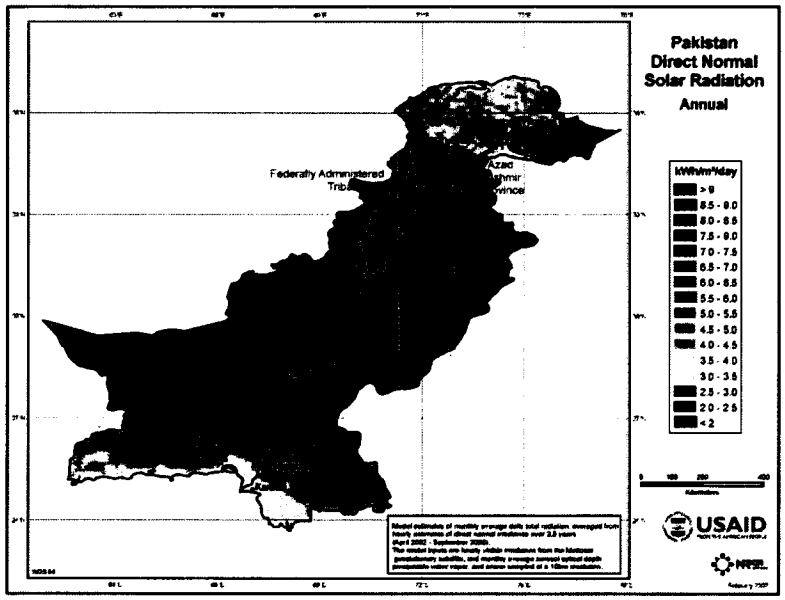


Figure 1.2: Solar Map of Pakistan

PROJECT OBJECTIVES

The overall objectives of the project are;

- Contribute to meeting the electricity supply deficit in the project area in particular; and country in general.
- Provide electricity to stimulate and support the expansion of local industry and service businesses.
- By using indigenous renewable resources of power generation, avoid depletion of natural resources for future generation and environmental stability.
- Create employment opportunities during construction and operations and also provide opportunities for developing eco-tourism.
- Contribute to improved electricity supply service delivery to a limited extent specifically having a wide rural outreach.
- Improve microeconomic efficiency of the power sector by reducing fossil fuel usage.
- Reduce greenhouse gas emissions from power generation and contribute to negligible emission, effluent, and solid waste intensity of power generation in the system.
- Conserve natural resources including land, forests, minerals, water, and ecosystems.
- Improve the local physical infrastructure such as roads and transmission network in the project area.

2 http://www.nrel.gov/international/ra_pakistan.html

Develop the local economy and create employment, particularly in rural areas and in a district that is considered as backward area, a priority concern of the Government of Pakistan.

1.6 OBJECTIVE OF THE ESIA STUDY

Pakistan Environmental Protection Act 1997 (PEPA 1997) requires the proponents of every development project in the country to submit either an Initial Environmental Examination or Environmental Impact Assessment to the concerned environmental protection agency.

The IEE/EIA Regulations 2000 issued under PEPA 1997 provides separate lists for the projects requiring IEE or EIA. Since the total power generation capacity of the proposed project is less than 200 MW, therefore IEE study is performed. Also in a various meeting organized by AEDB, EPA, UNEP, it was agreed to follow the same criteria for IEE or EIA as stipulated for thermal and hydro projects.

Both guidelines provide separate lists for the projects requiring IEE or EIA. This Initial Environmental Examination (IEE) report has been prepared in accordance with the provisions in the Pakistan Environmental Protection Agency (Review of IEE and EIA) Regulations, 2000. According to these regulations, an IEE is required for projects falling in any category listed in Schedule-I of the regulations, and an EIA is required for projects listed in Schedule-II of the regulations. These are also mentioned in the Punjab Environmental Protection Agency Regulations, 2016 and according to this regulation the e project falls in Schedule-I and required IEE study.

The document has been prepared to considering the requirements of **ADB's Safeguard Policy Statement 2009** as well as local and national standards. To comply with other lender's requirement, the IEE report also addresses **IFC's and World Bank group performance standards**.

In the context of the scope of the project, the IEE report has addressed the following objectives, where applicable;

The purpose of Initial Environmental Examination (IEE) is to identify the reasonably foreseeable environmental and social effects of the activities that will be conducted under this project;

- Category of the project consistent with Pakistan Environmental Protection Act, 1997
- Highlight baseline environmental and social conditions of the project area along with identification of environmentally sensitive area and concerned stakeholders
- Relevant host country laws, regulations, applicable treaties and agreements
- Protection of human health, cultural properties, and biodiversity including endangered species and sensitive ecosystems
- Major hazards; Occupational health and safety; Fire prevention and life safety
- Socioeconomic impacts; Land use: Land acquisition; Involuntary resettlement
- Impacts on indigenous peoples and communities; if applicable
- Cumulative impacts of existing proposed and anticipated future projects
- Efficient production, delivery and use of energy; and
- Pollution prevention and waste minimization, pollution controls (liquid effluent and air emissions) and solid and chemical waste management.
- GHG reduction potential.

1.7 CONCLUSIONS ON CATEGORY OF PROJECTS

The proposal is for PV based solar power project and there are no potentially significant adverse and irreversible social and environmental impacts. As per ADB Criteria of financing a project, environmental categorization of projects are being done according to type, size and location of the proposed project into 4 categories-A, B, C, and FI. The proposed Solar PV project falls under **'Category-B'** as per ADB's Environmental Categorization criteria. Also, a review of the broad Equator Principles criteria and requirements for the classification of Category 'A', 'B' & 'C' projects has indicated that the Solar Power Project is more closely aligned to 'Category B' project due to limited adverse social or environmental impacts and these are limited to site specific, largely reversible and readily addressed through mitigation measures.

1.8 METHODOLOGIES AND APPROACH OF IEE

The IEE study is focused on developing the environmental profile of the project area so as to evaluate the (baseline data) existing conditions on the physical and biological environment, and social environment together with

the anticipated environmental impacts and proposed mitigation measures.

A detailed assessment of the social and biological environment of the area **needs to be conducted** through field survey for the distance up to 10 Km radius of the project site, however, the influence zone of the environmental impacts should be considered as 5 Km.

The main purpose of IEE study is to ensure that:

- Any major adverse impact on the environment (physical, ecological and social) during different phases of projects viz. siting, design, construction, and operation are identified.
- Adverse impacts are appropriately addressed and adequate mitigation measures are incorporated in the siting, design, construction and operation phases of the project. Socioeconomic aspects are identified, and mitigation measures have been identified.
- Alternatives to achieve the objectives are analyzed.
- Environmental and Social Management Plan (ESMP) for sustainable development and operation of the project is developed for implementation and monitoring of the project activities.

The present IEE report has identified the significant environmental and social aspects and screened the potential aspects to ensure that the likely impacts due to proposed activities during construction, installation of Solar PV and operation of the proposed project, and the residual impact on adoption of mitigation measures have been critically assessed with respect to compliance with the Pakistan Environmental Protection Act 1997, Punjab Environment Protection Act 1997 (Amended 2012), the ADB Safeguard Policy Statement 2009 and World Bank, IFC. This report has been prepared based on the existing and available information to date.

The overall methodology and the main phases specifically adopted for conducting the IEE of The Project may be summarized as follows.

1.9 STRUCTURE OF REPORT

The report consists of seven chapters (including the present chapter) and the contents of the remaining chapters are briefly described in this section.

- **Chapter 2: Legal Policies and Institutional Framework:**
- **Chapter 3: Project Description:**
- **Chapter 4: Baseline Status:**
- **Chapter 5: Anticipated Environmental and Social Impacts and Mitigation Measures:**
- **Chapter 6: Environmental & Social Management Plan:**
- **Chapter 7: Public Consultation, Participation and Disclosure:**
- **Chapter 8: Conclusions & Recommendations:**

CHAPTER 2

LEGAL POLICIES & INSTITUTIONAL FRAMEWORK

2.1 INTRODUCTION

This chapter describes the relevant: national and international policies; legal and administrative framework; and institutional setup, in respect of the environmental and social assessment of the proposed Project.

Several laws exist in Pakistan containing a number of clauses concerning the protection of the environment. However, the first legislation on environmental protection was issued in 1983.

The Pakistan Environment Protection Ordinance, 1983 was the first legislation promulgated for the protection of the environment. Pakistan Environment Protection Agency was established in 1984. No significant environmental policy, guidelines, and regulations were made till the early 1990s. The National Conservation Strategy was developed and approved by the federal cabinet in 1992. Provincial Environment Protection Agencies were also established in 1992-93. National Environmental Quality Standards (NEQS) were established in 1993. Detailed environmental guidelines were issued in 1996. The National Assembly and the Senate conferred Pakistan Environment Protection Act in 1997.

2.2 NATIONAL ENVIRONMENTAL LAWS

There are several laws in Pakistan which contain provisions relating to the protection of the environment. However, the enactment of comprehensive legislation on the environment, in the form of an act of parliament, is a relatively new phenomenon. Most of the existing laws on environmental and social issues have been enforced over an extended period, and are context specific. The laws relevant to development projects are briefly reviewed below.

2.3 POLICY GUIDELINES (www.epa.gov.pk)

National Conservation Strategy

The National Conservation Strategy (NCS) is the primary policy document of the Government of Pakistan (GOP) on national environmental issues of the country. The Strategy approved by the Federal Cabinet in March 1992 was also recognized by International Financial Institutions, principally the World Bank. The NCS had identified 14 core areas including conservation of biodiversity, pollution prevention and abatement, soil and water conservation and preservation of cultural heritage. It had also recommended immediate attention to the stated core areas in order to preserve the environment of Pakistan.

A mid-term review of the NCS in 2000 concluded that achievements under the NCS were primarily awareness raising and institutional building rather than meaningful improvement of the environment and natural resources and that the NCS was neither designed nor adequately focused as a national sustainable development strategy (GoP, November 2002). Thus, the need for a more focused National Environmental Action Plan (NEAP) was formulated and approved by the Pakistan Environmental Protection Council in 2001 to practically improve the national environment with emphasis on poverty reduction, and economic as well as sustainable development.

NEAP now constitutes the national environmental agenda and its core objective is to initiate actions that would safeguard public health, promote sustainable livelihoods and enhance the quality of life of the people of Pakistan.

The GOP and United Nations Development Programme (UNDP) have jointly initiated an umbrella support program called the NEAP-Support Programme that was signed in October 2001 and implemented in 2002. The development objective supported by NEAP-Support Programme is environmental sustainability and poverty reduction in the context of economic growth. The objectives of the new policy have total 171 guidelines on sectoral and cross sectoral issues. The objectives of new policy include assurance of sustainable development and safeguard of the natural

wealth of country. The following are the approved Sectorial Guidelines:

- Water Supply and Management
- Air Quality and Noise
- Waste Management
- Forestry
- Biodiversity and Protected Areas
- Climate Change and Ozone Depletion
- Energy Efficiency and Renewable
- Agriculture and Livestock
- Multilateral Environmental Agreements
- Biodiversity Action Plan

The key to protection of the biological heritage of Pakistan lies in the involvement of local people and in the support provided by competent institutions for conservation and sustainable use. The Government of Pakistan has recognized the importance of these measures in the preparation of National Conservation Strategy and in becoming a signatory to and ratifying, the Convention on Biological Diversity (CBD) in 1994. Developing the Biodiversity Action Plan for Pakistan, 2000 has been the most significant direct steps towards addressing the biodiversity loss. This law is applicable for all the project and covers the core 14 points of NCS to sustain the environment for the betterment of future generation.

The Biodiversity Action Plan

The Biodiversity Action Plan (BAP), which has been designed to complement the NCS and the proposed provincial conservation strategies, identifies the causes of biodiversity loss in Pakistan and suggests a series of proposals for action to conserve biodiversity in the country.

The Pakistan Environment Protection Act, 1997 is the key legislation empowering the government to frame regulations for the protection of the environment. Detailed rules, regulations, and guidelines required to enforce the Environment Protection Act are still in various stages of development.

2.4 ENVIRONMENT INSTITUTIONS AND ADMINISTRATION

The Constitution of Pakistan distributes the legislative powers between the federal and the provincial governments through Federal and Concurrent Lists. The Federal list depicts the areas and subjects on which the Federal government has exclusive powers. The second, concurrent list contains areas and subjects on which both Federal and Provincial governments can enact laws.

The Ministry of Climate Change, Local Government, and Rural Development is responsible for environmental issues at the federal level. The NCS unit within the Ministry ensures implementation of the National Conservation Strategy.

The Pakistan Environment Protection Agency at the federal level is responsible for administering the provisions of the Environment Protection Act. It is responsible to ensure compliance with the NEQS, develop monitoring and evaluation systems and initiate legislation when necessary

The provincial Environment Protection Agencies are responsible for environmental planning and development, approval of Initial Environmental Examination (IEE) and Environmental Impact Assessments (EIA) of new projects at the provincial level.

2.5 LAWS, REGULATIONS AND GUIDELINES

Pakistan Environment Protection Act, 1997 is the basic law that empowers the Government of Pakistan to develop policies and guidelines for the protection of the country's natural environment. A brief description

of the laws is given below;

2.6 PAKISTAN ENVIRONMENTAL PROTECTION ACT, 1997

The PEPA, 1997 is the basic legislative tool empowering the government to frame regulations for the protection of the environment. The act is applicable to a broad range of issues and extends to air, water, soil, marine, and noise pollution, as well as to the handling of hazardous wastes.

The key features of the law that have a direct bearing on the proposed project relate to the requirement for an initial environmental examination (IEE) and EIA for development projects. Section 12(1) requires that: "No proponent of a project shall commence construction or operation unless he has filed with the Federal Agency an initial environmental examination or, where the project is likely to cause an adverse environmental effect, an environmental impact assessment, and has obtained from the Federal Agency approval in respect thereof." The Pak-EPA has delegated the power of review and approval of environmental assessments to the provincial environmental protection agencies.

2.7 PAKISTAN ENVIRONMENT PROTECTION AGENCY REVIEW OF IEE AND EIA REGULATION, 2000

The Pakistan Environment Protection Agency Review of IEE and EIA Regulations provide the necessary details for preparation, submission, and review of the IEE and EIA. Categorization of projects of IEE and EIA is one of the main components of the Regulations.

The IEE-EIA Regulations, 2000 also provide the necessary details on the preparation, submission, and review of IEEs and EIAs.

The following is a brief step-wise description of the approval process:

- A project is categorized as requiring an IEE or EIA using the two schedules attached to the Regulations.
- An EIA or IEE is conducted as per the requirement and following the Pak-EPA guidelines.
- The EIA or IEE is submitted to the concerned EPA—provincial EPAs if the project is located in the provinces or the Pak-EPA if it is located in Islamabad.
- A fee, depending on the cost of the project and the type of the report, is submitted along with the document.
- The submittal is also accompanied by an application in the format prescribed in Schedule IV of the Regulations.
- The EPA conducts a preliminary scrutiny and replies within 10 days of the submittal of a report, a) confirming completeness, or b) asking for additional information, if needed, or c) returning the report requiring additional studies, if necessary.
- The EPA is required to make every effort to complete the IEE and EIA review process within 45 and 90 days, respectively, of the issue of confirmation of completeness.
- If the EPAs accord their approval subject to a certain condition, then before commencing construction of the project, the proponent is required to submit an undertaking accepting the conditions as per mentioned in Schedule VII.
- Before commencing operation of the project, the proponent is required to obtain from the EPA a written confirmation of compliance with the approval conditions and requirements of the EIA.
- An Environment Management Plan (EMP) is to be submitted with a request for obtaining confirmation of compliance.
- The EPAs are required to issue a confirmation of compliance within 15 days of the receipt of the request and complete documentation.
- The EIA approval is valid for three years from the date of the accord.

- A monitoring report is to be submitted to the EPA after completion of construction, followed by annual monitoring reports during operation.

2.8 PUNJAB ENVIRONMENT PROTECTION AGENCY REVIEW OF IEE AND EIA REGULATION, 2016

The PEPA review of IEE and EIA regulations, 2016 (the 'Regulations'), prepared by the PEPA under the powers conferred by section of Punjab Environmental Protection Act, 2012 provide the necessary details in the preparation, submission, and review of the IEE, EIA and environmental checklist of the project

These regulations classify projects on the basis of the expected degree of severity of environmental impacts and list them in three separate schedules. Schedule-I lists projects that may not have significant environmental impacts and require an IEE. Schedule-II lists projects of potentially significant environmental impacts requiring preparation of an EIA. Schedule-III list projects of screening and requiring preparation of environmental checklist. The Regulations also require under the schedule-II solar energy projects if falls under any sensitive, protected area and under the Clause I: that all projects located in environmentally sensitive areas require preparation of an EIA. PEPA (Review of IEE /EIA regulations) 2016 has been provided in the report.

2.9 POLICY FOR DEVELOPMENT OF POWER GENERATION PROJECTS, 2006

The Alternative Energy Development Board was established as an autonomous body attached to the Cabinet Division on 12th May 2003. The AEDB was established to act as a central agency for the development, promotion, and facilitation of renewable energy technologies; the formulation of plans and policies; and the development of a technological base for manufacturing of renewable energy equipment in Pakistan. In February 2006, the administrative control of the AEDB was shifted from the Cabinet Division to the Ministry of Water & Power. The AEDB has developed the national policy for promoting renewable energy sources in the medium and long term, which is known as the Policy for Development of Renewable Energy for Power Generation, 2006 (Power Policy). AEDB is also responsible for procuring land leases from the Revenue department for solar and wind farm projects.

2.10 PROJECT DEVELOPMENT IN TERMS OF POLICY FRAMEWORK

The following paragraphs describe the timelines to obtain the permits:

Sr. No.	Activity Description	Duration (From 0 months)
1.	Issuance of Letter of Allocation of Project Land	0 months
2.	Completion and approval of feasibility studies (FS)	2 months
3.	Application of Generation License and Tariff Determination to NEPRA.	3 months
4.	Agreed Terms Sheet for Debt	4 months
5.	Achievement of Financial Close	5 months
6.	Achievement of Commercial Operation Date (COD)	6 months

CHAPTER 3

PROJECT DESCRIPTION

3.1 INTRODUCTION

The total area concerned piece of state land measuring a 500 Acres, situated in Three (03) KM North of Umarabad towards Khanozoi Right side of Kuchalak-Zhob (N-50) National Highway in Moza Neeli Tappa Bostan Tehsil

Karzai. The leased land is situated in the vicinities of latitude 30.45231 longitudes 67.10151 is allotted on the lease basis in favor of Secretary, Government of Balochistan Energy Department Quetta. This lease land Agreement made on 27th day of July 2017 between the government of Balochistan, Board of Revenue through Deputy Commissioner/Collector Pishin and Secretary Energy Department through his representative Ashfaq Ahmed (Director Electricity North Energy Department) for following terms and conditions

This lease will be initially for a period of (3) years extend able for another period.

The lease shall not assign, sublet mortgage or transfer in any manner the leased land or any part thereof without the express permission of the Government.

The lease shall utilize the land for any other purpose except with the prior permission of the board of revenue Baluchistan.

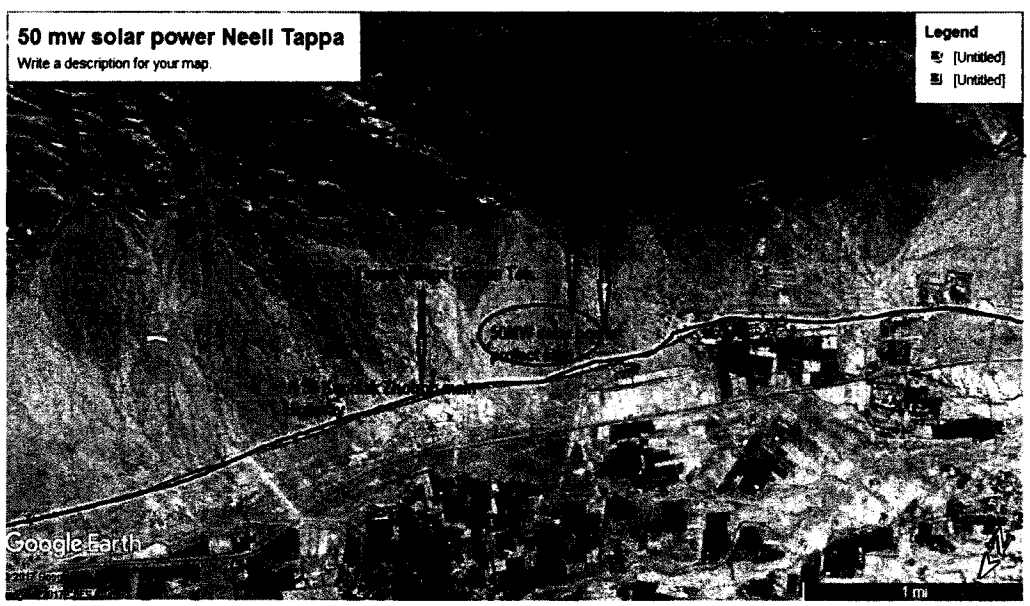


Figure 3.1 Location of the project

3.2 Project Accessibility

Three (03) KM North of Umarabad towards Khanozoi Right side of Kuchalak-Zhob (N-50) National Highway in Moza Neeli Tappa Bostan Tehsil Karzat Black Top Bituminous road passing through the project site.

Along Kuchalak-Zhob (N-50) National Highway, a town called "Neeli Tappa Town" at approximately 5.1 KM from Bostan. Access to the site is available from this town main highway N 50 National Highway.

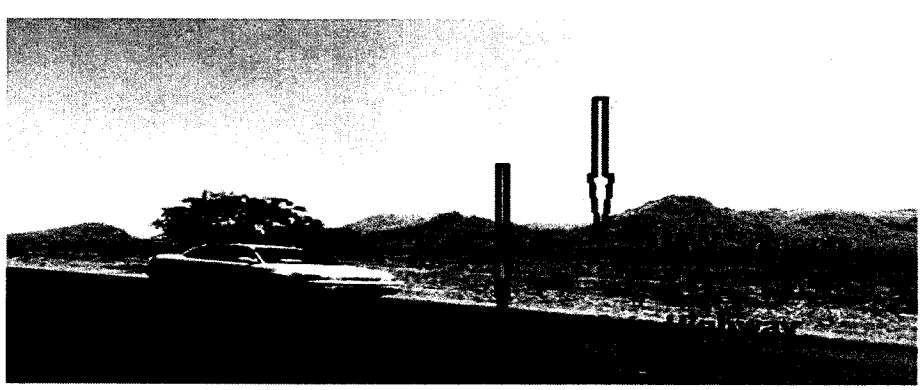


Figure 3.2 Panoramic view of Site access

3.3 LOCATION OF GRIDS

According to the following information from Electric Supply Company, there is a Grid Station which is operational 25 kilometers far from the project site.

Conversion of 01 No.66 KV Grid Station to 132 KV (AIS) Grid Station at Yaru Ariel with associated 132 KV D/C Transmission line (approx 25 KM from project site).

BASELINE ENVIRONMENTAL CONDITIONS

3.3.1 Project Area

Moza Neeli Tesil Karezat Sub Tehsil Bostan, Pishin District, near Kuchlak Zhob main highway in Quetta Capital city of the Balochistan, Pakistan. As part of this IEE study, an inspection visit was conducted with the assistance of Mr. Atif Saqib Geologist of Geo-services, Maqbool Anwar Rakhshani Ex Deputy commissioner, Muhammad Mati-Ullah Tehsildar, Muhammad Ummer lecturer and local Patwari land revenue department for evaluation of site conditions for technical and environmental study.

Based on the site visit information, publicly available information and from GEMS' past experience in conducting similar projects, GEMS has prepared this study report on Initial Environment Examination.

This report describes the various features of Initial Environment Examination of the project site in line with local and international standards. GEMS has also provided recommendations in this report to ensure sustainable development of the project.

The total area concerned piece of state land measuring a 500 Acres, situated in Three (03) KM North of Umarabad towards Khanozoi Right side of Kuchalak-Zhob (N-50) National Highway in Moza Neeli Tappa Bostan Tehsil Karzat. The leased land is situated in the vicinities of latitude 30.45231 longitudes 67.10151 is allotted on the lease basis in favor of Secretary, Government of Balochistan Energy Department Quetta. This lease land Agreement made on 27th day of July 2017 between the government of Balochistan, Board of Revenue through Deputy Commissioner/Collector Pishin and Secretary Energy Department through his representative Ashfaq Ahmed (Director Electricity North Energy Department) for following terms and conditions

This lease will be initially for a period of (3) years extend able for another period.

The lease shall not assign, sublet mortgage or transfer in any manner the leased land or any part thereof without the express permission of the Government.

The lease shall utilize the land for any other purpose except with the prior permission of the board of revenue Balochistan.

3.3.2 Topography

Soil type is generally silty clay and in stable conditions and not in loose dust form. Based on the findings from the site visit the Albedo value may range between 0.40 for Desert Sand to 0.25 for Grassland.

Elevation varies between 203 meters to 235. There were also accumulated water spots. The topographic study shall be conducted for this project.

Figure 3.3 Accumulated water ways

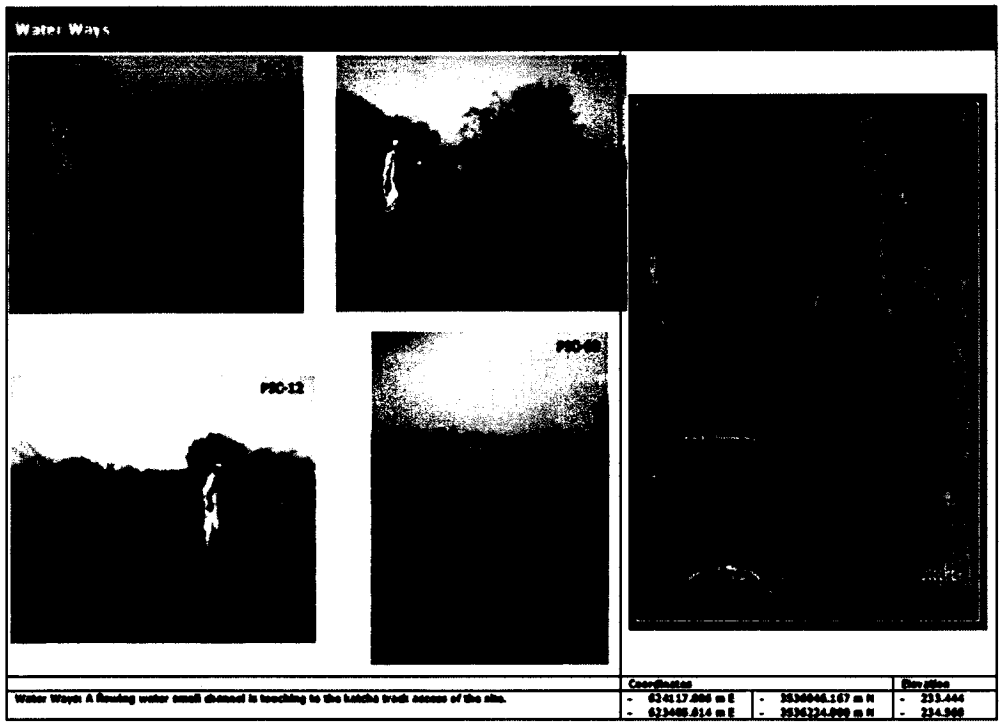


Figure 3.4 Site Soil

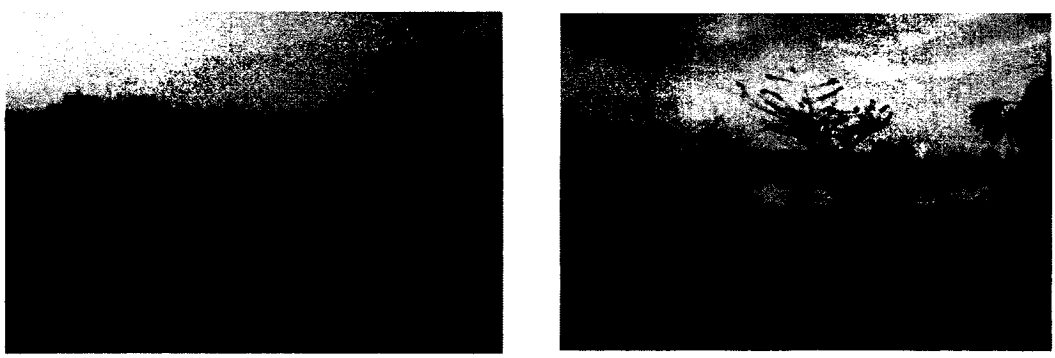


Figure 3.5 Site Alluvium

3.4 Climatology

The climate in the Quetta district is "desert." There is virtually no rainfall during the year. This climate is considered to be BWh according to the Köppen-Geiger climate classification. The average annual temperature in Quetta is 24.5 °C. The average annual rainfall is 249 mm. The driest month is November, with 3 mm of rain. In July, the precipitation reaches its peak, with an average of 63 mm. June is the warmest month of the year. The temperature in June averages 34.4 °C. At 12.1 °C on average, January is the coldest month of the year. There is a difference of 60 mm of precipitation between the driest and wettest months. The variation in annual temperature is around 22.3 °C.

	January	February	March	April	May	June	July	August	September	October	November	December
Avg. Temperature (°C)												
Min. Temperature (°C)	4.5	7.6										5.4
Max. Temperature (°C)												
Avg. Temperature (°F)												
Min. Temperature (°F)	40.1	45.7										41.7
Max. Temperature (°F)												
Precipitation / Rainfall (mm)	12	16	29	21	15	15	53	46	18	4	3	7

Figure 3.6 Historical average weather data for Quetta district

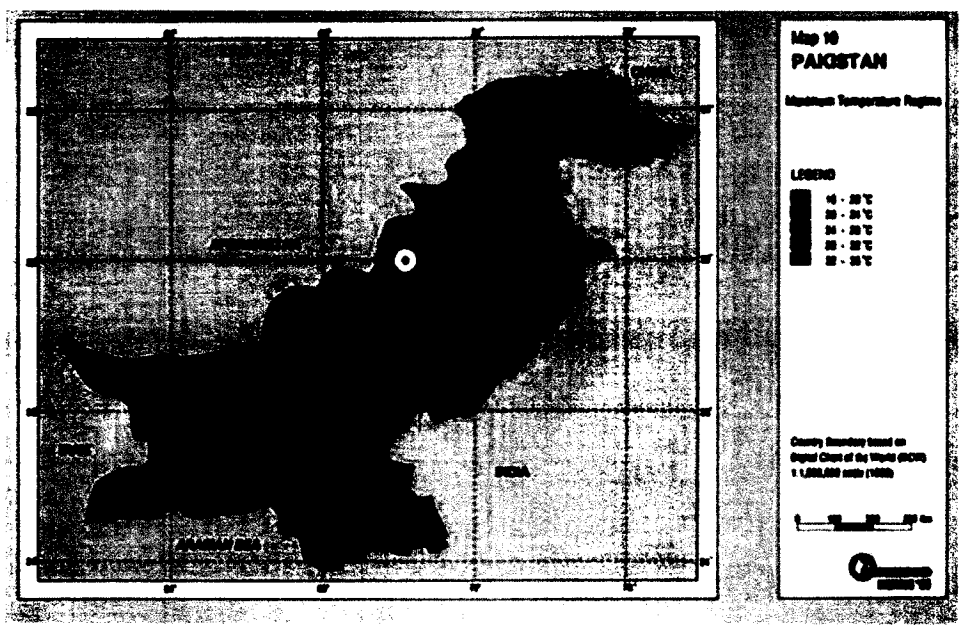


Figure 3.7 Maximum Temperature Regime Map of Pakistan

Figure 3.8: Rainfall Map of Pakistan

3.4 Biological Environment

3.4.1 Flora

The site does not have any protected flora. Only a few bushes and trees were found of 0.5m to 6m height, scattered from each other. There is no such threatening or endangers species exist as indicated by IUCN red list of the

species. There is not any environmentally sensitive area located in or near to the buffer zone of the project. There is no impact of project activity on the environmentally sensitive area.

3.9.1Fauna

Figure 3.9.2 Tree on site

During the site visit, there was cattle and livestock (cows and goats) found resting at the area. Apart from that, there are other species present in the area like diversified lizards and snakes.

3.5 Human Settlement Pattern

Quetta is the provincial capital and largest city of Baluchistan, Pakistan It has a population of 1,001,205 according to the 2017 census. The city is known as the fruit garden of Pakistan, due to the numerous fruit orchards in and around it, and the large variety of fruits and dry fruits produced there. The immediate area has long been one of pastures and mountains, with varied plants and animals relative to the dry plains to the west. Quetta is at an average elevation of 1,680 meters (5,510 feet) above sea level, making it Pakistan's only high-altitude major city.

Located in northwestern Baluchistan near the Pakistan-Afghanistan border, Quetta is a trade and communication center between the two countries. The city lies on the Bolan Pass route which was once one of the major gateways from Central Asia to South Asia. Quetta played an important role militarily for the Pakistani Armed Forces in the intermittent Afghanistan conflict.

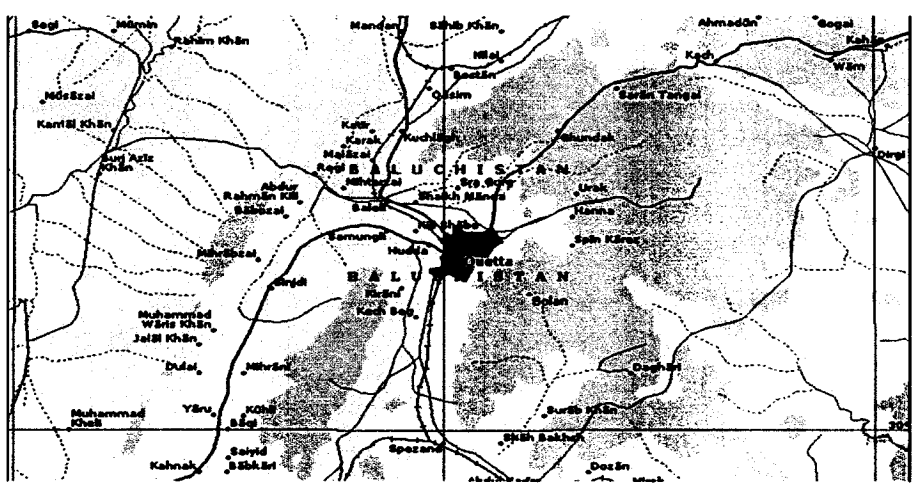


Figure 3.10 Population distribution in Quetta district

3.6 Classification of Land

It is evident from the table given in section 3.1 that 83 thousand Ha. arable land is potentially available for cultivation in the district. The area under cultivable waste is 43.37 thousand Ha. From the table, it can be seen that 47% of the 265,287 Ha. The area is not yet reported. The area which is now considered as cultivable waste that holds potential for future development. The table below provides information regarding irrigated and unirrigated areas.

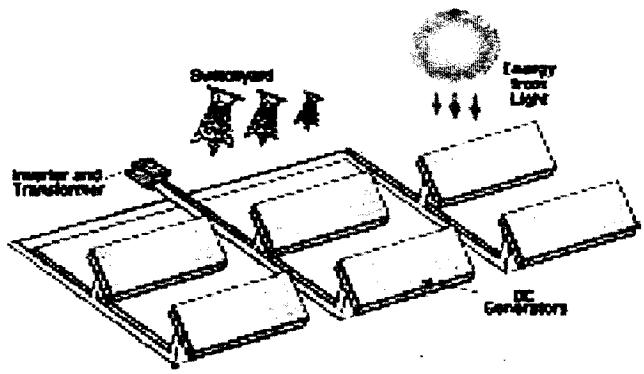
Irrigated v/s Un-irrigated Areas.

Year	Irrigated Area	Un-irrigated Area	Total Area
1992-93	10.661 (94%)	680 (6%)	11.341 (100%)
1993-94	11.978 (95.9%)	516 (4.1%)	12.494 (100%)
1994-95	12.138 (95.5%)	574 (4.5%)	12.712 (100%)

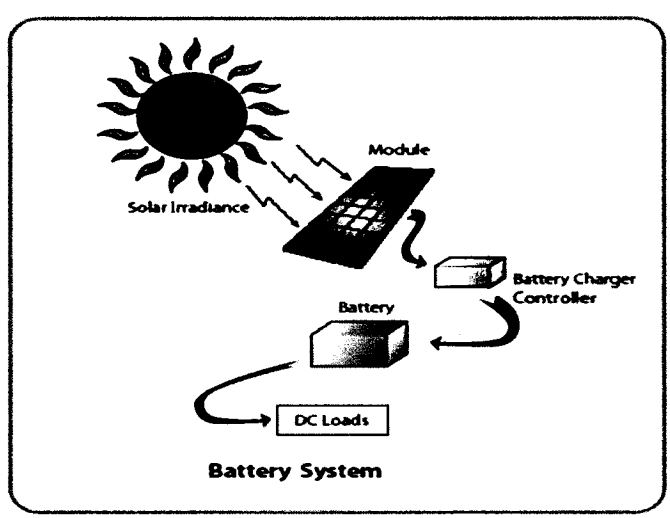
Source: Agricultural Statistics of Baluchistan 92-93, 93-94 and 94-95.

It can be seen from the table that the total area under cultivation during 1992-93 to 1994-95 has ranged from 11,341 to 12,712 Ha. The proportion of irrigated area has hovered around 94%. Farmers do not take the risk to cultivate un-irrigated lands. This is mainly due to the uncertain nature of rainfall. It should be noted that the total area mentioned in the table is much smaller than the arable land area given in the table in paragraphs the area in the table above gives the actual cultivated land in the years concerned.

3.7 PROCESS OF POWER GENERATION:



Photovoltaic (PV) is a method of generating electrical power by converting solar radiation into direct current electricity using semiconductors that exhibit the photovoltaic effect. Photovoltaic power generation employs solar panels composed of a number of cells containing a photovoltaic material. Materials presently used for photovoltaic include monocrystalline silicon, polycrystalline silicon, amorphous silicon, cadmium telluride, and copper indium selenide/sulfide Photovoltaic is the direct conversion of light into electricity at the atomic level. Some materials exhibit a property known as the photoelectric effect that causes them to absorb photons of light and release electrons. When these free electrons are captured, an electric current result that can be used as electricity.



3.8 LAYOUT

The major considerations which have been taken into account while planning the layout of various facilities in the plant are predominantly wind directions, power evacuation corridor, etc. Layout plan is enclosed in **Figure.**

The 50 MWp power plant should be a combination of 10 units of the 4MWp power unit. Each 4MWp power unit

will consist of 31 units of 131kWp PV system. Each 4MW PV system will be connected to 5 no of Inverter of 800kW each. Total 55556 strings should be planned for 40MW Solar PV Project which is located in a distributed manner throughout the plant. There should be total eight nos. of LT control Building and 2 nos. HT control Building.

Each LT Control Building consists of 1 5/3/2MVA, 33/0.415/0.415kV Transformer and 5 no of Inverter of 800kW and one LT switchboard for combining the power of five inverters. HT Control Building should consist of 1 no of 5/3/2MVA, 1 no. of 33/0.415/0.415kV Transformer, 1 no of 250kVA, 33/0.415kV Auxiliary Transformer and 33kV Metal Clad switchgear consisting of 6 nos. of O/G Feeders and 1 no of I/C Feeder. The 250kva auxiliary transformer should be fed to the auxiliary load of the HT & LT Control Buildings. HT side of 5/3/2MVA inverter transformer should be connected with the 33kV switchgear of HT Control Building through 33kV cable. The power output of the two 33kV Switchgear i.e. totals 50 MW approx. should be merged together in a 33kV Main Switchgear which is located in 33kV Main Switchgear Building. The main 33kV switchgear, located at 33kV Main switchgear Building, should be connected with two nos. of MVA power transformer through 33kV cable for evacuating power to proposed 220 kV switchyard through suitable rated overhead lines. Auxiliary load for 33kV Switchyard and HT Control Building should be fed from 250kVA Auxiliary transformer located at the HT Control Building

There will be a 300mm separation between two strings in a row. 2mt separation should be provided between two adjacent rows. A 5mt wide continuous road connecting all the ten blocks should run across the plant. The location also facilitates routing of 33kV underground cable for exporting power without interfering with the PV array layout.

Parameter	**Value**
PV Module	80Wp
Module length	1.2m
Module width	0.6 m
Module area	0.72 sqm
Capacity	80 Wp
Layout for one 4MWp Block	
Total capacity	4MWp
No. of Modules	534000
Spacing between two rows	2.0 m
Space + one row of module	3.8m
Area required for one 4MW block	115610.3sqmt.
Area required for ten 4MW block(A1)	1156103sqmt.
Area of 11 control building and 5mt road across the plant (A2)	39897 sqft.
Total Area required(A1 +A2)	1196000sqmt

Solar PV Array: Thin Film Solar PV technology has been selected for the 50 MW Solar PV Power Project. It should perform satisfactorily in relative humidity up to 100% with temperatures between -10°C and +85°C and withstand gust up to 200 km/h from the back side of the panel. This is qualified to IEC 61701.

Inverter and Control: Grid interconnection of PV systems is accomplished through the inverter which converts DC power generated from PV modules to high-quality AC power to the utility system at reasonable cost.

3.9 PLANT CONSTRUCTION & IMPLEMENTATION

Project Implementation Schedule

An implementation schedule, outlining the sequence of major activities and the time required for engineering, construction, installation, and commissioning of the 50MW solar PV power plant.

3.10 Plant Operation and Maintenance

The operation of the solar power plant is relatively simple and restricted to daylight hours. With automated functions of inverter and switchyard controllers, the maintenance will be mostly oriented towards better upkeep and monitoring of the overall performance of the system. The solar PV system requires the least maintenance of all power generation facility due to the absence of fuel, intense heat, rotating machinery, waste disposal, etc. However,

keeping the PV panels in good condition, monitoring and correcting faults in the connected equipment and cabling are still required to get maximum energy from the plant.

3.11 POWER TRANSMISSION LINE

The power generated from the proposed solar power plant should be evacuated through a 220KV transmission line to 220kV.

The power generated from the proposed solar PV power plant at LT level should be stepped up first to 33 kV level through suitably rated Transformers & then to 220 kV level.

3.11.1 Power Evacuation:

Several solar panels should be connected together through junction boxes & cables & feed power to an inverter. Inverter AC power should be stepped up for connection with the grid. For the proposed power plant, the solar panels should be suitably connected in series & parallel combinations as per the inverter requirement. The output of the modules should be taken from module terminal boxes through suitable size cable connection. Series junction boxes (as required) should be considered for each series mounting structure for taking out final output. Array junction boxes (as required) should be located suitable for paralleling various series junction box (SJB) outputs. Terminal blocks should be provided in the array junction box for paralleling +ve & -ve electrical output from different series junction boxes based on the configuration of array junction box.

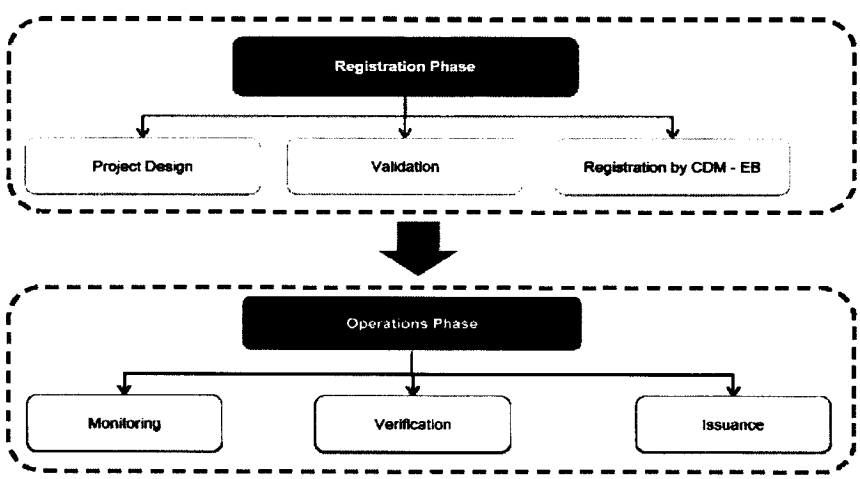
Main junction boxes should be used to connect the output of array junction boxes, the output of main junction boxes working as an input to the inverter. In the proposed scheme, inverters of 500kW each have been considered. The 320V Outputs of Four (4) nos. inverters are connected to the 320V LT panel. The Three winding step-up transformer of proposed rating 2500 kid should be used to step-up the voltage to 33kV level. The 33kv side of such five transformers, combining 10MW power, should feed 33kV switchgear which should be located in the HT Control Building. The power output of the two 33kV Switchgear i.e. totals 40 MW approx. should be merged together in a 33kV Main Switchgear which is located in 33kV Main Switchgear Building. The main 33kV switchgear building is approximately 2kM away from each of the HT Control Building. The interconnection between the two 33kV switchgear should be through the 33kV line. The Power should be evacuated by the use of 2 nos. of 18/24/30 MVA, 33/245kV Power Transformers through suitable rated overhead lines.

3.11.2 Forest clearance:

During detailed engineering, the forest/non-forest areas involved if any shall be identified and authenticated by concerned authorities. Forest clearance as per the requirements of the state/MOE&F shall be obtained. However, a preliminary survey shows that there is no forest land involved.

3.12 CDM Project Cycle

CDM Project cycle comprises of two major phases, registration and operation, to generate Carbon credits. These include:



3.12.1 Solar PV Project

As a part of the renewable energy source Solar Power projects are eligible to generate (CERs) under the Approved Consolidated Methodology (ACM0002). Crediting period of the CERs for the projects could be a fixed 10-year crediting period or a variable crediting period of 7 years not extending beyond 3 such periods (21 years). Approach to calculate CERs required to be followed under ACM0002 is mentioned below

3.12.2 Baseline Information:

As per the ACM0002, Baseline Emission factor / Emission Intensity of the NEWNE grid is calculated in line with Combined Margin (CM) approach providing weights to Operating Margin (OM) and Build Margin (BM) emission factors.

Central Electricity Authority (CEA), a statutory body incorporated under the Ministry of Power, Govt. of Pakistan, annually publishes "Baseline Carbon Dioxide Emission Database". As part of the Baseline Carbon Dioxide Emission Database, OM and BM for both NEWNE and Southern grids are disclosed publicly. For the most recent year, CEA in its publication "Baseline Carbon Dioxide Emission Database - Version 06" has released the required data. The process of calculation of CM emission factor for NEWNE grid is given below:

Combined Margin emission factor:

Parameter	Unit	Value
Weighted Av. OM for last three years	tCO2/MWh	0.9941
Weight of OM	WOM	75%
BM	tCO2/MWh	0.8123
Weight of BM	WBM	25%
CM	tCO2/MWh	0.9487

3.12.3 Electricity Generation:

As mentioned in the document earlier, Project will operate at a load factor of 19.06% which in turn would generate 66,786 MWh (Net) as mentioned as below:

The annual emission reductions for the entire crediting period of 10 years are noted as below 63,360.

Outlook

In Conference of Parties (CoP) 16 held, at Cancun, Mexico, in 2010, both the developed nations and developing nations adopted Cancun Adaptation Framework. Section 83 of the Cancun Adaptation Framework undertake to maintain and build upon the existing mechanism which means the CERs issued for the project activity would continue to meet compliance requirements for the next phase of the commitment period

Several Analyst reports suggest that the prices of the CERs would be higher than the prevailing CER prices (11.95 for the week ended June 17, 2011

CHAPTER 4

EXISTING ENVIRONMENTAL & SOCIAL CONDITION

4.1 GENERAL

Quetta is the provincial capital and largest city of Baluchistan, Pakistan It has a population of 1,001,205 according to the 2017 census. The city is known as the fruit garden of Pakistan, due to the numerous fruit orchards in and around it, and the large variety of fruits and dry fruits produced there. The immediate area has long been one of pastures and mountains, with varied plants and animals relative to the dry plains to the west. Quetta is at an average elevation of 1,680 meters (5,510 feet) above sea level, making it Pakistan's only high-altitude major city.

Located in northwestern Baluchistan near the Pakistan-Afghanistan border, Quetta is a trade and communication center between the two countries. The city lies on the Bolan Pass route which was once one of the major gateways from Central Asia to South Asia. Quetta played an important role militarily for the Pakistani Armed Forces in the intermittent Afghanistan conflict.

4.2 STUDY AREA:

An area of 2 km around the project can be considered as influence zone and hence it has been taken as a study area to understand even set in the vicinity of the proposed project. However, as the environmental setting is arrived based on secondary data, all available data has been used for the purpose of Environmental understanding.

4.3 DATA SOURCE:

4.4 SOIL

The soils of the Arid Zone are generally sandy to sandy-loam in texture. The consistency and depth vary according to the topographical features. The low-lying loams are heavier and may have a hard pan of clay, calcium carbonate ($CaCO_3$) or gypsum. The pH varies between 7 and 9.5. The soils improve in fertility from west and northwest to east and northeast. Desert soils are Regosols of windblown sand and sandy fluviatile deposits, derived from the disintegration of rock in the subjacent areas and blown in from the coastal region and the Indus Valley.

4.5 LAND USE

The proposed project area is Government wasteland. There are few shrub thickets near the project site. There are no settlements near the project site. Within the 2 Km survey area, there are some houses, some temporary huts and agricultural fields as shown in Figure. The soil is sandy which is porously comprising of more of gravel and less silt and clay content. There are some sand dunes in the small area. Overall the area is plain with a gentle slope.

Quetta comprises maximum wasteland which is essentially desert area in the country as well as highest solar radiation. Vicinity of the project area is almost sandy & barren.

4.6 CLIMATE

District Quetta has a very dry climate with very hot summer; a cold winter and sparse rains. The climate is extremely hot during summer with the maximum temperature reaching up to 49.2 degrees Celsius and extremely cold during winter with a minimum temp. in the range of 1-degree celsius. The variation in temperature from morning to noon and the late midnight is a sudden phenomenon. The average rainfall is only 16.4 cms as against the state average of 57.51 cms.

4.7 MICRO CLIMATE

The project area is located in the 'Hot and Dry' Climatic Zone1 of the country. According to Surface Meteorology and Solar Energy (SMSE) of NASA, site location receives daily global solar radiation from 3.31 kWh/m2 (in December) to 6.78 kWh/m2 (in June) over the year. The annual global solar radiation over the horizontal surface has been estimated as 1883 kWh/m2. The annual global solar radiation over the inclined surface (i.e. at the latitude of the location) has been estimated as 1995 kWh/m2. The microclimatic parameters namely ambient temperature, relative humidity, and prevailing wind speed of the project area are given in Table below for each month of the year. The rain fall data of the region of last 3 years average has also been presented in the region.

Month	Wind speed (m/s)	Air temperature (°C)	Relative Humidity (%)
Jan	3.8	16.3	38.3
Feb	3.9	18.7	32.7
Mar	4.0	24.7	25.6
Apr	4.1	29.1	28.2
May	4.5	31.6	36.6
Jun	4.8	31.1	54.7
Jul	3.9	29.6	67.4
Aug	3.4	28.7	69.7
Sep	3.6	28.8	56.4
Oct	3.5	27.3	34.7
Nov	3.7	22.7	29.4
Dec	3.8	18.2	35.0

4.8 TEMPERATURE

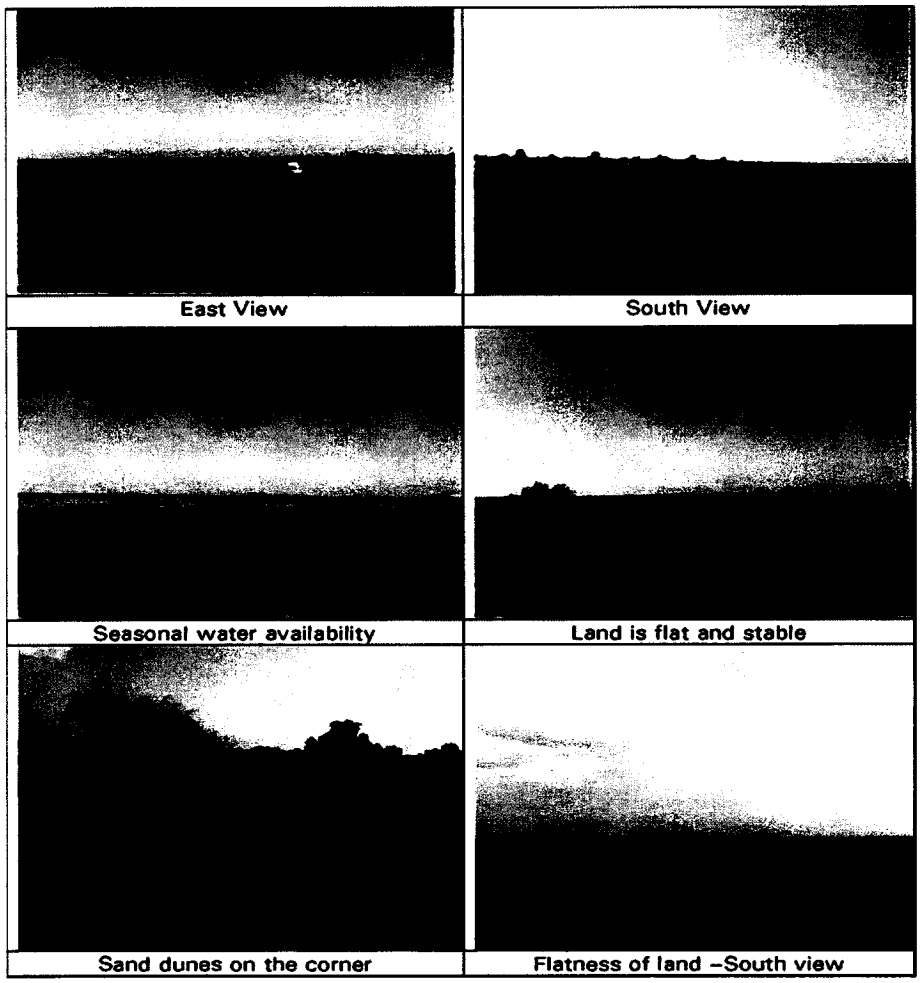
On average winter temperatures ranges from 8 to 28° C and summer temperatures range from 25 to 46° C.

4.9 WIND SPEED

Analysis of hourly wind speed shows that the winds are generally light to moderate in this area. The annual mean wind speed varies from 1.30 to 6.30 Km/hr.

4.10 WIND PATTERN

The wind rose diagram for seasonal has been drawn on the basis of hourly wind speed and direction data. South West wind is dominant throughout the season.



4.11 TERRESTRIAL ECOLOGY

The study area falls in the Thar Desert which is important from the biogeographic point of view as it presents an admixture of Palaearctic and Indo-Malayan elements. The 'Thar' desert is situated in the west of the Aravali ranges and lies between 24^0 00' N and 35^0 5' N latitude and 70^0 7' and 76^0 2' E longitude. The 'Thar' desert is a biologist's paradise with respect to the types of wild animals in general and the carnivores in particular.

4.11.1 Flora

The floristic and faunal description is based on literature review and field observations. The study area shows almost plain topography. The area is poor in forest resources. The physical set-up of the area, meteorological and hydrogeological conditions, and hostile to any form of life, plant or animal has tended to make the area almost barren and desolate.

The general feature of the study area shows a sparse vegetation cover and is largely dominated by Cutch Tree (*Acacia catechu*), bushes of *Calotropis gigantic*, Khejri (*Prosopis spicier* linn.), *Tropaeolum majus* and Chhota pile (*Salvadora persica*). Occasionally a fine carpet of grasses, Brut (*Cenchrus setigerous*) and Sean (*Elanorus hirsutism*) comes up with the first shower of rains and vanishes after three months of a short cycle. However, this vegetation is utilized both by cattle and men; cattle for their fodder and men for their fuel wood, thatching material, vegetable, medicines, and food. The other plant species observed within the study area are given in the table below:

Trees, Shrubs, and Herbs

1. *Acacia notice*
2. *Acacia senegal*
3. *Aerva catechu*
4. *Calligonum polygonoides*
5. *Calotropis Procera*
6. *Capparis deciduas*
7. *Citrullus colocynthis*
8. *Crotalaria burhde*
9. *Indigofera cordifolia*
10. *Leptadenia pyrotechnica*
11. *Maytenus emerginatus*
12. *Prosopis cineraria*
13. *Prosopis juliflora*
14. *Salvadora persica*
15. *Tecomella undulata*
16. *Tephrosia purpurea*
17. *Ziziphus nummularia*

Grasses and Hedges

1. *Aristida adscensionis*
2. *Cenchrus bulflorus*
3. *Cypurus perkinsonia*
4. *Cypurus canglomeratus*
5. *Elaenorus hirsutus*
6. *Dactyloctenium scindicum*
7. *Lasiurus sindicus*
8. *Ochthochloa compressa*
9. *Panicum antidotale*
10. *Pennisetum glaucum*
11. *Stipagrostis hirtigluna*

4.11.1 Fauna

The study on terrestrial fauna in the study area is based on the field investigation, reports of Forest Department, Documents of University and Zoological Survey of Pakistan. Due to scanty vegetation growth in this region, not much of varied animal life is found in this State. Despite this, still, a large variety of animals are found in this area. The different variety of faunal life can be categorized as (i) Primates, (ii) Carnivores, (iii) Angulated, (iv) Rodents, (v) Lagomorpha, (vi) Insectivore and (vii) Crustivore. Corresponding to its variegated topography and climate, the state has a wealth of animal life.

Mostly domestic animal like cow, sheep, buffalo, and goat are reported in the study area.

List of Fauna observed in Study Area

S.No	Scientific Name	Local Name
Mammals		
1	*Presbytis entellus*	Langoor
2	*Canis aureus*	Siyaar/ Jackal
3	*Gervus unicolor*	Sambhar
4	*Herpestes odwardsitotus*	Nebla
5	*Vulpus bengalensis*	Pakistann Fox
6	*Canis lupus*	Wolf
7	*Pipistrellus mimus*	Pakistann Pygmy Pipistrell
8	*Funambulus pennanti*	Five-striped Squirrel
9	*Tatera indica*	Pakistan Gerbille
Reptiles		
10	*Varanus monitor*	Goh
Avifauna		
11	*Vanollus indicus*	Red-wattled lapwing
12	*Himantopus himantopus*	Black winged stilt
13	*Columba livia*	Blue rock pigeon
14	*Streptopelia decaccto*	Ring dove
15	*Corvus spelendens*	House Crow
16	*Turdoides caudatus*	Common Babbler
17	*Copsychus saularjs*	Magpie Robin
18	*Passer domesticus*	House Sparrow
19	*Pavo cristatus*	Peacock
S.No	**Scientific Name**	**Local Name**
20	*Francolinus pondicarinus*	Titar
21	*Pycnonotus cafer*	Bulbul

National Parks and Wildlife Sanctuaries

There is no any wildlife sanctuary within 25km of the project area. The distance of desert national park from the site is at distance of 75 km.

Endangered Flora & Fauna

With reference to the list of endangered species prepared by Botanical Survey of Pakistan (BSP) and Zoological Survey of Pakistan (ZSP), Ministry of Environment and Forests, Government of Pakistan, none of the species present in the study area belonged to the endangered flora & fauna categorized under Schedule I.

4.12 BASELINE SOCIO-ECONOMIC STATUS

General

The study was undertaken with respect to demography, occupational pattern, land holding, literacy rate and other important socio-economic indicators of each District to decipher the socioeconomic structure of the entire project area.

CHAPTER 5

ENVIRONMENTAL AND SOCIAL IMPACTS AND MITIGATION MEASURES

5.1 INTRODUCTION

The proposed project may have an impact on the environment during construction & operation phases. During the construction phase, the impacts may be regarded as temporary or short-term; while long term impacts may be observed during the operation stage. Spatially the impacts have been assessed over the study area of 2 km radius of the project site.

The project has overall positive impacts by providing a competitive, cost-effective, pollution free reliable mode of Solar PV power. It will certainly meet the ever increasing Demand of Power and to bridge the Gap between Demand and Supply of Power.

5.2 POTENTIAL IMPACT GENERATION ACTIVITES

The construction and operation phase of the proposed project comprises various activities each of which may have an impact on environmental parameters.

During the construction phase, the following activities may have impacts on the environment:

- Site preparation
- Minor excavation and leveling
- Hauling of earth materials and wastes
- Cutting and drilling
- Erection of concrete and steel structures
- Road construction
- Painting and finishing
- Clean up operations
- Landscaping and afforestation

The activities can be divided into two categories, viz. sub-structural and super-structural work. Moreover, construction work will involve cutting of trenches, excavation, concreting etc. All these activities attribute to dust pollution. The super-structural work will involve steel work, concrete work, masonry work etc. and will involve the operation of large construction equipment like cranes, concrete mixers, hoists, welding sets etc. There may be the emission of dust and gases as well as noise pollution from these activities.

Mechanical erection work involves extensive use of mechanical equipment for storage, transportation, erection and on-site fabrication work. These activities may generate some air contaminants and noise pollution. The electrical activities are less polluting in general. Potential Impacts and Mitigation Measures (for construction and operation phase) is given in Appendix **V.**

5.3 IMPACT DURING CONSTRUCTION PHASE

The environmental impact during the construction phase is localized and of short term magnitude. However, as this project land shall be govt. barren land, the change in land use will be minimum.

The impact is primarily related to the civil works and some intensive impact due to the erection of the equipment. The details of the activities and probable impact are brought out in the table below:

TABLE 5.1: IDENTIFICATION OF ACTIVITIES & PROBABLE IMPACTS (CONSTRUCTION PHASE)		
Construction Activities	**Environment Attribute**	**Probable Impacts**
Land Acquisition	Land	□ No significant impact on land-use is expected.
	Socioeconomics	□ No Impact due to Rehabilitation & Resettlement issues is expected as govt. wasteland is being acquired for the project.
Site clearing and Leveling (cutting, stripping, excavation, earth movement, compaction)	Air	❖ Fugitive Dust Emissions ❖ Air Emissions from construction equipment and machinery
	Water	□ Runoff from construction area
	Land	□ Loss of top soil
	Ecology	□ Minimal loss of vegetation/habitat as the site has barren land with almost no vegetation.
Transportation and Storage of Construction Material/ Equipment	Air	❖ Air Emissions from vehicles ❖ Fugitive Dust Emissions due to traffic movement
	Water	□ Run-off from Storage Areas of construction Material
	Public Utilities	□ Increased flow of traffic
Civil Construction Activities	Air	❖ Air Emissions from construction machinery ❖ Fugitive Dust Emissions
	Water	□ Runoff from Construction Areas
Mech. and Elec. Erection Activities	Air	□ Air Emissions from Machines / activities
Influx of Labour and construction of temporary houses	Socioeconomics	❖ Employment opportunities shall increase ❖ Stress on infrastructure
	Land	□ Change in land use pattern of the area
	Water	□ Sanitary effluents from labor colonies
Transportation and Disposal of Construction Debris	Air	❖ Air Emissions from Transport Vehicles ❖ Fugitive Dust Emissions due to Movement of Traffic ❖ Spillage and fugitive emissions of debris materials
	Water	□ Run-off from Disposal Areas
	Soil	□ No Conversion of land into the waste land as already barren land.

5.3.1 Impact on Land Use

The land required for the proposed expansion project will be about 140 hectares. The construction activities attract a sizeable population and the influx of population is likely to be associated with construction of temporary hutments for construction workforce, having an effect on land use pattern of the areas surrounding the project. However, this impact is envisaged to be insignificant due to following reasons.

- Temporary labor colonies shall be situated in the areas already acquired for the project.
- It will be only a temporary change (restricted to construction period). After construction phase, the areas acquired by labor colonies shall be reverted back similar to pre construction stage

Further, M/S ETC shall also be in the process to improve the infrastructure of the area such as roads, schools, hospitals, etc. The project would add to the economic development of the area through allied business, which will be set-up along with the plant.

5.3.2 Impact on Soil Cover

As the construction activities for the main plant units of the project would be confined in the wasteland, the impact on the soil will be minimal and confined. Only cutting and filling are required during construction. The construction activities result in loss of vegetation cover (grass and shrubs) and topsoil in the plant area. No adverse impact on the soil in the surrounding area is anticipated. However, in order to minimize such impacts, appropriate soil erosion

control measures would be undertaken by M/S ETC to appease the chances of soil erosion. Completion of excavation and foundation work in limited time schedule would also reduce/minimize the chances of soil erosion

5.3.3 Impact of Solid Waste

Solid waste during the construction phase consists primarily of scrapped building materials, excess concrete, and cement, rejected components and materials, packing and shipping materials (pallets, crates, Styrofoam, plastics etc.) and human waste. During the construction, there will be a generation of garbage, for which designated practices of solid waste disposal shall be followed.

5.3.4 Air Impact

As the proposed project is Solar PV Project, the impact during construction of is expected to be minimal as a Greenfield Project plant.

Particulate matter in the form of dust would be the predominant pollutant affecting the air quality during the construction phase. Dust will be generated mainly during excavation, back filling, and hauling operations along with transportation activities. However, a high boundary wall will prevent the dust generated due to construction activities going outside the project area.

The main source of gaseous emission during the construction phase is a movement of equipment and vehicles at the site. Equipment deployed during the construction phase is also likely to result in a marginal increase in the levels of SO_2, NO_X, and particulate matter. The impact is reversible, marginal and temporary in nature.

5.3.5 Noise Impact

The major noise generating sources during the construction phase are vehicular traffic, construction equipment like Dozer, scrapers, concrete mixers, cranes, generators, pumps, compressors, rock drills, pneumatic tools, vibrators etc. The operation of this equipment will generate noise ranging between 75 – 90 dB (A).

To minimize the impact on nearby communities, construction schedules have been optimized. Also, the noise level is substantially lower near the plant boundary due to attenuation caused by the distance. Overall, the impact of generated noise on the environment during construction period is insignificant, reversible and localized in nature.

5.3.6 Impact on Water Environment

The construction personnel would be housed in temporary settlements. These settlements would discharge considerable amount of domestic wastewater. Stagnant pools of water would increase breeding of mosquitoes and generally create unsanitary conditions. The contractor will provide Soak pit with a depth of 2 meters to dispose of liquid waste so that such waters do not form stagnant pools nor aggravate soil erosion. The main pollutants are organic components and microorganisms with the potential to cause contamination of water quality. To address potential impacts on water quality, disinfected latrines (e.g., through regular liming) will be used as the main component of the sanitation system.

Construction processes include fabrication of concrete and related water usage. Wastewater from construction activities would mostly contain suspended impurities. The waste water will be arrested before discharge, to prevent solids buildup in the existing drains. Thus, the construction site wastewaters would be led to sedimentation basins, allowing a hydraulic retention time of 1 ½ to 2 hours, where excess suspended solids would be settled out and relatively clear supernatant would be discharged to the plant drain. Generally, Surface runoff water is not there in dry months during construction. Also, since the area is arid, there will not be any considerable surface runoff as it shall be lost due to evaporative losses. However, during monsoon, surface runoff including effluents may cause a load of suspended solids.

5.3.7 Ecological Impact

The project site is mainly barren land and there are no settlements near the site. The impact of the construction

activities would be primarily confined to the project site. Since, the entire land is barren land with some xerophytic plants, shrubs. Thus, the site development works would not lead to any significant loss of important species.

5.4 IMPACT DURING OPERATION PHASE

Various activities of operation and maintenance phase and their probable impacts on various sectors of the environment are presented in the table below.

TABLE 5.2: IDENTIFICATION OF ACTIVITIES AND PROBABLE IMPACTS (O&M)

O&M Activities	Sector	Probable Impacts
Transportation	Air	❖ Air Emissions from Vehicles ❖ Fugitive Dust Emissions due to Traffic Movement
	Public Utilities	❒ Increased flow of traffic
	Water	❒ Effluents from Oil Storage Areas
Burning of Fuel	Air	❒ No Stack emissions from solar Project
Water Treatment for various uses	Water	❒ Generation of Wastewater due to PV Cleaning Modules
Equipment Cooling	Water/ Ecology	❒ Discharge of Hot Water containing chemicals
Operation of Transformers and Switchyard	Water	❒ Generation of effluents containing oil

5.4.1 Impact on Land Use

The proposed project will be set up on government wasteland. The site, after completion of its development, would consist of built structures, landscaped to give a pleasing outlook.

Following the construction phase, the temporarily modified land use pattern, such as the construction of temporary tents to accommodate some construction personnel will be totally removed during the operation stage. Land released from the construction activities would be put to economic and aesthetic use to hasten recovery from adverse impacts.

5.4.2 Impact on Soil Cover

Most impacts of Solar PV project on soil are restricted to the construction phase, which will get stabilized during the operation phase.

The soil conditions of the project site would be allowed to stabilize during this period after the impacts of the construction phase. The topsoil in non-built up areas would be restored and such portions of the site would be subjected to plantations, which would help in the bonding of the soil, thus increasing its strength. During operation of a project, no appreciable adverse changes in the soils are anticipated.

5.4.3 Air Impact

Plant operation would affect the air quality, as solar green field project & no any gaseous emission by the project.

5.4.4 Noise Impact

Work Zone Noise Levels

Protective instruments will be provided to the operators and workers working near the high noise generating machinery. As per Occupational Safety and Health Administration (OSHA) Standards, the maximum allowable noise level for the workers is 90 dB (A) for 8 hours exposure a day. Therefore, adequate protective measures in the form of ear mufflers/ear plug to the workers working in high noise areas will be provided.

In addition, reduction in noise levels in the high noise machinery areas will be achieved by adoption of suitable preventive measures such as adding sound barriers, use of enclosures with suitable absorption material, etc.

5.4.5 Impact on Water Environment

5.4.5.1 Impact on Ground Water

No ground water due to plant operation will be drawn during operation phase for any purpose. So lowering of groundwater table will not be an issue. In addition, Rainwater Harvesting will be implemented at the proposed plant

to conserve storm water and help in recharge of ground water.

5.4.5.2 Impact on Surface Water Impact due to Discharge

There shall be a minimal discharge of wastewater from cleaning of Solar PV modules. The wastewater emanating from cleaning operations shall be recycled for plantation and green belt development around the plant. The rest of the wastewater will be deposited in rain water harvesting pond.

5.4.5.3 Terrestrial Ecology

There is no sensitive ecological area / protected forest area such as national wildlife park, bird sanctuary crossing the proposed route alignment. The removal of herbaceous vegetation from the soil and loosening of the top soil generally causes soil erosion. However, such impacts would be primarily confined to the project site during initial periods of the construction phase and would be minimized through the adoption of mitigation measures like paving and surface treatment and water sprinkling.

5.5 SOCIAL IMPACT

5.5.1 Traffic Congestion

No overburden on the local transportation system is envisaged due to the proposed Project.

5.5.2 Labour Influence

5.5.2.1 Construction Phase

During construction activities, there will be a sizeable influx of population and labor colony is being constructed with basic amenities for the laborers working on the project. This will have an effect on social fabrics of the areas surrounding the project. However, this impact is envisaged to be insignificant due to the following reasons:

- Temporary labor colonies shall be situated in the areas already acquired for the project.
- It will be only a temporary change (restricted to construction period). After construction phase, the areas acquired by labor colonies shall be reverted back similar to pre construction stage

M/S ETC has a Human Resources Policy, which specifies the terms of employment and working conditions. These include procedures for hiring and recruiting, probation, training, performance review, promotion, insurance, salary and compensation, resignation, layoff and retrenchment, leave and vacation, and superannuation, which follow Pakistann labor law. All the employees will have access to the human resources policy and procedures. Labour inspections are done annually by the relevant government agency, which reviews wages, working hours, benefits, etc.

Most of the construction labor will be on a contractual basis. Separate labor camps shall be made within the plant premises for the construction labors. Therefore, conflict of the migrating labor with locals, will not take place during the construction phase. Regarding monitoring of diseases corresponding to labor influx, regular health status monitoring of labors and its surrounding population will be carried out with the mobile health care facilities shall be developed and operated by M/S ETC in this area. The health areas and issues that require attention by M/S ETC are as follows:

TABLE 5.3- LABOUR HEALTH MANAGEMENT

Environmental Health Areas	Influx camp followers, job seekers, family, service workers	Resettlement; relocation	Water management Including creation of new water bodies; altering existing water bodies and changes in drainage pattern	Linear features Roadways; transport time routes;	Hazardous materials control and disposal	Changes in income & expenditure consumption including food/ housing inflation

Vector Related	Increasing human parasite	Movement to different prevalence area	Creation and movement of breeding grounds	Improper drainage, temporary water pool	Creation of breeding sites with drums at household level	
Respiratory & Housing	Crowded housing, both work camps and community	Number of occupants per room; mix of occupants children/elderly / adults (different vulnerability)		Facilitating mixing/into reaction of different groups		Housing inflation triggered crowding
Veterinary Medicine	Movement and migration of livestock	Movement and migration of livestock due to influx of new groups	Creation and/or movement of livestock watering locations		Inadvertent water source contamination on, of streams/ rivers	
Sexually Transmitted Infections; HIV / AIDS				Facilitating movement of high-risk groups into rural settings		Men with money mixing with vulnerable women
Soil, Water & sanitation	Overburden in existing services/systems; explosive food-borne epidemics	Failure to anticipate extended family influx in initial design	Changes in surface water flows/quality, potential groundwater drawdown		Releases into surface water; long-term impacts to ground water	
Food & Nutrition	Influx of extended family more	Shift from subsistence agriculture to	Changes in crop/garden selection and	Changes in access to gardens or		Food inflation further
	mouths to feed	peri-urban living/petty trading	planting cycle	local markets		marginalizing vulnerable groups
Accidents & Injuries	Overcrowding, falls, burns, road traffic			Road traffic, increased pedestrian activity	Unplanned releases/emissions	
Hazardous Materials Exposure	Squatter developments adjacent to industrial facilities with unplanned releases			Movement via trucks of hazardous materials across communities to project areas	Use of Project drums and containers for water and food storage; Inadequate incinerators design	
Psychosocial; Gender Issues	Cultural shock due to rapid societal change	Transformation n of rural to peri urban/urban lifestyle		Greater ease of mixing social/ ethnic groups		Sudden money influx in a barter economic structure

Cultural Health Practices	Introduction of new practices and / or elimination of existing practices	Introduction of new practices and/or elimination of existing practices				Shift to western medicine
Health Services Infrastructure & Capacity	Increased visits for out and inpatient services	Increased visits for out and inpatient services if access improves		Changes in access		Attraction of additional private providers/ increase in insurance enrollment
Noncommunicable; hypertension, diabetes	Changes in diet	urban living versus high-intensity subsistence farming				Shift from physical activity to sedentary lifestyle

5.5.2.2 Operation Phase

The operation & maintenance staff will be accommodated in the M/S ETC Township, which will be located at near Town. Therefore, no impact on the local life pattern is envisaged due to the operational worker of the project.

5.5.3 R&R Issue

The proposed project will be set-up on public barren land. Therefore there is no R & R issue for the proposed project.

Change in Socio-economic Condition

Employment: The project will generate employment opportunities for the local population. Even indirect job opportunities will be created outside the project boundary. Many people will find employment in service sector and marketing of day-to-day needs viz. poultry and other agricultural products. The project will improve the basic infrastructure and the people of nearby villages can also use these amenities.

- Provision in project contracts to provide priority in employment
- Training for skills up-gradation
- Encouraging labor co-operative of displaced families and giving priority to labor cooperatives of displaced families for award of miscellaneous contracts
- Reservation of shops for displaced families in employee Township
- Efforts to employ educated unemployed youth

Overall there will be a marginal impact on the socio-economic condition of the locality and the impact will be mostly positive.

Development of Infrastructure: The job opportunities in non-agricultural sector are likely to increase. The installation of the power plant is expected to further increase the prospects by bringing in direct and indirect employment opportunities.

As the project and consequent activities are expected to generate additional employment and income opportunities for the local population, market expansion supported by infrastructural development will foster economic growth in the area. The flow of reliable and adequate power from the proposed plant will not only enhance growth in the region but will also bring about a change in energy consumption pattern by switching over from other sources of energy. This will ease off burden on the existing biomass.

CHAPTER 7

ENVIRONMENTAL & SOCIAL MANAGEMENT PLAN

7.1 INTRODUCTION

Environmental & Social Management Plan is an implementation plan to mitigate and offset the potential adverse environmental & social impacts of the project and enhance the positive impacts. Based on the environmental baseline conditions, planned project activities and impacts assessed earlier, this section enumerates the set of measures to be adopted to minimize the adverse impacts. The process of implementing mitigation and compensatory measures, execution, agencies responsible for their implementation and indicative costs is discussed in this chapter.

The project has overall positive impacts by providing a competitive, cost-effective, pollution free reliable mode of Solar PV power. It will certainly meet the ever increasing Demand of Power and to bridge the Gap between Demand and Supply of Power.

7.2 ENVIRONMENTAL & SOCIAL MANAGEMENT PROCESS

The ESMP has been designed within the framework of the requirement under Pakistan legislation and ADB's SPS on environmental and socio-economic aspects.

The mitigation measures to be adopted for the implementation of the proposed project include the following:

- Environmental Management Plan;
- Rainwater Harvesting
- Clean Development Mechanism;
- Occupational Health and Safety;
- Labour Working Conditions;
- Construction Labour Management;
- Environmental Action and Monitoring Plan;
- Community Development Plan;
- Public Consultation and Information Disclosure Plan;
- Grievance Redressal Mechanism;
- Disaster Management Plan

The ESMP has been prepared considering life cycle approach of the project that proposed Solar Power Limited will own and operate.

The Project will develop and implement following management action plans under the ESMP: **a) During Design Phase:**

- Design of Clean Development Mechanism

b) During construction phase

- Construction Labour Management Plan;
- Health and Safety Management Plan (Construction Phase);

The ESMC is responsible for processing and implementing all subproject(s). Subprojects will be monitored by qualified technical staff/experts (e.g., design and technical reports, feasibility studies, environmental and/or social assessments, and associated EMP's and budgets), who will also ensure and monitor compliance with ADB and Government safeguard requirements. Summary appraisal reports will be submitted to the ADB subsequent to obtaining the ESMC's approval and clearance(s) from the GoR during the operation phase. The ESMC will prepare and submit performance monitoring reports to the ADB twice yearly. Activities to be monitored include: all planning, coordination and management activities related to the implementation of safeguard issues; the identification of corrective and preventive actions; records of health and safety matters and training activities; consultations with project affected peoples (as and when needed, particularly during the implementation); feedback, trouble shooting and project related grievances (per the project grievance redress mechanism); preparation of progress and monitoring reports as required by the ADB; and verifying the projects overall compliance with safeguard measures and its progress towards achieving the intended loan outcomes. ADB will continue to monitor

project compliance with ADB safeguard plans and requirements on an ongoing basis throughout the duration of the contract.

The ESMC comprises of a team of qualified and experienced environmental engineers, analytical chemists, horticulturists, safety engineers and well-trained personnel for environmental monitoring. The EMC also conducts regular training programs for the other personnel in the areas of environment, air quality and water quality aspects, energy and water conservation measures, safety and health aspects etc.

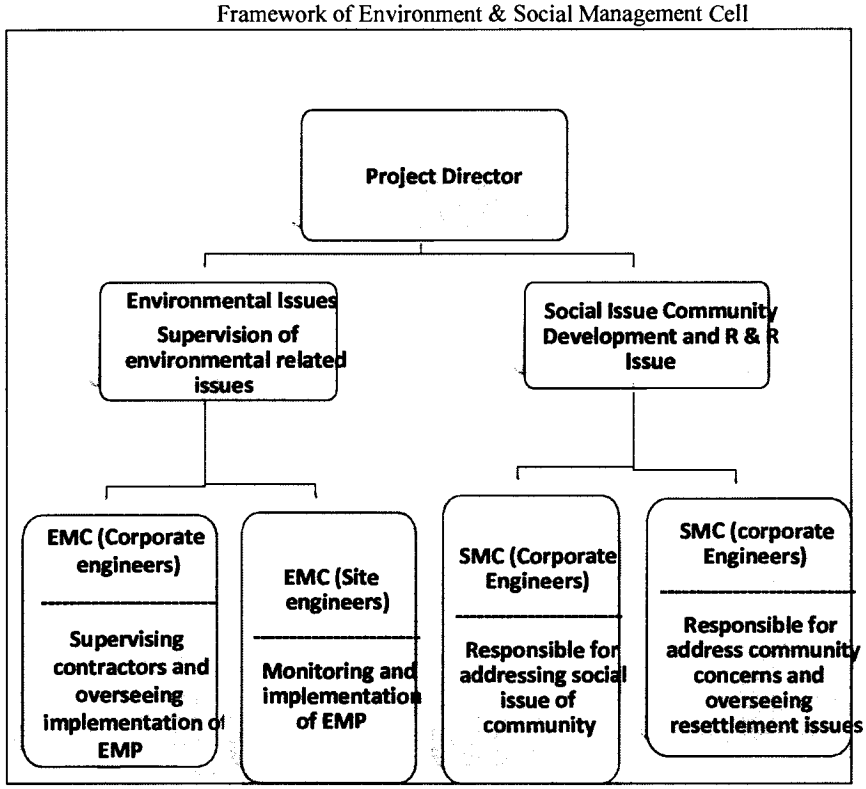
The ESMC is supported by well-equipped testing laboratory and other facilities to facilitate effective working.

The responsibilities of the various members of the environment management cell are presented in Table 7.1.

Table 7.1:
Key Responsibilities of Environmental & Social Management Cell

S. No.	Designation	Responsibility
1.	Project Director (1 no.)	Environmental and Social policy and directions
2.	Head-Operations (1 no.)	Overall in-charge of operation of environment & social management facilities; Ensuring legal compliance by properly undertaking activities as laid down by various regulatory agencies from time to time and interacting with the same.
3.	General Manager (2 no.)	Secondary responsibility for environment & social management and decision making for all environmental issues including Safety and Occupational Health

Framework of Environment & Social Management Cell



Corporate Social Responsibility Plan (Community Development Plan)

Corporate social responsibility is M/S ETC 's self-regulation integrated into a business model. CSR policy functions are built-in, self-regulating mechanism whereby business monitors and ensures its active compliance with the spirit of the law, ethical standards, and international norms. The goal of CSR is to embrace responsibility for the company's actions and encourage a positive impact through its activities on the environment, consumers, employees, communities, stakeholders and all other members of the public sphere.

Philosophy - Corporate Social Responsibility

- ❖ In line with the group's philosophy, M/S ETC 's social responsibility would not be an occasional act of charity or a one-time token financial contribution to a local school, hospital or environmental NGO. It would be an ongoing year-round commitment, which would be integrated into the very core of SPL's business objectives and strategy.
- ❖ The objective is to communicate to the local community, the nature, importance, and impact of the project on the local community, the state, and the country. The initiatives are being designed, to create a positive impact on the lives of the local people and improve their living conditions. Monetary and short term initiatives are kept to the minimum. A major focus is to initiate activities which are sustainable and will help to build a lasting relationship with the local community. This would also help in creating inter-dependencies with the local community so that they also have a sense of responsibility towards the well-being of the project.
- ❖ The proposed action plan will serve as a preliminary framework and would be modified based on results of such initiatives and feedback from community and stakeholders.

Identifying CSR initiatives in line with local requirements

Based on site visits by M/S ETC Power team and discussions with local people, following issues have been highlighted

Table: 7.2

	Area	Community Need
i.	**Health**	• Non-availability of adequate health related infrastructure; women and children are most affected • Low awareness on hygiene, sanitation, and dietary issues
ii.	**Education**	• Facilities for higher secondary education are inadequate and distant • Higher education and counseling for youth missing • Technical skill building institutions far and few and have poor infrastructure
iii.	**Employment / Livelihood**	□ Scope of employment for unskilled or semi-skilled laborers
iv.	**Financial literacy**	□ Lack of information/ about long term fiscal planning needs. Very important to prevent misuse of compensation package

Keeping in mind the above-mentioned issues, M/S ETC's CSR initiatives would focus on the following areas:

- ❖ Improving medical facilities in the villages around the project area.
- ❖ Improving awareness and providing sufficient training in hygiene, sanitation and proper diet
- ❖ Encouraging people to send children to school and also educate themselves through adult literacy programs
- ❖ Improving education infrastructure by providing better teaching aid and training for teaching faculty.
- ❖ Building skills among villagers as per skills requirements of the project during construction as well as during the operations phase.
- ❖ Encouraging entrepreneurial spirit among people and supporting such initiatives by conducting training programs to acquire and enhance skills. □ Creating awareness about long term financial planning

7.3 ESMP DURING CONSTRUCTION AND OPERATION

The project activities will be executed in the phased manner, Pre-construction Phase, Construction Phase and Operation phase. The major activities to be undertaken are described below.

7.3.1 CONSTRUCTION PHASE

The environmental issues during construction stage generally involve safety and public health issue. The Contractor is required to comply with the laws with respect to environmental protection, pollution prevention, safety and other

applicable law. Environmental pollution during the construction phase will be less but control of pollution during this phase is of considerable importance. The EMP is an executable part of Project, and the activities are to be guided, controlled, monitored and managed as per the provision provided. Following activities require attention during the construction phase.

7.3.2 Construction/Labour Camp Management

- The labor camp construction, upkeep, and maintenance at the 50 MW Solar PV project site are under the scope of the contractor.

  500 laborers are likely to cause an influx in the project area. A proper Construction Camp Development Plan has to be formulated to control degradation of the surrounding landscape due to the location of the proposed construction camp. Although it is the responsibility of EPC contractor to implement, M/S ETC shall ensure that it is strictly followed.
- Sufficient supply of potable water will be provided at camps and working sites. If the drinking water is obtained from the intermittent public water supply then storage tanks will be provided. All water supply storage may be at least 15m away from the toilets or drains.

  It is the responsibility of EPC contractor to fulfill the water requirement during the construction period. M/S ETC will ensure that water will be supplied through water tanker from the nearby area, where sufficient water is available.
- Adequate sanitation facility, Septic tank, will be provided.
- Health check-up will be conducted. These activities may be provided by the construction contractor.
- At every Camp, first aid facility will be provided. Suitable transport will be provided to take an injured or ill person to the nearest hospital.
- An adequate supply of fuel in the form of kerosene or LPG will be provided to construction labors to avoid felling of trees for cooking and other household activities.
- All the construction workers will be provided with proper training to handle potential occupational hazards and on safety and health, which include the following:
- Environmental Awareness program
- Medical surveillance
- Engineering controls, work practices, and protective equipment
- Handling of raw and processed material
- Emergency response

7.4 LABOUR AND WORKING CONDITIONS

Through a constructive employee-management relationship, and by treating the employees fairly and providing them with safe and healthy conditions, tangible benefits may be created, such as enhancement of the efficiency and productivity of their operations. The basic objectives are to ensure following.

- To establish, maintain and improve the employee-management relationship
- To promote fair treatment, nondiscrimination and equal opportunity of employee, and compliance with national labor and employment laws
- To protect the employee by addressing child labor and forced labor
- To promote safe and healthy working conditions, and to protect and promote the health of workers by evolving safe working practices.
- To respect the worker's rights to freedom of association and the effective recognition of the right to collective bargaining, as per the relevant conventions of the International Labor Organization

The organization shall work to achieve these objectives, all relevant provisions of employment laws will comply.

7.4.1 Working Relationship

All employees and workers directly engaged by the contracting agencies will be communicated their working conditions and terms of employment, including their entitlement to wages and any other benefits.

7.4.2 Workers Organizations

The company will not discourage workers from collective bargaining in a positive manner for mutual benefit.

7.4.3 Equal Opportunities

The company will base the employment relationship on the principle of equal opportunities and fair treatment and will not discriminate with respect to aspects of the employment relationship including recruitments and hiring, compensation, working conditions and terms of employment, access to training, promotion, termination of employment or retirement and discipline except on the basis of merit.

7.4.4 Equal Opportunities for Women

The Company will base the employment relationship on the principle of equal opportunities and fair treatment and will not discriminate on gender. Instead, the company will encourage the women participation and will frame appropriate policies to achieve the same.

7.4.5 Child Labour

The company will not employ children in any manner i.e. economically exploitative or is likely to be hazardous or to interfere with the child education or to be harmful to the child's health or physical, mental, spiritual, moral or social development. Children below the age of 18 years will not be employed in dangerous work. The company, in fact, discourages child labor & encourages them to go to School by providing free education facilities & also providing education stipend for attending school.

7.4.6 Occupational Health and Safety

The company will provide the employees with a safe and healthy work environment taking into account inherent risks in its particular sector and specific classes of hazards in the works premises, including physical, chemical and biological hazards. The company will take steps to prevent accidents, injuries and disease arising from, associated with or occurring in the course of work by minimizing as far as reasonably practicable the causes of hazards.

TABLE 7.3: Major Environmental Mitigation Measures during Construction Phase

Mitigation Measure	Purpose	Failure consequence	Responsible Organization
Water sprinkling	Control of fugitive dust during construction and transportation activity	Increment in ambient SPM concentration	Contractor □ M/S ETC Management Environment Consultant
Transportation of construction material in covered trucks	Control of fugitive dust	Increase in dust emission	• M/S ETC Management • Environment Consultant
Regular maintenance of transport vehicle and provision of acoustic cover on construction machinery	Control of Noise	Increase the noise level of surrounding area	□ Contractor □ M/S ETC Management
Provision of environmentally safe camping area for laborers	To provide a clean and healthy living condition for labors	Unhealthy living condition and spread of disease	□ Contractor □ M/S ETC Management

7.5 OPERATION PHASE

During operation phase of the proposed project pollution impacts are minimized. However, in order to limit within predicted impact levels and to further mitigate the impacts wherever possible on individual environment components, the following mitigation measures are recommended:

TABLE 7.4: Environment Impact and Mitigation Measure

Possible Impact	Mitigation during planning and design	Mitigation during operation
Air Impact	Incorporate consultant and engineers advice	□ No Air Pollution
Soil Quality Degradation	Consider strategies to avoid soil quality degradation	
Occupational health hazard		□ Periodic health check-up
Possible Impact	**Mitigation during planning and design**	**Mitigation during operation**
Safety of workers		• Workers would be provided with hand gloves ear muffs, safety boots, safety Goggles, helmets etc. • Workers should be trained to follow safe working practices
Transmission line	□ Avoid, as far as practicable, operations in Environmentally Sensitive Areas, Eco-Sensitive Zones, Wetlands, Wildlife Sanctuaries, National Parks and Biosphere Reserves. If it is inevitable, the proponent should obtain approvals as required under the relevant laws.	• Abate pollution in all its activities and operations. It should adopt the good practices of the sector. • Take due precautions to avoid disturbance to human habitations, tribal areas and places of cultural significance and minimize the same wherever inevitable.

Note: M/S ETC management shall have the responsibility to implement mitigation measures during operation

7.5.1 Air Environment

Dust generated as a result of clearing, leveling and site grading operations should be suppressed using water sprinklers. It should be ensured that the construction machinery using diesel driven prime movers are properly maintained to minimize exhaust emissions of CO, SPM, and Hydrocarbons. Further, the construction activity should be restricted to daytime as far as possible to avoid disturbance to surrounding areas.

7.5.2 Noise Environment

All noise generating equipment used during the construction phase should be provided with noise control devices and properly maintained. Wherever required, personal protective equipment such as ear plugs, ear muffs etc. should be provided to the persons working in high noise areas, to minimize their exposure to noise.

7.5.3 Storage of Hazardous Materials

The hazardous materials stored at the construction site like acetylene cylinders, petroleum, spirit, diesel, lubricating oil, paints etc. should be stored as per the statutory provisions of Manufacturers, Storage, and Import of Hazardous Chemicals Rules. 1989 under the Environment (Protection) Act, 1986

7.5.4 Safety Measures

The site should have necessary security arrangements to prevent entry of unauthorized personnel and proper control of hazardous materials on site. All the employees, as well as contractor's labor, should be trained in safety aspects related to their job, with a special emphasis on safe handling of material, safety in welding and fabrication, working at heights etc. All the personnel should be provided with safety appliances such as face shields, helmets, safety Goggles, safety shoes, hand gloves etc., as per the job requirement.

To ensure that the local inhabitants are not exposed to these hazards, the site should be secured by fencing and manned at entry points.

7.5.5 Labour Deployment and Labour Camp Management Plan

M/S ETC shall draw a Labour Deployment & Welfare Management Plan for the proposed Solar PV project. The EPC Contractor and the subcontractor shall ensure the compliance of the labor welfare arrangement plan:

- Accommodation for Labour – Provision of Military Tents for accommodating outstation labors
- Accommodation for Women Labour- Separate provision of Military Tents for accommodating women labors
- Prevention from Insects/Snakes – Carbolic Acid bottles will be buried under the ground surrounding the perimeter of the Labour accommodation area to prevent them from the risk of Snakes/Insects
- Sanitation for Labour – Portable Toilets/WC will be provided for Labour. Waste water will be disposed of in septic tanks/ soak pits.
- Sanitation for Women Labour- Separate Toilets/ WC will be provided for women labor. Waste water will be disposed of in septic tanks/ soak pits.
- Water Arrangements – Treated Water will be made available at Site for Labour drinking purpose.
- Health arrangements - Tying up with Local Doctor for any exigencies at the site. Also, the doctor will make occasional visits to site for Health checkup of labor
- Strict adherence to the Labour Laws applicable in the area of work will be ensured through robust Time Office Department at Site.

7.6 OPERATION AND MAINTENANCE PHASE

The problems envisaged during the operation and maintenance phase are an accident, exposure to heat, noise, arc lights, chemicals etc. Suitable personal protective equipment should be provided to all employees, likely to be exposed to these situations. The working personnel should be given the following personal protective equipment:

- Industrial safety helmet.
- Crash helmets.
- Face shield with replacement acrylic vision.
- Zero power plain Goggles with cut type filters on both ends.
- Welder's equipment for eye & face protection.
- Cylindrical type ear Plugs.
- Earmuffs.
- Canister gas mask.
- Self-contained breathing apparatus.
- Leather apron.
- Aluminized fiberglass fix proximity suit with hood and gloves.
- Safety belt/line man's safety belt.
- Leather hand gloves.
- Canvas cum leather hand gloves with leather palm.
- Electrical safety shoes with and without steel tie.
- Gum boots.

In addition, medical facilities should be made available round the clock for attending any medical emergency during construction & operation phases.

7.7 WASTE MANAGEMENT PLAN

7.7.1 Scope & Purpose of the Plan

This Waste Management Plan identifies the wastes that are likely to be generated during the construction and operation of the proposed Plant and documents cradle to grave waste management practices to be employed for their collection, storage, treatment and/or disposal.

Specifically, the waste covered by this WMP includes the following sources:

- Construction and commissioning of plant and the associated facilities
- Operation of plant and the associated facilities throughout the project lifecycle.
- Temporary accommodation during the construction phase for the workers.
- Other operations like equipment maintenance, road construction, site preparation etc. □ Operation and maintenance of infrastructures both during construction and operation phase.

WMP is intended to serve as a guideline for the project proponent & the contractor(s) to manage wastes effectively

during construction and operation phase. The contractor(s) should prepare their own WMP in compliance with this WMP and implement the same during the construction phase. M/S ETC should implement the WMP throughout the operational phase.

The WMP describes how wastes will be managed during the construction and operation phase of the project and how the project will:

- Minimize the potential to cause harm to human health and the environment.
- Comply with ADB's social safeguards policy statement and with Pakistan Environmental Regulations.
- Reduce operational costs and any potential liabilities which may arise from waste handling operations.

This plan also ensures that every waste stream and solid waste materials from the main plant site and the associated facilities will be managed effectively.

7.7.2 Solid and Hazardous Waste Management

The mitigation measures with respect to waste treatment, storage, handling, and disposal during both phases of the project have been discussed below:

7.7.3 Construction Phase

- A waste inventory of various waste generated will be prepared and periodically updated. ¬ The excavated material generated will be reused for site filling and leveling operation to the maximum extent possible.
- The scrap metal waste generated from the erection of structures and related construction activities will be collected and stored separately in a stack yard and sold to local recyclers. □ Food waste and recyclables viz. paper, plastic, glass etc will be properly segregated and stored in designated waste bins/containers. The recyclables will be periodically sold to local recyclers while food waste will be disposed of through waste handling agency.
- Hazardous waste viz. waste oil etc will be collected and stored in the paved and bounded area and subsequently sold to authorized recyclers. Necessary manifest for the same will be maintained.

7.7.4 Operational Phase

There should be no solid wastes likely to be generated during operation phase

7.7.5 Road Safety & Traffic Management Plan

The plan encompasses the addresses of community safety related impacts that may arise from the increased vehicular traffic due to movement of equipment/machinery and vehicles along the site access and approach roads, particularly during the construction phase. The plan will be regularly reviewed and as vehicle movement requirements are identified in detail.

7.7.6 During Construction Phase

The following mitigation measures will be implemented during this phase:

- Project vehicular movement will be restricted to defined access routes.
- Proper signage will be displayed at important traffic junctions along the vehicular access routes to be used by construction phase traffic. The signage will serve to prevent any diversion from designated routes and ensure proper speed limits are maintained near residential areas. □ Any road diversions and closures will be informed in advance to the project vehicles accessing the above route. Usage of horns by project vehicles will be restricted near sensitive receptors viz. schools, settlements etc.
- Traffic flows will be timed wherever practicable during the period of increased commuter movement in the day.
- Temporary parking facilities should be provided within the work areas and the construction sites to avoid road congestion.

- The vehicular movement to be controlled near sensitive locations viz. schools, colleges, hospitals identified along designated vehicular transportation routes.
- Routine maintenance of project vehicles will be ensured to prevent any abnormal emissions and high noise generation.
- Adequate training on traffic and road safety operations will be imparted to the drivers of project vehicles. Road safety awareness programs will be organized in coordination with local authorities to sensitize target groups viz. school children, commuters on traffic safety rules and signages.

7.7.7 During Operational Phase

Since limited vehicular movement is anticipated during operational phase considering only the daily movement of project personnel any impacts arising from the same can be effectively addressed through implementation of mitigation measures as discussed during the construction phase.

7.8 Environmental Impacts Associated With Construction and Operation Stage

7.8.1 Environment Impacts due to Project Location and Design

Potential adverse environmental impacts associated with transmission lines have been avoided or minimized through careful route selection. The alignment is sited away from major settlements, whenever possible, Forests areas and vegetation areas are avoided wherever possible; however, the route alignment passes through shrub lands, cultivated and abandoned fields. Alignment in this project has avoided geologically unstable areas, which can also pose foundation related problems. No land acquisition is required for placing transmission towers on private land.

7.9 Environmental Impacts Associated with Pre-Construction Stage

Acquisition of Cultivable and Noncultivable lands

There may be a loss of agricultural productivity due to obstructions and reduced land availability. Thus the following measures will have to be taken prior to the project activities:

- Protect /preserve topsoil and reinstate after construction is completed,
- Repair /reinstate damaged bunds after construction are completed, and • Compensation for temporary loss in agricultural production.

7.9.1 Impact on Climate

The Transmission lines area consists of barren uncultivated lands. Also, there will be few removals of trees, therefore, there will be no impact on the climate conditions from the transmission lines during the construction and operation phases.

7.9.2 Impact on Air Quality

During the construction phase, the activity would involve excavation for the tower erection, movement of vehicles carrying the construction materials along the haul road (through unbuilt roads, which are not maintained).

All these activities would give rise to the emission of dust particles thereby affecting air quality marginally at the site. The impact will be temporary in nature and therefore is assessed as of low significance. Covering of stockpiles and a sprinkling of water during excavation will reduce the dust emission to a great extent. The construction of transmission line and the substation will not have any negative impact on the air quality of the region during the operation phase.

7.9.3 Impact on Noise Levels

During the construction phase, the major sources of noise pollution are a movement of vehicles carrying the construction material and equipment to the site. Most of the access roads along the alignment are motor able and project traffic would be negligible. The major work of the construction is expected to be carried out during the daytime. Apart from vehicles bringing in materials to the nearest road, construction works for the transmission line will require minimal powered equipment. As such, noise emissions will be minor. As the predominant land use

along most part of the alignment is barren and inhabited, there will be few residential areas exposed to noise generated during the construction phase and the noise produced during the construction period will have a negligible impact on residents.

During the operation phase of the project, there may be corona noise from the conductors which will be felt only up to 15 to 30 m area, hence the ambient noise level will meet the CPCB standard for residential areas: 55 dB(A) during daytime and 45 dB(A) during night time.

7.9.4 Impact on Surface Water Quality

There are no any major surface water bodies in the area.The construction and operation of the transmission lines will not have any major impact on the surface and ground water quality in the area.

7.9.5 Impact on Water Resources

Water needs during construction of the Project would be limited to sanitary water and minimal amounts of water for construction (such as spraying for dust prevention). This would be a negligible impact on water resources. Operation of the lines would not require any water.

7.9.6 Impact on Ground Water Quality

In Transmission line construction activity, no chemical substance or oil is used hence there is no impact on ground water quality

7.9.7 Impact on Terrestrial Ecology

There is no sensitive ecological area / protected forest area such as national wildlife park, bird sanctuary crossing the proposed route alignment. The removal of herbaceous vegetation from the soil and loosening of the top soil generally causes soil erosion. However, such impacts would be primarily confined to the project site during initial periods of the construction phase and would be minimized through the adoption of mitigation measures like paving and surface treatment and water sprinkling.

7.9.7.1 Removal of Trees

As per the preliminary survey hardly any trees shall be removed during the line construction. The initial construction works along the alignment involving land clearance, cutting, filling, and leveling that may cause loss of vegetation. Appropriate compensation will be governed by the Resettlement Framework.

7.9.7.2 Effect on Local Road Network

Transformers, tower material, substation equipment, iron bars, concrete materials, piling equipment, will be transported through the provincial and local road network to the project site. This may impact local traffic temporarily. Appropriate maintenance all road sections, which will be utilized for the construction related activities shall be carried.

7.9.7.3 Disposal of Debris

As a result of construction related activities, spoilage and debris will be generated during the construction stage. Proper disposal of the debris shall be ensured to minimize the impact on the surrounding ecology, public health and scenic beauty.

7.9.7.4 Impact on Human Environment

Project activities could impact the health and safety of the work force and of the general public, in particular, in terms of risk of accidents and exposure to electromagnetic fields along the alignment. The accidents may be caused due to electro-cutting, lightning, fires, and explosions. Necessary training regarding safety aspects to the personnel working at the line will be provided by the contractor. Personal protective equipment like safety gloves, helmet, harness, Goggles, mufflers will be provided during the construction period and during the maintenance work. First

aid facilities will be made available with the labor gangs and doctors called in from nearby towns when necessary. Workers are also covered by the statutory Workmen Compensation as per GOP laws by the contractor.

7.10 Socio-Economics

Construction of transmission line will generate local employment, as a number of unskilled labors will be required at the time of construction activities. Local employment during this period will increase socioeconomic standards.

7.11 Resettlement and Rehabilitation

For the construction of transmission line, involuntary resettlement impacts are yet to be determined as some minor changes in transmission line route shall not be ruled out till M/S ETC obtains RoW permission for the transmission line. The land acquisition will not be done as far as possible. But, if M/S ETC has to do it under inevitable circumstances then M/S ETC will adopt and implement a Resettlement Framework consistent with the ADB Safeguard Policy Statement

7.12 Cultural sites

There are no archaeological, historical or culturally important sites along the route alignment, hence no impact on these sites is envisaged. In the case of discovery of archaeological features during excavation/construction works, a chance finds the procedure to notify relevant authorities will be put in place by M/S ETC.

7.13 Solid Waste Disposal

The solid waste generation will be at the location of the tower erection site which will include metal scraps, wooden packing material. Waste will be minimized and recycled wherever possible. Final waste will be collected and disposed of in compliance with applicable regulations and rules.

7.13.1 Liquid Waste Disposal

There will be no oil or chemical waste generated during the construction of transmission line, hence no mitigation is required.

Thus following measures are needed to protect and enhance the quality of environment during the construction stage:

- A better way to overcome garbage disposal as mentioned above by reducing or avoiding the need to construct labor camps, thus the selection of the majority of skilled and unskilled workers from the project area of influence will be a proper measure in this regard.
- Contractor shall provide adequate facilities, soak pits to manage liquid waste
- Provision of the solid waste disposal, sanitation and sewage facilities at all site of the construction/labor camps to avoid or minimize health hazards and environmental pollution.
- The contractor should handle and manage waste generated from the construction/labor camps without contamination to the natural environment and it will reduce risk to the general public who stay close to sites. Also, the contractor should be responsible to enhance the quality of the environment.
- An adequate supply of water should be provided to the urinals, toilets and wash rooms of the workers' accommodation.

Contractor shall provide garbage bins to all workers' accommodation and construction sites, for dumping wastes regularly in a hygienic manner in the area.

7.14 SAFETY & EMERGENCY PLAN

Safety of both men and material during construction and operation stages are of concern to industries. Keeping in view the safety requirements during construction and operation and maintenance phases, a safety policy will be formulated for the present Solar PV project. Separate safety rules should be prepared for each type of occupation/processes involved in the project in consultation with manufacturer/supplier of equipment and materials and regular safety inspection should be ensured by a competent person of all buildings, equipment, work places,

and operations.

7.14.1 Safety Organization

The organization already has a Safety Department headed by Senior Manager and having qualified and experienced supporting staff. The responsibilities of Safety Department include identification of the hazardous conditions and unsafe acts of workers and advise on corrective action, organize training programs and provide professional expert advice on various issues related to occupational safety and health. He is also responsible to ensure compliance with Safety Rules/Statutory provisions. Safety Department has prepared.

7.14.2 Safety Awareness among Workers/Employees

Training programs in safety and accident prevention should be organized at all levels of employees with a view to familiarize them with the general safety rules, safety procedures in various operational activities and to update their knowledge in safety and accident prevention, industrial hygiene and emergency equipment. These training programs should be conducted periodically in a planned manner to refresh their knowledge.

7.14.3 First Aid Training

First aid training programs should also be conducted for all employees with the help of qualified medical and para-medical staff. This program may be conducted in batches. The program should include basic first-aid techniques and should be repeated periodically to refresh knowledge.

7.15 ACCIDENT REPORTING

Whenever accidents or dangerous events occur such incidents should be reported as notified in the sections 88 and 88A of Factories Act 1948, amended from time to time and also as per the schedule 6 of the Manufacture, Storage and Import of Hazardous Chemicals (MSIHC) Rules, 1989.

7.16 SAFETY REVIEW CHECK LIST

A checklist is one of the very useful tools for hazard identification. A checklist should be prepared and used as a final check that nothing has been neglected.

7.17 FIRE FIGHTING ARRANGEMENT

The plant should be well equipped with fire protection systems and it has a fully-fledged fire station operated by Central Industrial Security Force (Fire Wing). The fire station is headed by Asstt. Commandant and his supporting staff at various levels. The fire control room is manned in 3 shifts round the clock.

7.18 CLEAN DEVELOPMENT MECHANISM (CDM)

The Clean Development Mechanism (CDM) is one of the three mechanisms under the Kyoto Protocol (KP), 1997 that enables developing countries to assist developed countries in meeting their greenhouse gas (GHG) emission reduction targets.

Being a renewable energy source with zero (GHG) emissions, solar energy becomes eligible under various GHG reduction and climate change mitigation programs. The entire proceeds of carbon credit from approved CDM project, if any, should be retained by the generating company.

7.19 ENVIRONMENTAL MONITORING PROGRAMME

Regular monitoring of critical environmental parameters is of immense importance to assess the status of the environment during plant operation. The monitored data can serve as an indicator for any change in environmental quality due to the operation of the plant with respect to baseline environmental conditions so that suitable migratory steps could be taken in time to safeguard the environment.

Monitoring indicators have been developed for each of the activity considering the mitigation measures proposed.

7.20 SOCIAL MANAGEMENT PLAN

7.21 RESETTLEMENT BUDGET AND FINANCING PLAN

Proponent plans to procure 140 acres of Government barren land for the project. The project would not result in physical and displacement as these lands are all barren and vacant. However, M/S ETC will adopt a Resettlement

Framework. Some provisions of the RF are described below:

1. Procedure for damage tree compensation is in place with a standard format. For damage of trees, horticulture department circular will be used for calculation and based on an assessment of Tehsildar the amount will be paid. Additionally, the budget includes costs relating to the hiring of the staff, coordination, site visits by the expert and other logistic support for the disbursement of compensation to the APs. M/S ETC will ensure that the budget outlined in the assessment should be kept ready in advance for the timely payment of compensation. A contingency of 10% additional costs has been kept as a provision to meet any variation in the cost during implementation. A tentative budget has been calculated for the project and details for the same are given in the table. 7.5

TABLE 7.5: Resettlement Budget

Item	Unit Rate Rs	Amount (Rs)
A. Compensation for loss of trees	Lump sum	12 Million
B. Provision for unanticipated impact due to construction of transmission line towers	Lump sum	18 Million
Total (A+B)		30 Million
Contingency (10% of the Compensation)		8 Million
Grand Total (PKR)		38 Million

7.22 COMMUNITY DEVELOPMENT PLAN

Any company, along with active support from the government, has a role to play in the development of an area in which it works. In most cases, it is difficult to operate and do business without the cooperation of the local communities and other stakeholders. To build a good rapport with the local communities, it is essential to engage the local community along with the administrative machinery to develop an ongoing process of development of the villages surrounding the plant involving the kind of joint initiatives

The community development plan would initially be targeted nearby villages. But should be expanded to other areas. The various areas where involvement can be made are discussed below.

7.22.1 Health Care Facilities:

Project proponent can help villagers by arranging the health care support in form of bi weekly clinics, family planning camps, eye camps, Mother – Child care camps, etc. and ambulance service. Can also support the developments of permanent health care facility in the project affected villages in consultation with the district administration. The center should be equipped to handle primary level emergencies throughout the day and should be accessible to the villagers. It should also have the infrastructure and expertise required to handle delivery patients.

7.22.2 Drinking Water:

At present people are dependent on the tube wells for the drinking water. The scarcity of water during summer months due the drop is water table has observed in the region. The proponent can undertake repair work on old tube wells and sinking of new tube wells or supply of low voltage electric motors as per the needs of the villagers.

CHAPTER 8.

CONSULTATION, PARTICIPATION AND DISCLOSURE

8.1 INTRODUCTION

The need for public consultation and disclosure arises from the universal belief that transparency and accountability are fundamental to fulfilling any development mandate and in strengthening public involvement in the decision making process.

For all Categories, "A" and "B" projects the project proponent or third party experts must have consulted with project affected communities in a structured and culturally appropriate manner. The public consultation should involve affected communities; the process must ensure their free, prior and informed consultation (FPIC) and facilitate their informed participation.

8.2 Categorization of projects and activities

i. All projects and activities are broadly categorized into two categories - Category A and Category B, based on the spatial extent of potential impacts and potential impacts on human health and natural and man-made resources.

ii. All projects or activities included as Category 'An' in the Schedule, including expansion and modernization of existing projects or activities and change in product mix, shall require prior environmental clearance from the Central Government in the Ministry of Environment and Forests (MoEF) on the recommendations of an Expert Appraisal Committee (EAC)

iii. All projects or activities included as Category 'B' in the Schedule *will* require prior

8.3 ADB's Safeguard Policy Statement:

As per the Safeguard Policy Statement (SPS) of ADB, a Public Consultation and participation plan needs to be included in the Report for all stages of the project (project design, construction, and operations phase) for categories "A" and "B". Also, a documentation of meaningful consultation with affected local communities especially projects affected persons needs to be carried out.

8.4 Participants of Discussion

The venue for the consultation was a Tehsildar,s Office located in the village closest to the Project site. 15 persons attended the consultation, Community participants included people from different walk of the society. Participants include Numberdar (Village head) and levies officials, State revenue department officials, Teachers, equipment suppliers, employees and local villagers. It was attended by some prominent people of the locality as well as common villagers also.

Fig: 8.1 Discussion with local community regarding project construction

Fig 8.2: Levies officials during project visit

List of attendees:

Sr No.	Name of Stakeholder
1	Mr.Khan Muhammad S/O Haji Hussaim Muhammad
2	Mr. Zain-ul-ah Kaker Tehsildar Bostan
3	Mr.Haji Muhammad Daffadar ASI Levies
4	Mr. Mati-ul-ah Naib Tesildar
5	Mr. Maqbool Anwar Rakhshani Ex. Deputey Commisioner
6	Mr. Muhammad Ummer (Lecturer Boys Degree College Pashi)
7	Malik Muhammad Ayaz S/O Haji John Muhammad
9	Mr. Haji Inayat-ul-ah S/O Haji Ghulam Haider
10	Mr. Farooq Ahmed S/O Wali Muhammad
11	Mr. Malik Fateh Muhammad S/O Ghulam Ahmed
12	Mr. Serdar Muhammad S/O Haji Taj Muhammad
13	Mr. Faiz Muhammad S/O Noor Muhammad

8.5 Public Consultations (Field Consultation)

To make the discussion unbiased and fruitful, prominent people from the local community (Namberdar) were given the authority to conduct the local stakeholders' consultation process. It was decided to conduct the consultation process in the local vernacular language and National language of Pakistan so that the language barrier should not prove a hindrance in taking the process to its logical conclusion. Pamphlet and summary of projects were distributed among the public. The meeting started with the presentation made by officials about the company followed by the process of electricity generation using Solar Photovoltaic technology. Local stakeholders' were informed about the project execution, social and environment impact due to project especially during the construction phase and utilization of local resources by the company during the construction phase. The local stakeholders were informed about the benefits of the project along with environment and social impact, especially during the construction phase.

During the interactive session, questions were raised by the local community on various aspects such as the impact

of the project on their economic conditions, future expansion plans of the project in the same locality, employment of local community in the project etc. which were answered satisfactorily by the concerned person. Some of the issue raised by local stakeholders regarding additional economic activities, use of local resources by project company especially during the construction phase is listed below. Initially, people have apprehension about their land being acquired for the project.

CHAPTER 9

CONCLUSION AND RECOMMENDATION

Impacts are manageable and can be managed cost effectively - Environmental impacts are likely to result from the proposed transmission system development. Careful mitigation and monitoring, specific selection criteria and review/assessment procedures for subprojects have been specified to ensure that minimal impacts take place. The detailed design would ensure inclusion of any such environmental impacts that could not be specified or identified at this stage are taken into account and mitigated where necessary. Those impacts can be reduced through the use of mitigation measures such as a correction in work practices at the construction sites, or through the careful selection of sites and access routes.

The selected land is located on the government land. Thus the acquisition of land will not be required from the surrounding communities. Since proposed land is covered with shrubs and weed plants, thus there is no need for removal of trees for the construction of the Solar PV project.

The proposed project will have a number of positive impacts and negative impacts to the existing environment as follows:

- Significantly improvement in the economic activities in the surrounding areas due to the generation of direct and indirect employment opportunities.
- There is the negligible removal of trees for the transmission line, which is the main positive impact to the proposed project area. Compensatory afforestation will take place where tree removal is unavoidable.
- Environment pollution due to cut and fill operations, transportation of construction materials, disposal of debris, nuisance from dust, noise, vehicle fumes, black smoke, vibration are the short term negative impacts due to the proposed project.

No reliable baseline information on water, air and noise/vibration exists with respect to the transmission line and substation locations.

Proper GRM will have to be implemented by the proponent to overcome public inconvenience during the proposed project activities. It is highly recommended to establish a tree replanting program which would be undertaken as per the directives/requirements of the Forest Department and financed by the company where ever trees will be planted for the corresponding number of trees that are cut.

. Based on the environmental and social assessment and surveys conducted for the Project, the potential adverse environmental impacts can be mitigated to an acceptable level by adequate implementation of the mitigation measures identified in the EMP. Adequate provisions are being made in the Project to cover the environmental mitigation and monitoring requirements, and their associated costs. Adequate provisions are being made by the owner of the project to cover the environmental mitigation and monitoring requirements, and their associated costs.

9.1 CONCLUSIONS

An environment and social analysis have been carried out looking at various criteria such as topology, air, noise, water resources and water quality, ecology, demography of the area, climate and natural habitat, community, and employee health and safety etc. The impact analysis found that due to careful consideration of environmental and social aspects during route and site selection by the proponent, no major adverse impacts are expected. There is no adverse impact on the migration of habitat, any natural existing land resources, and effect in the regular life of people. The environment and social impact associated with transmission line project is limited to the extent of the construction phase and can be mitigated through a set of recommended measures and adequate provision for the environment and social impacts which cover monitoring, measuring and mitigation.

EMP has been prepared. Most impacts are expected to occur during the construction phase and are considered to

be of a temporary nature. The transmission corridor was carefully selected after undergoing an options assessment. This enabled the right of way alignment to bypass villages and important water supplies and resources. The main project impacts are associated with clearing of shrub vegetation, waste management and excavation and movement of soils.

From this perspective, the project is expected to have a small "environmental footprint". No endangered or protected species of flora or fauna are reported at any of the subproject sites. Adequate provisions have been made for the environmental mitigation and monitoring of predicted impacts, along with their associated costs.