11534

AB SOLAR PARK (PVT) LTD.

November 13, 2019

The Registrar
National Electric Power Regulatory Authority
NEPRA Tower, Attaturk Avenue (East)
G-5/1, Islamabad

Subject: **Application for a Generation License for 20 MWp AB Solar Private Limited for its Captive (Wheeling) Solar Power Plant to be located at Village Chab, Tehsil Jhand, District Attock, Province of Punjab.**

Dear Sir,

I, Abdul Basit Javed, Director, being the duly authorized representative of "AB Solar Park Private Limited" by virtue of board resolution dated November 11, 2019, hereby apply to the National Electric Power Regulatory Authority for the grant of a Generation License to "AB Solar Park Private 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. 1 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 Pay Order No.**32200963** dated 12-11-2019 drawn on Askari Bank Limited in the sum of PKR 271,236 /- (Pakistani Rupees Two lacs, seventy one thousand, two hundred and thirty six rupees Only) being the nonrefundable license 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.

Office Address: Hno 28 street 2 MPCHS E11-1 Islamabad Pakistan. Tel: +92-51-8734203 Fax:+92-51-8734204

AB SOLAR PARK (PVT) LTD.

Yours faithfully,

Abdul Basit Javed
Chief Executive Officer and Authorized Representative

Office Address: Hno 28 street 2 MPCHS E11-1 Islamabad Pakistan. Tel: +92-51-8734203 Fax:+92-51-8734204

AB SOLAR PARK (PVT) LTD.

Board Resolution

Extract of resolutions passed unanimously by the board of directors of AB Solar Park Private Limited on November 11, 2019:

"RESOLVED THAT AB Solar Park Private Limited, a company incorporated under the laws of Pakistan with registration number 0141691 and having its registered office located at House no. 28, Street No. 2, Sector E-11/1, MPCHS, Islamabad, (the **"Company"**) be and is hereby authorized to file Generation License Application (including any modification) for submission to the National Electric Power Regulatory Authority (**"NEPRA"**) in respect of its 20 MWp Captive (Wheeling) Solar Power Project to be located at Village Chab, Tehsil Jhand, District Attock, Province of Punjab, 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 filing a Generation License Application (including any modification) for submission to NEPRA, Mr. Abdul Basit Javed, Director and Chief Executive be and is hereby empowered and authorized for and on behalf of the Company to:

(i) review, execute, submit, and deliver the Generation License Application (including any modification) and any related documentation required by NEPRA including but not limited to filing, signing, presenting, modifying, amending or withdrawing the application and other documents, and responding to any queries of any nature whatsoever in respect thereof;

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

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(iii) appoint or nominate any one or more officers of the Company or any other person or persons, singly or jointly, in his sole and absolute discretion to communicate with, make presentations to and attend NEPRA hearings and to appear before NEPRA or any other relevant regulatory or governmental authority in any proceedings, hearings or representations pertaining to the Company or the Project;

(iv) do all such acts, matters and things as may be necessary for carrying out the aforesaid purposes and to give full effect to each of the matters approved in the above resolutions."

"AND FURTHER RESOLVED THAT Abdul Basit Javed, Director and Chief Executive, 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 he may deem appropriate.

AB SOLAR PARK (PVT.) LTD.

Abdul Basit Javed
Chief Executive Officer

Muhammad Salim Javed
Director

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

AB SOLAR PARK (PVT.) LTD.

Mr. Salman Alam
Company Secretary

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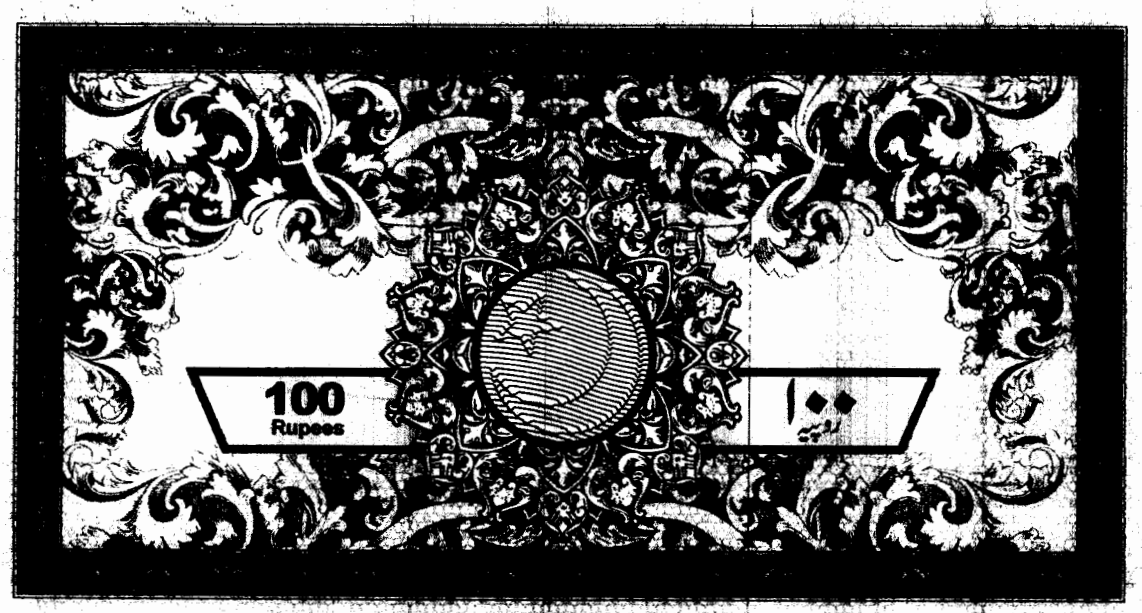


BEFORE THE NATIONAL ELECTRIC POWER REGULATORY AUTHORITY

AFFIDAVIT

AFFIDAVIT of Abdul Basit Javed, Director and Chief Executive of M/s AB Solar Park Private Limited, a company registered under the laws of Pakistan with registration number 0141691 and having its registered address at House no. 28, Street No. 2, Sector E-11/1, MPCHS, Islamabad.

I, the above named Deponent, do hereby solemnly affirm and declare that:-

1. I am the authorized representative of M/s AB Solar Park Private Limited, having age of 29 years and holding CNIC No. 1730167550577.

2. The contents of the accompanying Application for Generation License dated November, 05, 2019 of the Company's 20 MWp Captive (Wheeling) Solar Power Plant at Village Chab, Tehsil Jhand, District Attock, Punjab, Pakistan, including all supporting documents are true and correct to the best of my knowledge and belief, and nothing material or relevant thereto has been concealed or withheld therefrom.

3. I also affirm that all further documentation and information to be provided by me in connection with the aforesaid Generation License Application shall be true and correct to the best of my knowledge and belief.

AB SOLAR PARK (PVT.) LTD.

.....
Deponent

VERIFICATION:-

It is hereby verified on solemn affirmation at Islamabad, Pakistan on this 13th day of November, 2019 that the contents of the above Affidavit are true and correct to the best of my knowledge and belief and that nothing material or relevant thereto has been concealed or withheld therefrom.

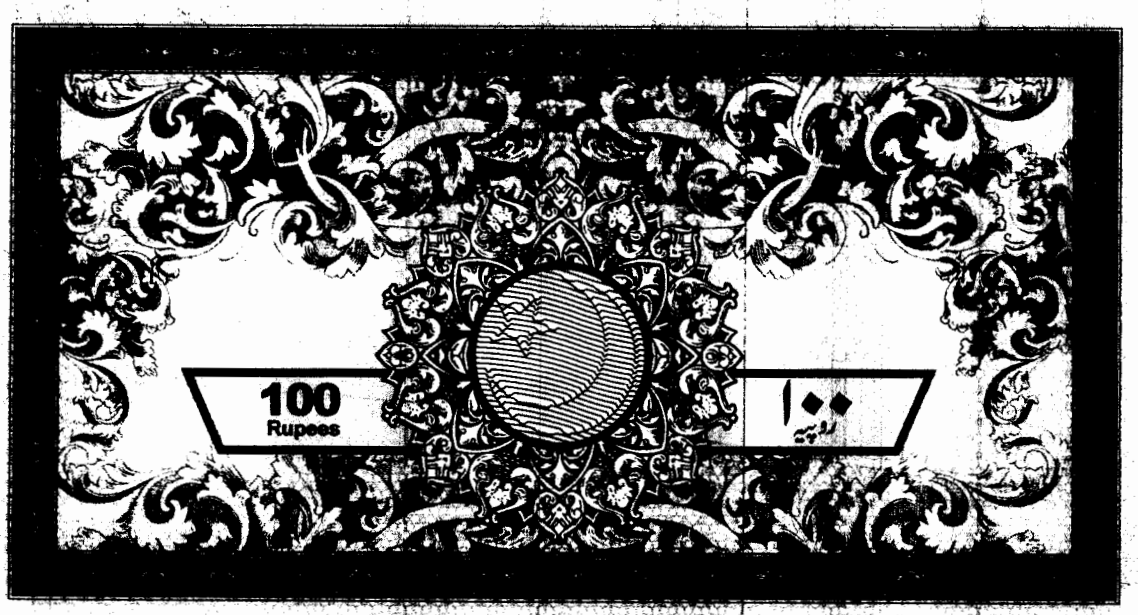
AB SOLAR PARK (PVT.) LTD.

.....
Deponent

ATTESTED
ASAD ABBAS JAFRI
NOTARY PUBLIC
ISLAMABAD

13 NOV 2019

A060504



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AB SOLAR PARK (PVT.) LTD.

.....
Deponent

ATTESTED
ASAD ABBAS JAFRI
NOTARY PUBLIC
ISLAMABAD

13 NOV 2019

Prospectus

Introduction to the Sponsors

The Project is an initiative of AASAL Solar Power (Private) Limited whose major shareholder (95%) is Mr. Abdul Basit Javed, a qualified Chartered Accountant, with net worth of 40 million USD. Mr. Abdul Basit owns and manages family properties of agricultural and commercial nature; measuring about 4,000 acres (directly owned by Mr. Abdul Basit Javed) in the province of KPK. AB Solar Park Private Limited is a special purpose vehicle being specifically incorporated to undertake the captive solar power project. AB Solar Park Private Limited is owned 90% by Mr. Abdul Basit Javed and 10% by Mr. Muhammad Salim Javed.

Abdul Basit Javed has played major role in bringing FAS Power Trading Company of Saudi Arabia into Pakistan which is establishing a 50 MWp Solar Power Plant in KPK. Similarly in the past he advised Target Group in developing 50 MWp Kulachi Solar Power Project (Private) Limited.

He has also made his footprints in the energy sector of the country through substantial investment in hydropower sector. His company AASAL owns two hydropower Projects of 6.6 MW and 20.6 MW with approved feasibilities by PEDO where as other four projects of 45 MW, 65 MW, 100 MW and 100 MW respectively are in the LOI stage. The company also owns a 49.5 MW Solar Power Project in D.I.Khan which is currently with NEPRA for tariff award. The project is intended to sale electricity to Government of Pakistan via CPPA-G. The company is therefore successfully managing and developing more than 400 MW with different partners. In solar power industry AASAL has successfully completed bidding in numerous projects of United Nations for Solarization of different units in entire KPK. AASAL has also successfully won the project of Solarization of Quaid E Azam University Islamabad having capacity of 12 MWp.

Introduction to the Project

The Applicant is applying for the Generation License in accordance with SRO. 549(I)/2016 dated June 13, 2016, "NEPRA (Wheeling of Electric Power) Regulations, 2016. The project is based on the same NEPRA regulations whereas the concept it that Applicant shall generate 20 MW of Solar Power in Village Chab, Tehsil Jhand, District Attock. The energy generated from the project shall be wheeled through the IESCO network up-till

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Islamabad and then distributed and sold on Bulk Power Consumer in sector I-9 (Industrial Estate). The Bulk Power Consumer shall be the local Telecom Companies which shall be utilizing the energy generated. Discussions have been carried out with IESCO regarding availability of network. Lakkarmar 132 kV Grid Station of IESCO has been shortlisted as the respective Grid Station through which the electricity shall be injected into the IESCO network. Grid Interconnection Study has been awarded to Power Planners International for completing the Load Flow, Stability, Dynamic Analysis and Transient Stability tests.

The project site is near Chab village, approximately 30 km from Jhand City. It is located at 33°12'48.53"N 71°51'14.52"E at an altitude of 238 meters having a distance of approximately 150 km from Islamabad.

The Project site consists of approximately 70 acres of land. The site selected for the project is generally flat, with a minor slope towards the southeast, with the slope increasing towards the southern end of the site boundary.

The Project shall have an installed capacity of 20 MWp. The scheme of interconnection with IESCO grid has been determined in the Grid interconnection studies.

Salient Feature of the Facility for which license is sought

Project Capacity	20 MWp
Type of generation Facility	Solar PV Power Plant
Type of Technology	Mono Crystalline Silicon
Module	Longi Solar LR4-72HPH 420-440M
Inverter	TBEA TC2500KF
Proposed Interconnection Scheme	4.5 KM In/Out arrangement with 132 kV Grid Station Lakkarmar
Project Cost	12 Million USD Equity: 2.4 Million USD, Debt: 9.6 Million USD

Upon issuance of the Generation License, the applicant would execute Energy Purchase Agreements (EPA) with the Bulk Power Consumer and aims to reach financial close by March 2020 and the expected commercial operation date of the Project by September 2020.

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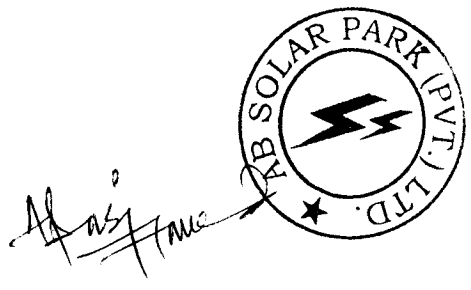
Proposed investment

The total cost of the project is approximately US$ 12 million with the proposed capital structure comprising of 80% debt and 20% equity as per recently issued National Electric Power Regulatory Authority (Benchmarks for Tariff Determination) Guidelines, 2018. Total debt component is estimated at US$ 9.6 million while total equity component is estimated at US$ 2.4 million. Debt funding mix is assumed at 50:50 foreign and local debt. Whole equity component will be provided by the project sponsors.

Social and Environmental Impact of the Proposed Facility

As per the IEE Report, the Project has no significant adverse impacts and shall contribute positively to the environment and socioeconomic development of the area. Further, the Project land is marginal in nature with no endangered flora or fauna species in the area. Appropriate measures for environmental monitoring and mitigation have been proposed in the study. The proposed project site is a barren land and no population exists near the project site.

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



SCHEDULE-I

The Location, Size (i.e. Capacity in MW), Type of Technology, Interconnection Arrangements, Technical Limits, Technical/Functional Specifications and other details specific to the Generation Facilities of the Licensee are described in this Schedule.

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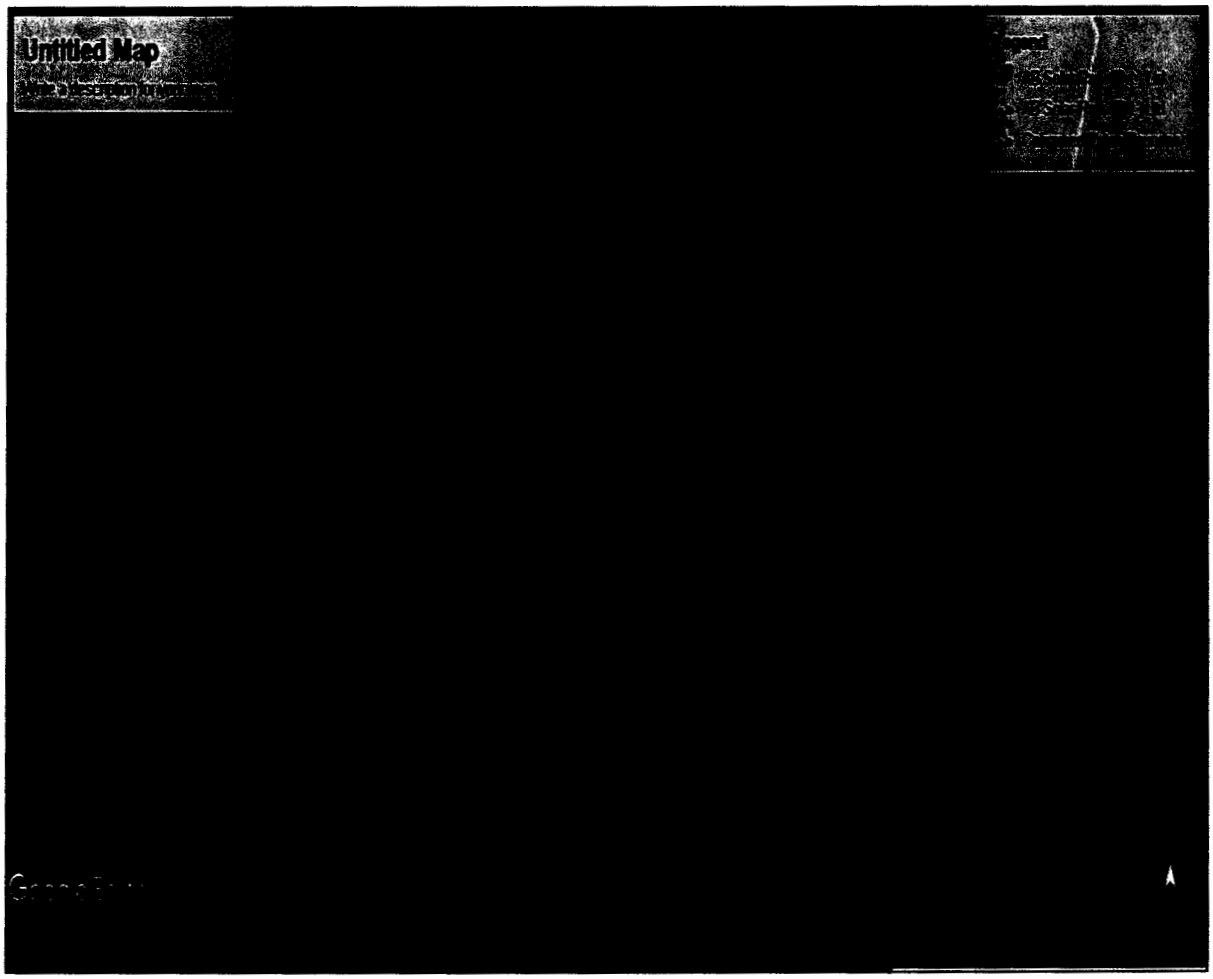
Location of the Generation Facility/Solar Power Plant/ Solar Farm of the Licensee



Project Site

The project site is accessible through Rawalpindi-Jand-Kohat Road (N-55) at the distance of approximately 150 km from Islamabad with an estimated time of 3 hours. The project area runs through central Indus basin. Central Indus Platform Basin (CIPB) rests on the continental margin of Indo-Pakistani Plate. CIPB is bounded in south by Jaisalmer-Mari-Kandhkot High, while Sulaiman Range defines the western boundary. Sargodha Ridge (Kirana Hills) marks the north-eastern boundary. The Punjab Platform dips westward into the Sulaiman Foredeep. The structural style of the Central Indus Platform Basin is obscured at surface by thick alluvial cover.

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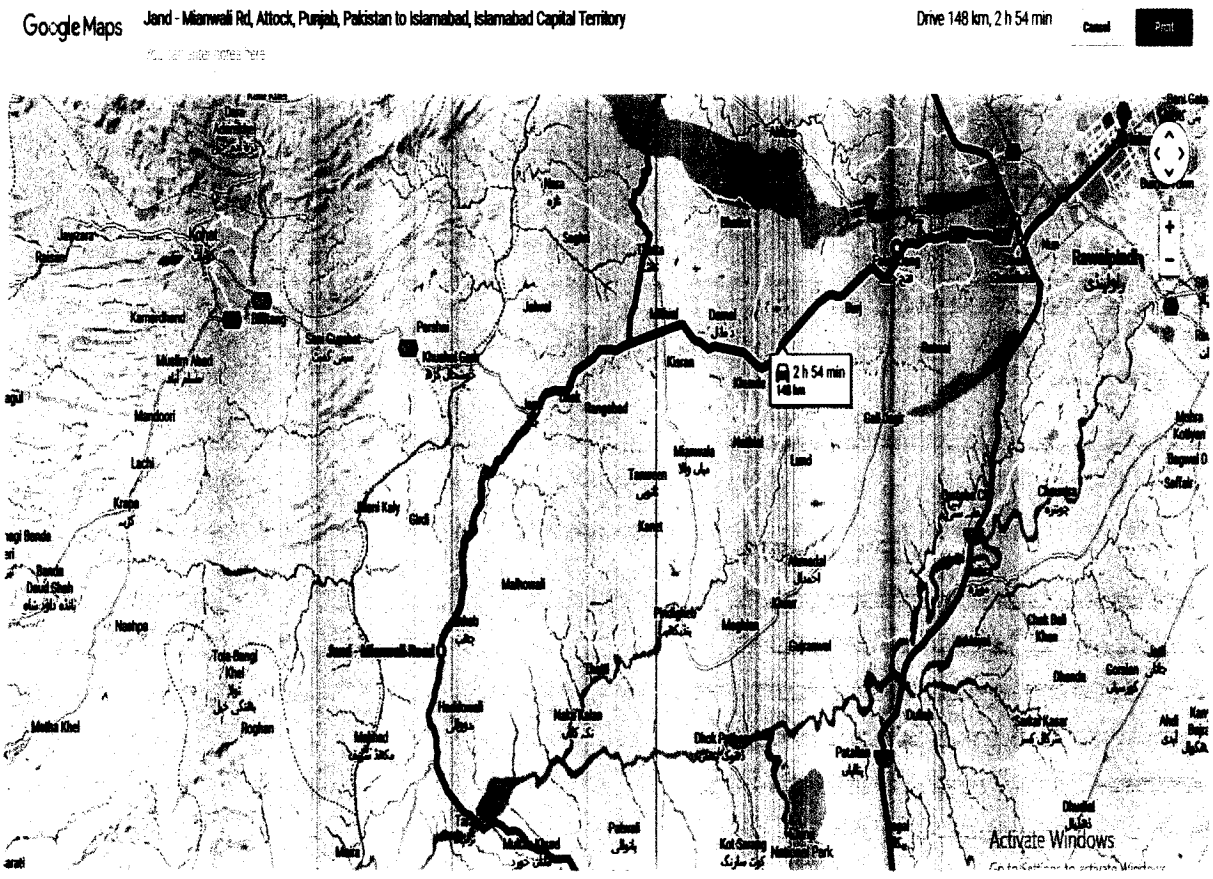
Relevant site details are summarized in the following table;

Particulars	Description
Project Site	Village Chab
Tehsil	Jhand
District	Attock
Province	Punjab
Latitude	33°12'48.53"N
Longitude	71°51'14.52"E
Road Access	Asphalt road attached to the site
Project Site Area (Assessed)	70 Acres

Plant Location



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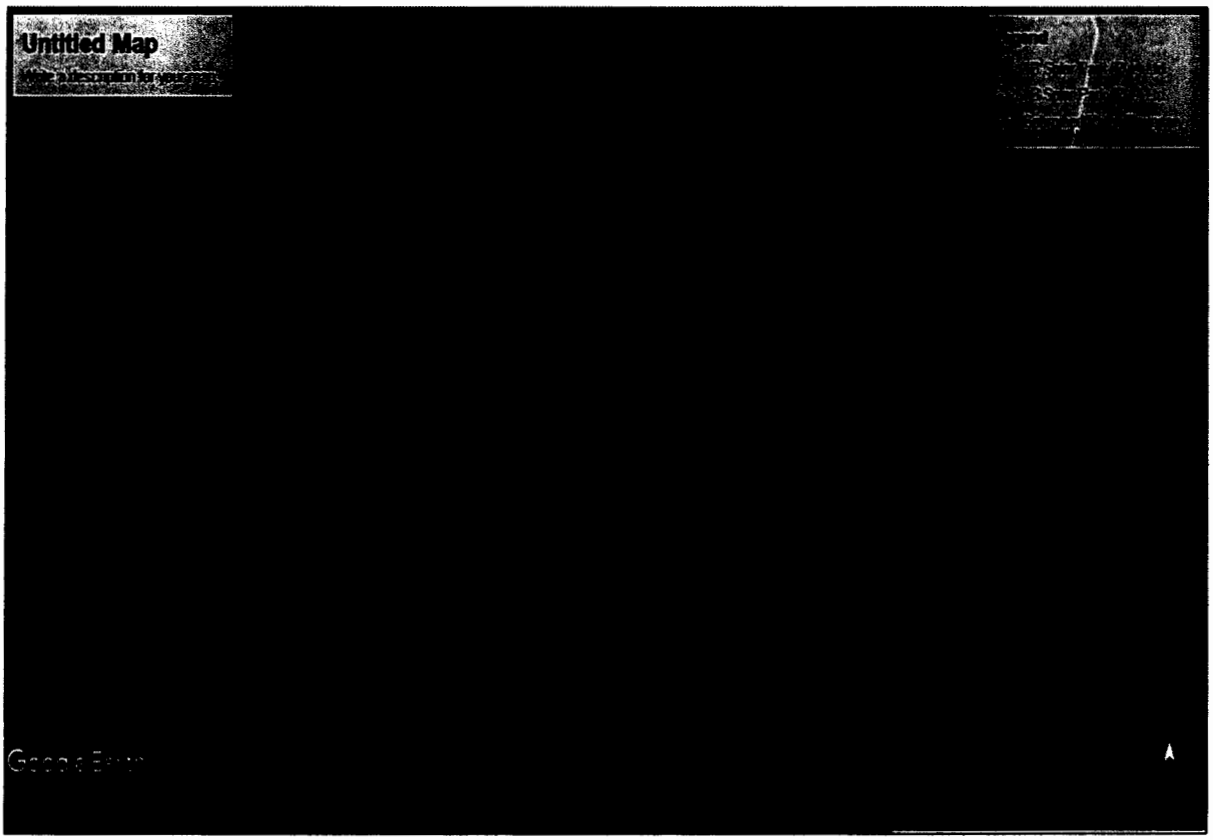
Generation License
20 MW AB Solar Park (Pvt.) Ltd
Tehsil Jhand, Attock
Punjab

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

Land Coordinates of the Project site	33°12'53.07"N	71°51'8.53"E
	33°12'53.39"N	71°51'21.08"E
	33°12'42.53"N	71°51'8.71"E
	33°12'42.47"N	71°51'20.95"E



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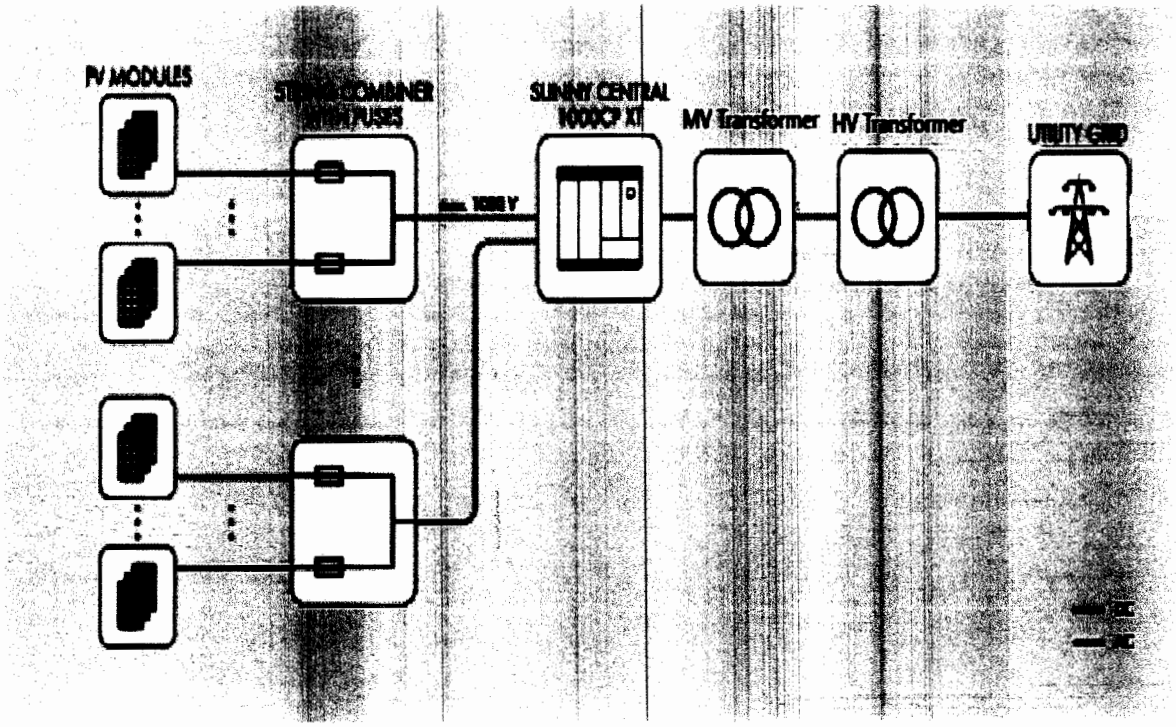
Generation License
20 MW AB Solar Park (Pvt.) Ltd
Tehsil Jhand, Attock
Punjab

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



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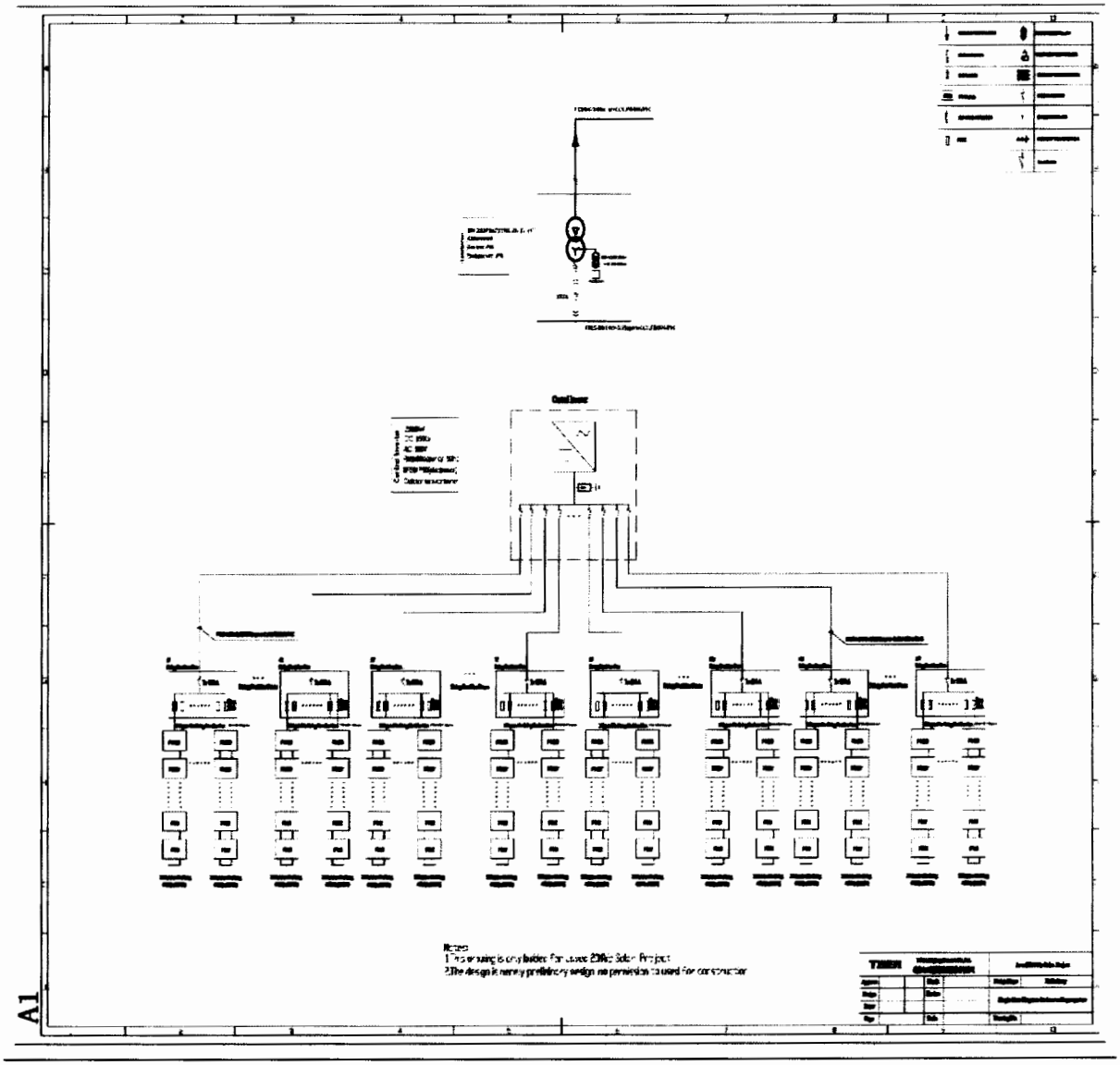
Generation License
20 MW AB Solar Park (Pvt.) Ltd
Tehsil Jhand, Attock
Punjab

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



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

The project will be connected by making an In/Out on 132kV Rail Single circuit between the Project and Lakkarmar Substation of IESCO by a feed length of 3.5km of Rail conductor. Steady state power flow assessment has been performed using the base case provided by IESCO. Pre-project power flow study was conducted to analyze the magnitude and phase angles of bus voltages, line loadings and power flows under steady-state conditions. Post project power flow analysis has also been performed after the interconnection of the proposed project with the IESCO transmission system. The power flow results for the system intact and for the contingency conditions shows that the power flows on all the transmission line branches are within their normal thermal loading limit. There is no capacity constraint in terms of power flow or voltage ratings within the study area. Dynamic stability analysis has been performed to access the dynamic impact of the Solar power plant on national grid system due to disturbances at the power plant and vice versa. The results of dynamic stability analysis indicate that the power system is stable for the interconnection proposal and it also fulfils all the criteria for generation connection with the power system. Short circuit analysis has been performed to evaluate the contribution of the proposed project in fault current levels of substations in its electrical locality. Fault currents have been computed based on simulation of three-phase and single-line-to-ground faults by applying the criteria as mentioned in the IEC-60909 standard.

Result of the analysis shows that the calculated fault currents are below the circuit-breaker interrupt ratings of existing grid stations located in locality of the project. Based on the study results, it is concluded that proposed generation interconnection assessment for 20 MW (AC) Solar PV Power Generation project meets the NEPRA grid code planning criteria.

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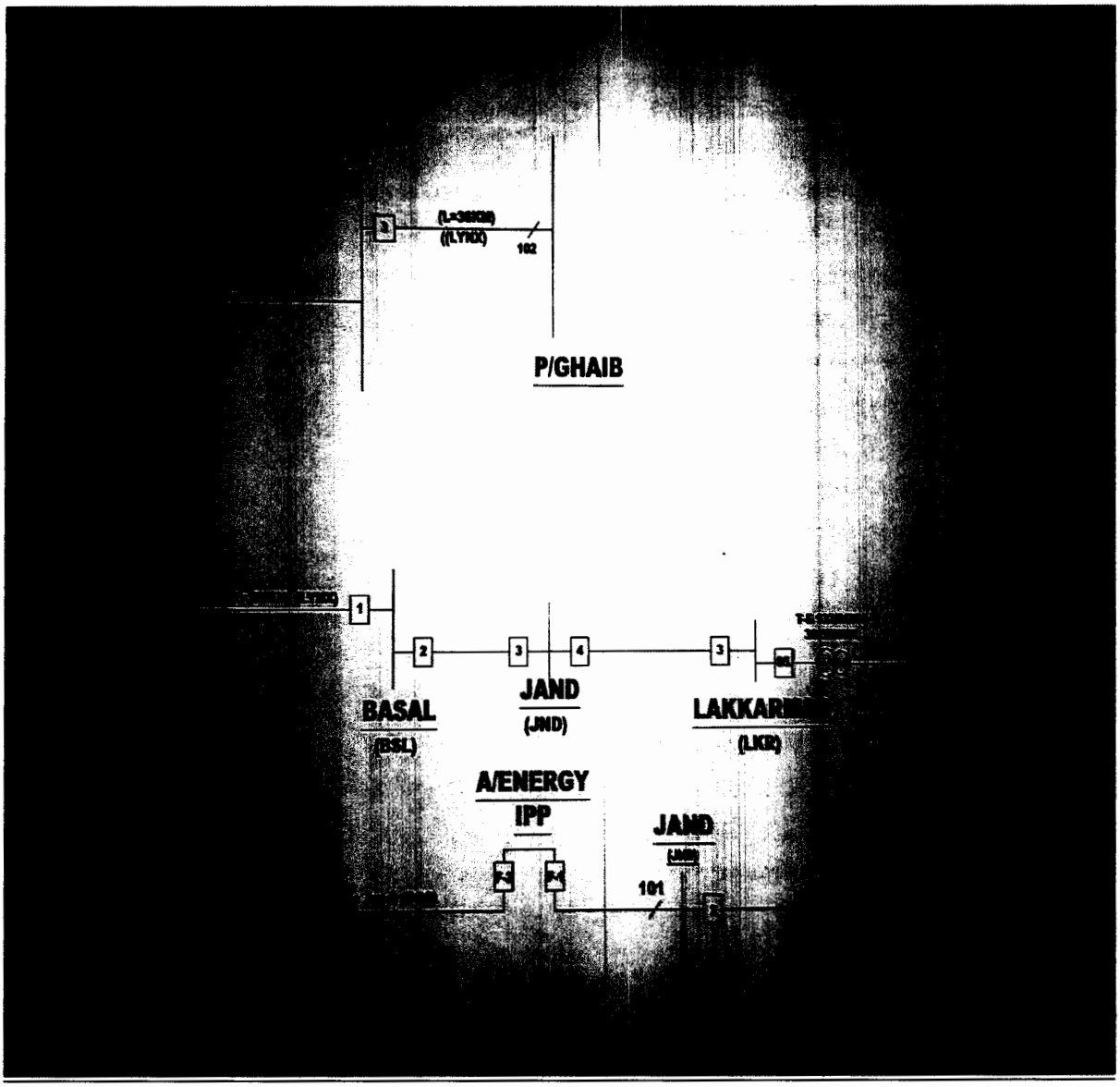
Generation License
20 MW AB Solar Park (Pvt.) Ltd
Tehsil Jhand, Attock
Punjab

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



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Details of
Generation Facility/Solar Power Plant/Solar Farm

(A). General Information

(i).	Name of Company/ Licensee	AB Solar Park Private Limited
(ii).	Registered/Business Office	House no. 28, Street No. 2, Sector E-11/1, MPCHS, Islamabad
(iii).	Plants Location	Chab village, Jhand Tehsil, District Attock, Punjab
(iv).	Type of Generation Facility	Solar Photovoltaic (PV) Power Plant

(B). Solar Technology & Capacity

(i).	Type of Technology	PV Cell
(ii).	System Type	Grid Connected but for Captive Use
(iii).	Installed Capacity[1] of the Generation Facility/Solar Power Plant/Solar Farm (MW)	20 MW_P

(C). Technical Details of Equipment

(a).	**Solar Panels – PV Modules**

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(i).	Type of Module	PV Modules crystalline silicon (Mono-crystalline)
(ii).	Type of Cell	Low LID mono PERC half cut
(iii).	Dimension of each Module	Dimensions (L×W×H) (mm) 2115×1052×35
(iv).	Module Surface Area	2115x1052 (mm)
(v).	No. of Panel /Modules	46,536 Solar PV modules
(vi).	Total Module Area	103,541 sq. m
(vii).	Total Land Area Used	70 acres
(viii).	Panel's Frame	Anodized aluminium alloy frame.
(ix).	Weight of one Module	24 kg
(x).	Module Output Warranty	10 year product warranty
		25 years Linear power output warranty
(xi).	Number of Solar Cells in each module	144-cell (6x24)
(xii).	Efficiency of module	19.3%
(xiii).	Environment Protection System	ISO 14001:2004: ISO Environment Management System
(xiv).	Nominal Maximum Power (Pmax) at STC	430 W
(xv).	Power Tolerance at STC	0 - +5 W
(xvi).	Open circuit voltage (Voc) at STC	49.2 V
(xvii).	Short circuit current (Isc) at STC	11.19 A

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(xviii).	Maximum system Voltage at STC	1500 DC (IEC/UL)
(b).	**PV Array**	
(i).	No. of PV modules	46,536
(ii).	Modules in a string	28 module
(iii).	Total number of strings	1662
(c).	**PV Capacity**	
(i).	Total	20 MWp
(ii)	Junction Boxes	IP 68, three diodes
(d).		
(i).	Inverter Model	TC2500KF
(e).	**Input (DC)**	
(i).	Max. Allowable Input voltage	1500V
(ii).	MPP voltage range [@ 25°C/@ 40°C/@ 60°C]	900V to 1300V
(iii).	Maximum DC Current	3118A
(iv).	Rated Input Voltage	900V
(v).	Max. Number of Inputs	16*400A or 20*250A
(f).	**Output (AC)**	
(i).	Max. AC power @ 40°C	2,750kVA
(ii)	AC frequency operation range	48/52Hz

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(iii).	Rated power frequency/rated grid voltage	50 Hz / 630 V	
(iv).	Power factor at rated power/ Displacement power factor, adjustable	1 / 0.8 leading to 0.8 lagging, adjustable	
(v).	Feed-in phases/ connection phases	3/3	
(g).	**Efficiency**		
(i)	Max. efficiency/ European efficiency/ CEC efficiency	99% / 98.7%	
(h).	**Protective Devices**	(a). Input-side disconnection device (b). Output-side disconnection device (c). DC overvoltage protection (d). Stand-alone grid detection active/passive (e). Grid monitoring (f). Ground fault monitoring (g). Insulation monitoring (h). Surge arrester for auxiliary power supply	
(i).	**Environmental Enclosures**	Operating Temperature Range	-25C - +60C (above 50C, derating)
		Maximum permissible value for relative humidity (non-condensing)	0% - 95% (non-condensing)
		Noise emission	68 dB(A)
		Operating Elevation	4000m, without derating ≤ 2000m (according to GB/T3859.2)

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(j).	**Grid Operation Protection**	(a).	Over-voltage/undervoltage Protection
		(b).	Over-frequency/under frequency protection
		(c).	Anti-island protection strategy
		(d).	Over-current protection
		(e).	Anti-discharge protection
		(f).	Overload protection
		(g).	Low voltage ride through
		(h).	Lightning protection
		(i).	ZVRT
		(j).	Anti-discharge protection
		(k).	Stand-alone Grid detection
(k).	**Data Collection System**		
(i).	Weather Data	(a).	Pyranometer – Sets (Incline to record irradiation level) [Yes]
		(b).	Thermometer – Sets (to record ambient temp) [Yes]
(ii).	System Data	(a).	DC input voltage (V) & current (A) of each inverter (phase, line) [Yes]
		(b).	Total DC power (kw) generated by PV array [Yes]
		(c).	AC output voltage (V) and current (A) of each Inverter (Phase, Total) [Yes]
		(d).	AC output power (kW) and energy (kwh) of each inverter [Yes]
		(e).	Frequency (Hz) [Yes]

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		(f).	Power Factor (PF) [Yes]
		(g).	Temperature inside inverter station [Yes]
(l).	**Isolating Transformer**		
(i)	Model	Siemens	
(m).	**Medium Voltage Side**		
(i).	Rating	630V // 33kV step-up	
(ii).	Type of Transformer	Oil and Natural Air	
(iii).	Input voltage	630V	
(iv).	Output Voltage	33kV	
(v).	Purpose of Transformer	Step-up	
(n).	**Low-Voltage Side**		
(i).	Nominal Input Voltage	630 V	
(o).	**Outdoor Cubicle Control Room**		
(i).	Data record	Continuous logging with data logging software [Yes]	
(ii).	Control room system	Computerized data acquisition system [Yes]	
(iii).	Control room system detail	Interfacing hardware & software, Industrial type PC, which will be robust & rugged suitable to operate in the control room environment [Yes]	
(p).	**Mounting Structure**		
(i).	Application	Ground Mounted	

AB SOLAR PARK (PVT.) LTD.

(ii).	Model	Sigma I XL
(iii).	Module Layout	Multi-variation, maximum table length 25 m
(iv).	Module inclination	26°
(v).	Quantity	70,000
(vi).	Structure Profile/s	Steel Zinc –flake-coated Stainless Steel Extruded aluminum
(vii).	Foundation structure	Reinforced concrete pile or Spiral steel piles

(D). <u>Other Details</u>

(i).	Expected COD of the Generation Facility/Solar Power Plant/Solar Farm (Anticipated)	August 15, 2020
(ii).	Expected Useful Life of the Generation Facility/Solar Power Plant/Solar Farm (Anticipated) from COD	25 Years

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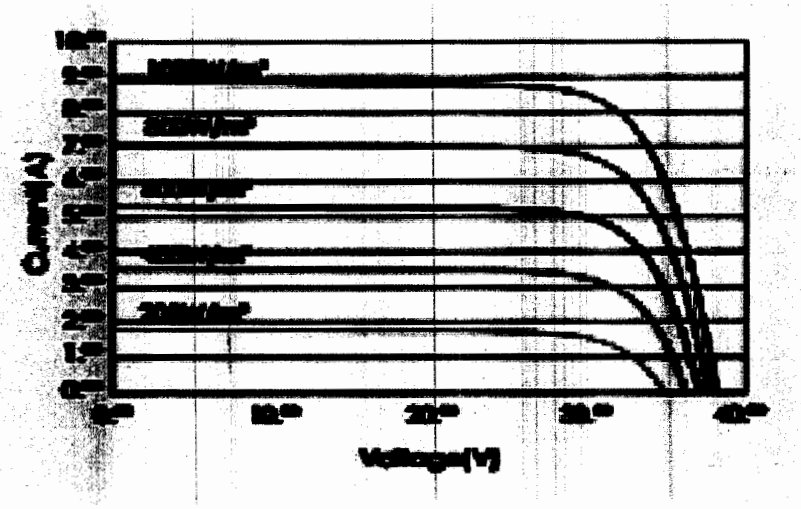
Generation License
20 MW AB Solar Park (Pvt.) Ltd
Tehsil Jhand, Attock
Punjab

V-I Curve of Solar Cell



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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.

AB SOLAR PARK (PVT.) LTD.

SCHEDULE-II

(1).	Total PV Installed Capacity of Generation Facility	20 MW_P
(2).	Average Sun Hour Availability/Day (Irradiation on Inclined Surface)	6 Hours
(3).	Days per Year	365 days
(4).	PV Plant Generating Capacity Annually (As Per Simulation)	35,357 MWh
(5).	Expected Total Generation in 25 years Life Span	883,925 MWh
(6).	Generation per Year from plant keeping 24 Hours Working	20 x 24x 365 = 175,200
(7).	Net Capacity Factor (4/6)	20.1% at P50

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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Profile of Experience of the Applicant, Management, Staff and its members in the electricity industry

The Project is an initiative of AASAL Solar Power (Private) limited "AASAL", whose major shareholder (95%) is Mr. Abdul Basit Javed, a qualified Chartered Accountant, with net worth of 40 million USD. Mr. Abdul Basit owns and manages family properties of agricultural and commercial nature; measuring about 4,000 acres (directly owned by Mr. Abdul Basit Javed) in the province of KPK.. Abdul Basit Javed has played major role in bringing FAS Power Trading Company of Saudi Arabia into Pakistan which is establishing a 50 MWp Solar Power Plant in KPK. Similarly in the past he advised Target Group in developing 50 MWp Kulachi Solar Power Project (Private) Limited. AASAL owns two hydropower Projects of 6.6 MW and 20.6 MW. The feasibility study of both the projects have been completed by Lahmeyer Germany and the same are approved by panel of expert (POE) of PEDO where as other four projects of 45 MW, 65 MW, 100 MW and 100 MW are in the LOI stage. The company is therefore successfully managing and developing more than 400 MW with different partners. In solar power industry AASAL has successfully completed bidding in numerous projects of United Nations for Solarization of different units in entire KPK. AASAL has also successfully won the project of Solarization of Quaid E Azam University Islamabad having capacity of 12 MWp. Another 49.5 MW Javed Solar Park (Pvt.) Ltd is already with NEPRA for tariff determination. Javed Solar Park is one of the first Solar Power Projects in KPK.

The Project Company, AB Solar Park Private Limited is going to be one of the primary Wheeling/Captive (Power Producer) in Solar Energy in Punjab province.

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Safety plans, emergency plans

Fire Protection

The solar PV module, inverter and structure installation shall be Class-A certified. Fire-resistant cables shall be used and, especially on the DC-side, TUV-certified DC cables shall be used. Fire extinguishers shall be located at regular spacing at the project site, as there is no fire station in the near vicinity.

Environment Management

As renewable energy projects are generally considered environmentally friendly, there are a few aspects that should be closely monitored and managed as they could otherwise have adverse impacts. The measure to be adopted by the Project include:

1. Oil-leaking transformers. There will be 6 MV transformers and two HV transformers installed at the Project, and dry type will be used.
2. Preserving the agricultural land utilized for solar project installation. Native plant species which do not intervene with solar PV performance shall be managed and retained.
3. Adequate recycling program for broken or damaged solar PV modules. The O & M Contractor will be required adhere to a recycling plan to reduce the environmental impact of disposing of solar PV modules.
4. Some solar PV modules, such as thin film modules (CdTe), can also leak hazardous substances. A proper containment mechanism shall be devised for such hazards.
5. A total of 35,357 MWh of energy will be produced by the Single Axis system on an annual basis at P50. All energy is to be offtake by the local power utility, IESCO, and would displace a proportionate amount of fossil fuel-fired thermal generation. This would correspond to an annual maximum carbon footprint reduction of 16,686 metric tonnes for a tracking system. For more details on the plant's environmental monitoring program (EMP), see Vol. 4 of the Project Feasibility Study.

Health & Safety Management

An adequately designed solar system is one which caters to all safety considerations in its design. There are several codes and standards relating to safety practices, particularly in solar PV equipment manufacture and installation. Agencies with codes and standards relevant to solar PV systems include:

- National Fire Protection Agency (NFPA)

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- Underwriters Laboratory (UL)
- Institute of electrical and electronics engineers (IEEE)
- International Electrotechnical Commission (IEC), and
- CEC (California Energy Commission)

The NFPA's 70 NEC (National Electric Code), Chapter 6, has been particularly developed for sizing and installing solar PV systems. NESC (National Electric Safety Code), updated by IEEE every five years, is another valuable source of information for devising health and Safety protocols for the Project. EPC contractors shall be advised to conform to the relevant industry-standard safety codes, such as those mentioned above, and detailed guidelines shall be developed by the owners' engineer.

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Infrastructure: Roads, rail, staff colony, amenities

Roads

In order to successfully move all project related equipment from sea port to the point of installation at the project site, a series of existing roads are available. The project will use the existing roads to the extent possible. Unpaved road of approximately 2.1 km will be used to access the project site. This road needs to be developed enough so to enable travel of containers carrying trucks/trailers and low bed trailers for transporting substation transformers and other equipment's. Local government will be briefed on the importance of this road connecting to the project site, particularly highlighting the establishment of other solar projects at the adjacent sites as well. Internal roads with in the power plant facility are within the scope of the project.

Colony for Staff

During the construction phase a staff colony will be constructed as part of the project. The colony will all the basic amenities for laborers and other staff working on the project. After the construction phase, a part of the staff colony will be used for the O&M staff of the project.

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Control, Metering, Instrumentation and Protection

Power Station Control System

A SCADA system will be an integral part of the project EPC scope and would be accessible to the sponsor, O&M operator, grid operator and asset manager. This operating system will help monitor energy generation in detail, report and troubleshoot faults, and help evaluate asset performance, component degradation and other important variables that need to be regularly assessed for ensuring effective solar PV and plant performance. The SCADA interface will also be accessible to local operator at the plant's control room for operational command and control purposes. All ancillary services and functions which the inverter is capable of will be operable through the control system. In case of a tracking system, the control system will also allow changing panel orientations based on specific requirements, if and when required.

Training and development plan

The Operations & Management (O&M) of the Project shall be managed by the EPC Contractor for initial 2 years post-COD as Warranty Period O&M under the EPC Contract. The O&M for years 3 – 8 shall be carried out by the same contractor under the O&M Contract. Throughout the O&M period, the Contractor shall be responsible for On Job Training (OJT) of the local team, which shall remain part of the O&M and gradually take over after completion of O&M tenure.

The EPC and O&M Contracts shall mention in detail the training requirements for the operation of the Solar project and the Project Company's personnel. As per the Contracts, the Contractors shall be required to provide details of how training will be carried out, including the number of days of training outside Pakistan, and the number of people who will be trained under their offer. The Contractor will ensure that the personnel working on the solar project during the construction and the operation period are correctly trained and qualified for the roles that they are performing and that a record of their training is maintained.

The Contractors shall be required to provide special emphasis to the Health & Safety (H&S) aspects of the Project construction and operations, for which specific training will be provided by the Contractors to all of the operations and maintenance personnel, including the regulatory requirements for the use of any special safety equipment required for the undertaking of such functions. Such training will be in addition to any other training provided and will continue, for each individual, until each said individual can be certified by the Contractors as having attended the full H&S training, thus gaining sufficient appreciation of the H&S requirements to operate the Project.

Although the content of training modules will be finalized between the Contractors and the Project Company prior to COD, some specific training needs that will be covered include the following:

a) Procedures for operation and maintenance of the solar project and its associated equipment.
b) Awareness and application of safe systems of work and responsibilities of all staff involved in operations and maintenance duties.
c) Fire control and prevention (including equipment maintenance and management and 'emergency plan').
d) First-aid provision (including 'emergency plan').
e) Working at heights (including 'emergency plan').

AB SOLAR PARK

f) Working on, at or near rotating plant.
g) Working on, at or near high and low voltage AC and DC apparatus (HV & LV) and the differences between live, not live and dead circuits.
h) Working on, at or near energized systems (such as pressure vessels, accumulators, springs, gearing, torque arms, unearthed electrical systems and dampers).
i) Working on, at or near hazardous substances (oils, chemicals, insulators and gases).
j) Confined space works and requirements therein.

The Contractors shall provide or procure the provision of these training needs for all O&M personnel in order that the O&M services may be performed in accordance with the Project Agreements and Prudent Industry Practices.

AB SOLAR PARK (PVT.) LTD.

A064367

SECURITIES AND EXCHANGE COMMISSION OF PAKISTAN

SECP

COMPANY REGISTRATION OFFICE

CERTIFICATE OF INCORPORATION

[Under section 16 of the Companies Act, 2017 (XIX of 2017)]

Corporate Universal Identification No: **0141691**

I hereby certify that **AB SOLAR PARK (PRIVATE) LIMITED** is this day incorporated under the Companies Act, 2017 (XIX of 2017) and that the company is **limited by shares.**

Given under my hand at **Islamabad** this **Thirty First** day of **October,** Two **Thousand** and **Nineteen**

Incorporation fee Rs. **1000.0/-** only

(Muhammad Sadiq Shah)
Additional Joint Registrar
Islamabad

No. ADI 60298
Dated 31/10/19

CERTIFIED TO BE TRUE COPY

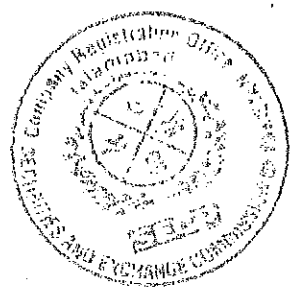
No. ADI 62657
Dated 21/11/19

Additional Joint Registrar
Company Registration Office Islamabad

THE COMPANIES ACT, 2017 (XIX of 2017)

(A Private Company Limited by Shares)

MEMORANDUM OF ASSOCIATION



AB SOLAR PARK (PRIVATE) LIMITED

THE COMPANIES ACT, 2017 (XIX of 2017)

(PRIVATE COMPANY LIMITED BY SHARES)

Memorandum of Association

of

AB SOLAR PARK (PRIVATE) LIMITED

1. The name of the Company is **AB SOLAR PARK (PRIVATE) LIMITED.**
2. The Registered Office of the Company will be situated in the Islamabad Capital Territory.
3. (i) The principal line of business of the company shall be 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 of concerned authorities; and to locate, establish, construct, equip, operate, use, manage and maintain thermal power plants, coal fired power plants, hydal power plants, alternate energy, solar energy, wind mills, power grid station, 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, computer centres, shops and necessary devices, showrooms, depots, factories, workshops, plants and to provide transforming, switching, conversion and transmission facilities, subject to permission of relevant authorities.

   (ii) Except for the businesses mentioned in sub-clause (iii) hereunder, the company shall engage in all the lawful businesses and shall be authorized to take all necessary steps and actions in connection therewith and ancillary thereto.

   (iii) Notwithstanding anything contained in the foregoing sub-clauses of this clause nothing contained herein shall be construed as empowering the Company to undertake or indulge, directly or indirectly in the business of a Banking Company, Non-banking Finance Company (Mutual Fund, Leasing, Investment Company, Investment Advisor, Real Estate Investment Trust management company, Housing Finance Company, Venture Capital Company, Discounting Services, Microfinance or Microcredit business), Insurance Business, *Modaraba* management company, Stock Brokerage business, forex, real estate business, managing agency, business of providing the services of security guards or any other business restricted under any law for the time being in force or as may be specified by the Commission.

   (iv) It is hereby undertaken that the company shall not:

a) Engage in any of the business mentioned in sub-clause (3) (iii) above or any unlawful operation.

b) Launch multi-level marketing (MLM), Pyramid and Ponzi Schemes, or other related activities/businesses or any lottery business.

c) Engage in any of the permissible business unless the requisite approval, permission, consent or licence is obtained from competent authority as may be required under any law for the time being in force.

4. The liability of the members is limited.

5. The Authorized Share Capital of the Company is Rs. 100,000/- (Rupees one hundred thousand only) divided into 10,000 (Ten thousand only) ordinary shares of Rs. 10/- (Rupees ten only) each with powers to the Company from time to time to increase or reduce its capital subject to any permission required under the law.

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

Serial No.	Name	CNIC No. (in case of foreigner, Passport No)	Father's / Husband's Name in full	Nationality with any former Nationality	Occupation	Residential Address in full	Number of shares taken by each subscriber	Signatures
1	*ABDUL BASIT JAVED*	*17301-6755057-7*	*MUHAMMAD SALIM JAVED GANDAPUR*	*PAKISTANI*	*BUSINESS*	*HOUSE NO. 69 A, STREET NO. 3, SECTOR E-11/1, MPCHS, ISLAMABAD*	9,000 (Nine thousand only)	
2	*MUHAMMAD SALIM JAVED GANDAPUR*	*17301-7780149-7*	*SARDAR ATTAULLAH GANDAPUR*	*PAKISTANI*	*BUSINESS*	*HOUSE NO. 69 A, STREET NO. 3, SECTOR E-11/1, MPCHS, ISLAMABAD*	1,000 (One thousand only	
Total number of shares taken							10,000 (Ten Thousand Only)	

Dated October 31, 2019

CERTIFIED TO BE TRUE COPY

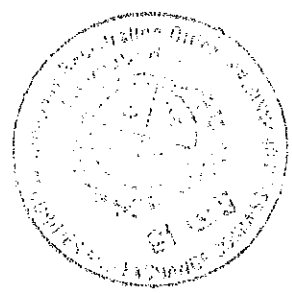
Registrar
Company Registration Office, Islamabad

No. ADI
Dated

THE COMPANIES ACT, 2017 (XIX of 2017)

(PRIVATE COMPANY LIMITED BY SHARES)

Articles of Association



of

AB Solar Park (Private) Limited

THE COMPANIES ACT, 2017 (XIX of 2017)

(Private Company Limited by Shares)

ARTICLES OF ASSOCIATION

OF

AB SOLAR PARK (PRIVATE) LIMITED

1. The Regulations contained in Table 'A' to the First Schedule to the Companies Act, 2017 (the "Act") shall be the regulations of **AB SOLAR PARK (PRIVATE) LIMITED** (the "Company") so far as these are applicable to a private company.

PRIVATE COMPANY

2. The Company is a "Private Company" within the meaning of Section 2(1)(49) of the Act and accordingly:

(1) No invitation shall be made to the public to subscribe for the shares or debentures of the Company.

(2) The number of the 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, where two or more persons hold one or more shares in the company jointly, they shall be treated as single member; and

(3) The right to transfer shares of the Company is restricted in the manner and to the extent herein appearing.

TRANSFER OF SHARES

3. A member desirous to transfer any of his shares shall first offer such shares for sale or gift to the existing members and in case of their refusal to accept the offer, such shares may be transferred to any other person, as proposed by the transferor member, with the approval of the Board of Directors.

DIRECTORS

4. The number of directors shall not be less than two or a higher number as fixed under the provisions of the Act. The following persons shall be the first directors of the Company and shall hold the office upto the date of First Annual General Meeting:

1. *ABDUL BASIT JAVED*
2. *MUHAMMAD SALIM JAVED GANDAPUR*

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 set opposite to our respective names.

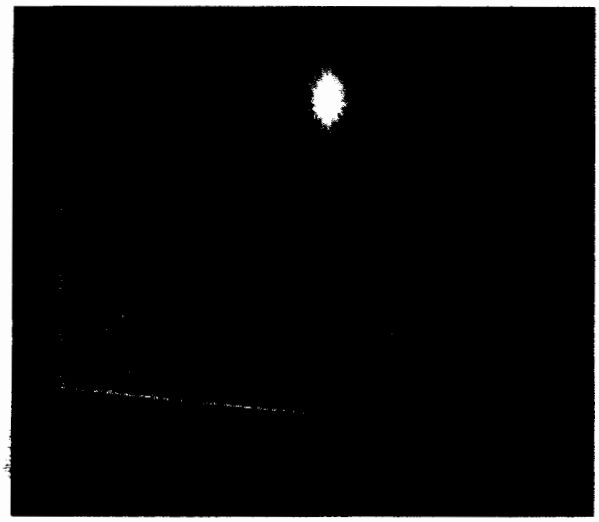
Serial No.	Name	CNIC No. (in case of foreigner, Passport No)	Father's / Husband's Name in full	Nationality with any former Nationality	Occupation	Residential Address in full	Number of shares taken by each subscriber	Signatures
1	*ABDUL BASIT JAVED*	*17301-6755057-7*	*MUHAMMAD SALIM JAVED GANDAPUR*	*PAKISTANI*	*BUSINESS*	*HOUSE NO. 69 A, STREET NO. 3, SECTOR E-11/1, MPCHS, ISLAMABAD*	9,000 (Nine thousand only)	
2	*MUHAMMAD SALIM JAVED GANDAPUR*	*17301-7780149-7*	*SARDAR ATTAULLAH GANDAPUR*	*PAKISTANI*	*BUSINESS*	*HOUSE NO. 69 A, STREET NO. 3, SECTOR E-11/1, MPCHS, ISLAMABAD*	1,000 (One thousand only	
			Total number of shares taken				10,000 (Ten Thousand Only)	

Dated October 31, 2019

No. ADI
Dated

CERTIFIED TO BE TRUE COPY

Abdul Basit Javed Registrar
Company Registration Office Islamabad



20 MW AB SOLAR PARK (PVT.) LTD FEASIBILITY STUDY

PROJECT:
The Project is located near the village of Chab in Jhand in Attock District of the Punjab Province.

TABLE OF CONTENT

Appendices

Abbreviations and Acronyms

AC	Alternating current
ADB	Asian Development Bank
AEDB	Alternative Energy Development Board
amsl	Above mean sea level
a-Si	Amorphous silicon
BOS	Balance of system BSF (Back surface field)
CAGR	Compound annual growth rate
CdTe	Cadmium telluride
CEC	California Energy Commission
CIGS	Copper indium gallium (di) selenide
CO_2	Carbon dioxide
CO_2e	Carbon dioxide equivalent
COD	Commercial operations date
CPM	Carbon pricing mechanism
CPPA-G	Central Power Purchase Agency Guarantee
CUF	Capacity utilization factor
DAS	Data acquisition system
DC	Direct current
eBOS	Electrical balance of system
EMP	Environmental monitoring program
EPA	Energy Purchase Agreement
EPC	Engineering, procurement and construction
ESMAP	Energy Sector Management Assistance Program
FIT	Feed-in tariff
GHG	Greenhouse gas
GIS	Geographical information system
h	Hour
HV	High voltage
IA	Implementation Agreement
IDC	Interest during construction
IEC	International Electro technical Commission
IEEE	Institute of Electrical and Electronics Engineers
ILR	Inverter load ratio
IPP	Independent power producer

IRR	Internal rate of return
km	Kilometer
P-EPA	Punjab Environmental Protection Agency
kV	Kilovolt

LCOE	Levelized cost of electricity
LID	Light induced degradation
LoI	Letter of Interest
LoS	Letter of Support
LV	Low voltage
m	Meter
MENA	Middle East and North Africa
MPPT	Maximum power point tracking
ms	Millisecond
MV	Medium voltage
MW	Megawatt
MW_P	Megawatt peak
NASA	National Aeronautics and Space Administration
NEC	National Electric Code
NEPRA	National Electric Power Regulatory Authority
NESC	National Electric Safety Code
NFPA	National Fire Protection Agency
NOC	No objection certificate
NREL	National Renewable Energy Laboratory
N-S	North-south
NTDC	National Transmission & Despatch Company
O&M	Operation and maintenance
OEM	Original equipment manufacturer
PEC	Pakistan Engineering Council
PERC	Passivated emitter rear cell
IESCO	Islamabad Electric Supply Company
PF	Power factor
PFC	Power factor correction or control
PID	Potential induced degradation
POE	Panel of Experts
POI	Point of interconnection
PV	Photovoltaic
Px	x% outcome probability (e.g., P90)
RFP	Request for proposals
RMU	Ring main unit
ROE	Return on equity
ROEDC	Return on equity during construction
Rs	Pakistan rupee

s	Second
SBP	State Bank of Pakistan
SCADA	Supervisory control and data acquisition
SECP	Securities & Exchange Commission of Pakistan
SLD	Single line diagram
SPV	Special purpose vehicle
STC	Standard testing conditions
TDS	Total dissolved solids
ToR	Terms of reference
TUV	Techischer Überwachungsverein (Technical Inspection Association)
UL	Underwriters Laboratory
V	Volt
VAR	Volt-ampere reactive
W	Watt
W_p	Watt peak

1. Introduction

20 MW AB Solar Park, is initiative of AASAL Solar Power (Pvt.) Ltd which owns another 49.5 MW Solar Power Project in D.I.Khan, KPK. The 49.5 MW Solar Power Project is one of the first ever Solar IPP of Khyber Pakhtunkhwa Province. The 20 MW AB Solar Park is based on the concept of Captive/Wheeling Power Plant. Pakistan has many Captive Power Projects now, however a project specifically designed on Wheeling basis, will be the first of its kind. The concept is as follows; to produce electricity at project site in District Attock, input it at Lakkarmar 132 kV Grid Station, wheel it via IESCO network to main Islamabad city and take the output from I-9, 132 kV Grid Station. In this case, AB Solar Park shall be the Power Generation Company, IESCO shall be the wheeler of electricity and Bulk Power Consumers shall be the Power Purchasers. The project is based on the SRO. 549(I)/2016 dated June 13, 2016, "NEPRA (Wheeling of Electric Power) Regulations, 2016. Lakkarmar 132 kV Grid Station of IESCO has been shortlisted as the respective Grid Station as per NEPRA Grid Code, through which the electricity shall be injected into the IESCO network. Grid Interconnection Study has been awarded to Power Planners International for completing the Load Flow, Stability, Dynamic Analysis and Transient Stability tests.

The project site is near Chab village, approximately 30 km from Jhand City. It is located at 33°12'48.53"N 71°51'14.52"E at an altitude of 238 meters having a distance of approximately 150 km from Islamabad.

The Project site consists of approximately 70 acres of land. The site selected for the project is generally flat, with a minor slope towards the southeast, with the slope increasing towards the southern end of the site boundary.

The Project shall have an installed capacity of 20 MWp. The scheme of interconnection with IESCO grid has been determined in the Grid interconnection studies.

2. Project Overview

2.1 Project Location and Capacity

The Project is located near the village of Chab in Tehsil Jhand, District Attock of the Punjab Province. The project site is located approximately 20 km from the center of Jhand City. The coordinates of the project site are 33°12'48.53"N 71°51'14.52"E (**Exhibit 2.1**). The site selected for the project is generally flat, with a minor slope towards the southeast, with the slope increasing towards the southern end of the site boundary. The site area is approximately 70 acres. The land at the location and its surroundings is semi-arid agricultural, with a small village situated some 165 m north of the site's northwestern corner. The power plant under consideration is the first ever captive/wheeling solar PV powered generation plant. The project capacity is 20 MWp (DC) at standard testing conditions (STC) and will be feeding grid-compatible electricity at 132 kV at IESCO's Lakkarmar substation.

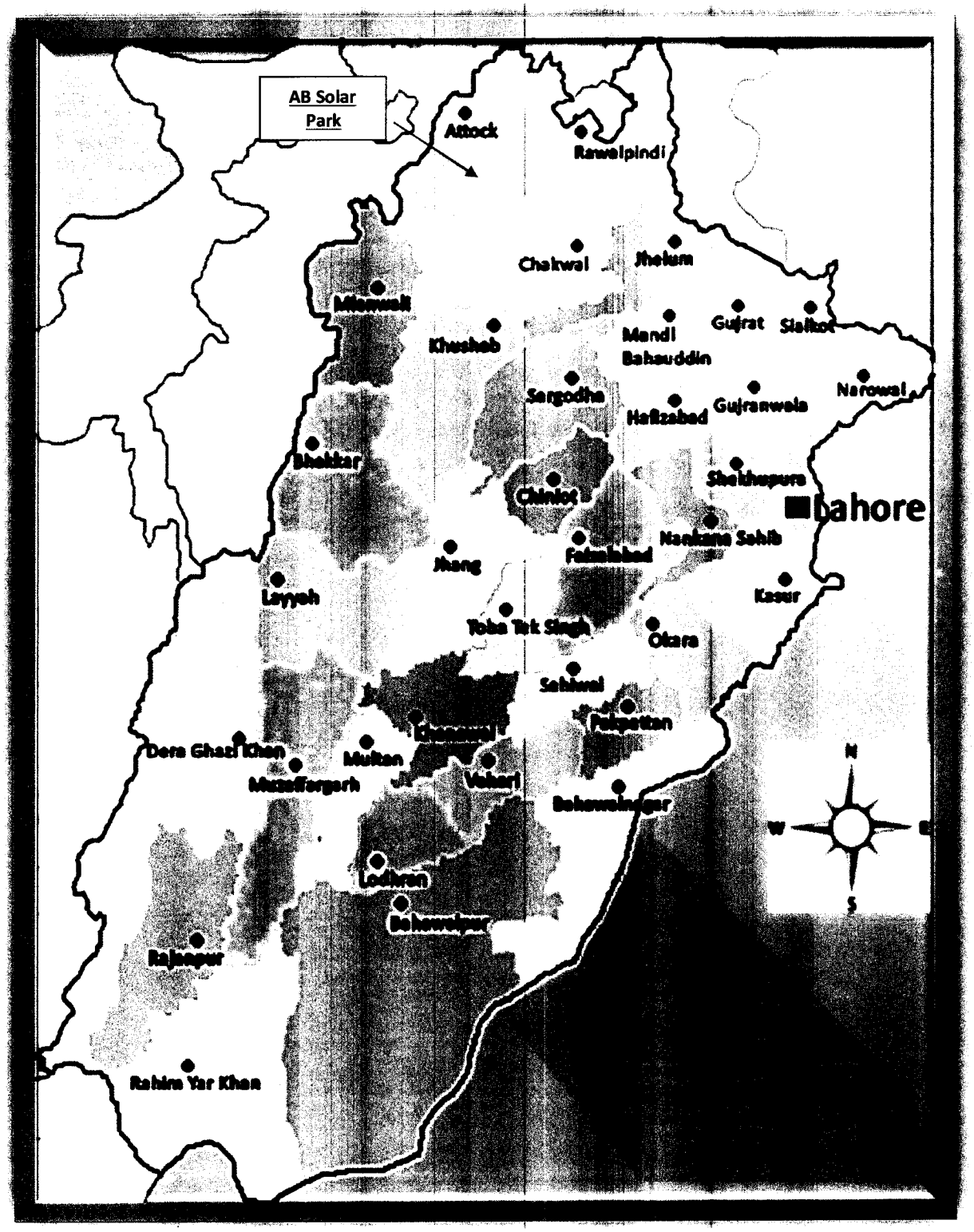
2.2 Plant Layout and Configuration

There are several configurations in which a grid-connected solar PV system can be designed, based on different site-specific variables and depending on the size of the project. The Project is intended to be close to the 20 MWp (DC) capacity mark and is categorized as a commercial utility-scale solar power project. Based on the preliminary design, the Project uses centralized inverter skids of 2.5 MW (AC) rated output capacity and each of these 6 central inverters. The total project capacity is thus 20 MWp (DC). The solar PV modules selected as power generators are standard 4-busbar 144-cell crystalline silicon (c-Si) modules. There will be a total of 46,536 solar PV modules of 430 Wp each, with a total of 6 arrays, with 28 modules per strings, and having 276 strings per module in parallel having module area 103,541 meter square. Therefore, there will 28 modules in series and 1,662 strings in parallel having module area 103,541 meter square making up a total plant capacity of 20 MWp (DC). For every 28 strings (also known as 'home runs'), there will be one combiner box and disconnect, and 6 DC combiner boxes of different capacities for every block. DC cables from each one of them terminate at the inverter. The inverters will produce three-phase 400V AC output, which will be then stepped up to 33 kV by a step-up transformer and transferred to the 132- k V Substation through underground trenches. The objective of this configuration is to minimize the EPC cost for the sponsor while maintaining the 17% CUF benchmark at P90 that is determined by the national electricity regulator (NEPRA) for that location/region for utility-type grid-connected system typically employed in emerging solar markets, such as Pakistan's. However the CUF shall be more than 19% in our case due to efficient modules and inverters. All such IRR kickers have been listed, While there are other configurations and/or design modifications that can improve the eventual IRR for the project owners, the design configuration

recommended for this opportunity is that of a standard however along with their merits and demerits, in the following sections to enable the sponsor to make an appropriate final determination.

See **Appendix A** for the basic plant layout details.

Exhibit 2.1: Project Location



2.3 Site Geological Conditions

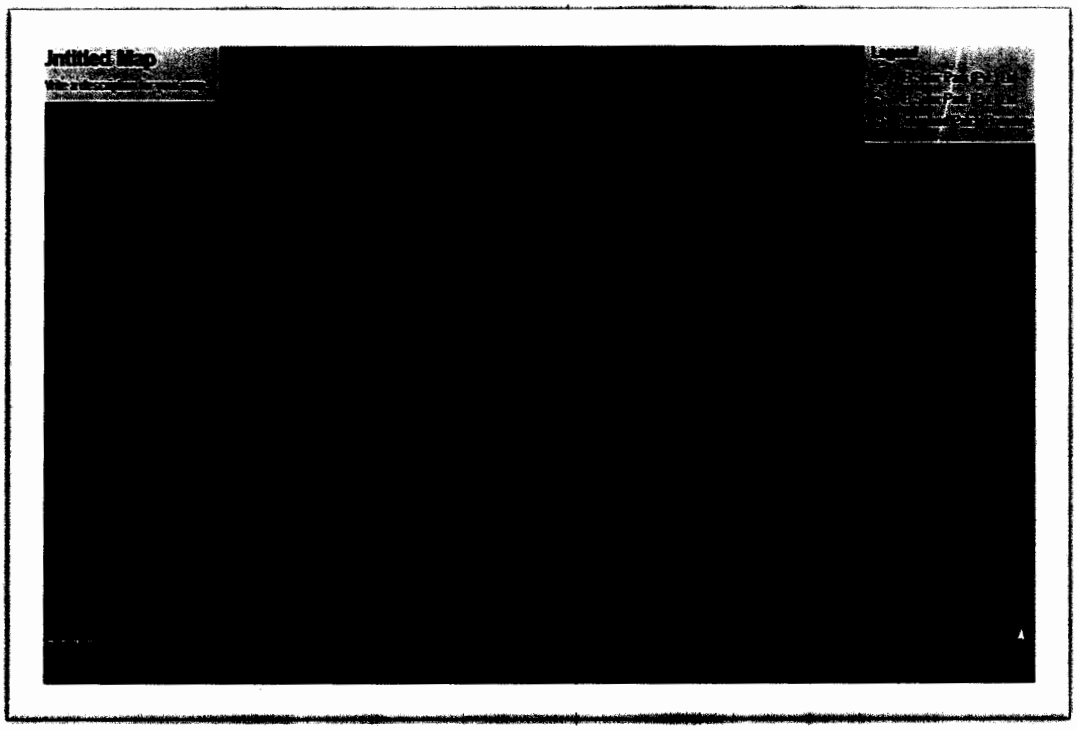
Site-specific geological details are an important consideration for determining the technical feasibility, reliability and longevity of a utility-scale solar project. One of the main design considerations and components of such a solar PV project is the metal structure used to support the solar PV modules. There are number of key considerations that go into the reliable design of this supporting structure, such as:

- Moisture content in the soil and the associated impact on metals.
- Understanding and predicting annual variation of the soil's water content due to water logging and temperatures to determine the long-term effects of moisture on metal.
- Gradients at the site area need to be determined for the design of the supporting structure. Also, since the land experiences seasonal surface water flows due to precipitation and rainwater runoff from adjoining areas, it is critical to determine flow patterns and directions, and if any local ponding can occur within the construction site.
- Soil composition, classification and load bearing capacity, based on which it can be determined whether any special design considerations would be required in selecting the pile type and supporting frame specifications.
- Project-specific seismic zone needs to be specified for the design of the supporting structure and foundations.

These parameters directly impact the cost of installing the mounting structure and, hence, the project itself, as well as its commercial feasibility. Relevant information on these considerations has been obtained as part of the geotechnical and topographic investigations of the site and is included in. A summary of the relevant information is given below (in the order of the parameters listed above):

- The site area is generally flat, having a slope of 0.17% to 0.21% over the entire area as evident in the topographic survey. The maximum gradient is around 5% near Corner B of the plot (**Exhibit 2.2**). Another part of the site with rising undulations has been avoided for the placement of solar modules.
- The soil is classified as clayey sand (CS) and poorly graded clayey sand (SP-SC) up to 4.2 m. Soil cohesion, c, ranges from 663 psf (3,219 kg/m^2) to 1,432 psf (6,998 kg/m^2) and angle of internal friction, Φ, varies from 19.8 to 29^o.
- The Project site is located at Chab, which falls under Seismic Zone 2B as per the Pakistan Building Code. This zone is categorized as a 'minor to intermediate damage' zone. This is a low-risk technical design aspect for the structure and generally all solar PV supporting structures, procured locally or internationally, will comply with this requirement. No additional cost repercussion is expected in order to meet this design requirement.

Exhibit 2.2: Project Site and Environments



2.4 Solar Power Plant Equipment

There are three main components that make up a grid-connected utility-scale solar PV plant that need to be specified:

- Solar PV generator
- Inverter
- Supporting structure and arrangement.

Apart from these three main components, selection of the power transmission equipment and associated protection at the designated voltage also needs to be determined in the preliminary design stage of the solar project. The following sections list the range of components and equipment that will be evaluated and appropriate ones selected for the proposed Project based on technical and commercial considerations.

2.4.1 Solar PV Generator

Photovoltaic manufacturing is a fast-growing industry, with a compound annual growth rate (CAGR) of 42% between 2000 to 2015.There are two main types of solar photovoltaic technology that dominate the commercial solar PV market. Wafer-based crystalline silicone (c-Si) modules accounted for 93% of the global solar PV

manufacturing capacity in 2015. These c-Si modules are further classified into mono and poly (multi) crystalline solar PV modules, where multi-crystalline solar PV modules make up 68% of total production. The remaining market share is taken up by thin film modules approximately 7% of worldwide sales, which include cadmium telluride (CdTe), copper indium gallium (di) selenide (CIGS) and amorphous silicon (a-Si) solar modules. A brief technical comparison of the three types of PV technologies is given below:

Mono and polycrystalline solar PV modules differ by cell manufacturing process and technology. While mono-crystalline solar PV cells require a more expensive manufacturing process owing to the need for higher purity levels and single-cell grain structure, which result in more efficient solar cells, polycrystalline solar cells are cheaper to manufacture but are slightly less efficient. The difference in efficiency is usually not more than 1% to 2% for standard high-efficiency 60-cell c-Si modules and 144-cell c-Si modules. This small efficiency difference does not impact the yield of the solar system appreciably, but does affect the space occupied by the solar PVplant. Owing to the minor difference in efficiencies, the difference in space requirements is also small, and given that sufficient land is available for the Project, this efficiency gain at a higher cost does not appear to warrant consideration.

The technical parameter of a solar PV module that directly impacts the energy yield of a solar plant is the correlation and dependence of module output wattage with module temperature. This is represented by the term 'temperature coefficient of power'. The lower this temperature coefficient is, the higher is the resistance of the solar PV module output against high temperatures and, therefore, the higher the expected yield of the solar PV plant. This becomes an even more relevant concern in high temperature zones, such as the Attock region. It has been generally observed that for 144-cell, Tier 1 Chinese solar manufacturers, mono-crystalline cells demonstrate slightly better characteristics when it comes to temperature resistance. However, this is not true for all solar PV module manufacturers, as for some brands the temperature resistance profile is the same for their mono and polycrystalline PV cells.

Most importantly, polycrystalline modules are cheaper by 5% to 10% compared to mono-crystalline modules, based on current solar PV market prices as they are simpler to manufacture. However now mono-crystalline has also increase their efficiencies and conversion rate per module, which is almost 20%. Therefore we have decided to go with mono-crystalline.

The thin film PV market has a 7 to 8% share of the global solar module sales, and is primarily dominated by the American manufacturer First Solar with its Series 4 module, which is considered the industry benchmark. The efficiency of the Series 4 module ranges from 16% to 17% and like what is currently offered by polycrystalline modules; mono-crystalline modules, on the other hand, are slightly more efficient. However, an advantage of thin film modules is their improved resistance to heat and, hence, better performance in high temperature zones. Thin

film modules also have an improved spectral response compared to conventional c-Si modules in areas with high relative humidity. The advantage ranges from 5% to 7%, depending on site-specific temperature profiles. These modules also offer more resistance to drop in output due to shading by landscape features. However, since nearby shading structures is not a concern at the Project site, this advantage would not be of much relevance.

The downside of thin film modules is their higher output voltage, because of which the number of strings increases, leading to an increase in associated parts and accessories (jumpers, connectors, etc.) and balance of system (BOS) cost for a few components. Since the maximum wattage of each module is not more than 123 Wp, the cost of structural accessories also increases. In fact, this is one of the major considerations because of which First Solar is releasing their new Series 6, which is expected to be close to 450 Wp per module.

Thin film modules, despite using less silicon material, are more expensive to make due to the encapsulation and lamination cost that they incur. The cost of thin film modules from First Solar are also more expensive compared to conventional polycrystalline modules, but the relevant factor is by how much? Since the objective here is to reach the lowest levelized cost of electricity (LCOE). There have been some solar auctions in the MENA region (desert type locations) where developers have come up with extremely low tariffs using First Solar's thin film modules. Thus, it is important to determine what sort of cost per watt First Solar can offer for a 20 MWp capacity project in north part of Punjab, Pakistan.

Selecting a solar PV module supplier is not only about evaluating technical parameters on offer, but also about the bankability of the manufacturer in question and the supply and timelines of delivery risks, especially if the company ceases production and support at some point in the future. There need to be other suppliers in the market who can step in with a similar standard product, so that plant operations are not affected.

Considering all of the above factors, conventional high-efficiency 144-cell mono-crystalline solar PV modules have been selected for this feasibility study, and the following critical steps are recommended for the Project sponsor to evaluate carefully during the RFP stage

- PID (potential induced degradation[2])-resistant modules should be preferred, since they reduce the degradation involved and, hence, improve LCOE. Cost impact in $/W to be determined.
- 1,500 V solar PV modules should be preferred since they reduce the amount of source circuits by 33%, hence resulting in reduced electrical balance of system (eBOS) cost. The increased voltage increases string sizes and hence reduce other eBOS accessory requirements. More details on this later in this volume.
- Double-glass modules offer increased degradation protection in the absence of a back sheet and improved strength and durability of the solar module. Modules become PID-free without the frame. However, there is a requirement of unorthodox mounting structures for these frameless solar modules. There is also no requirement of grounding the solar module frames in this case.
- PERC (passivized emitter rear cell) polycrystalline solar modules have reflectors at the rear of the cells which reflect back the longer wavelength (i.e., infrared) light which is missed out during the first pass, increasing electron capture and therefore producing more energy. Generally, conventional solar PV modules have a BSF (back surface field) and charge carriers are lost to the metallization of the rear cell. PERC solar PV modules therefore operate well even in diffused sunlight and low light conditions. However, PERC-based modules are associated with higher degradation because of the presence of more material, and hence must be evaluated carefully.

Apart from these technical parameters, it is particularly important to assess the bankability of the solar PV manufacturer and to comprehensively understand the warranty and guarantee terms and claim processes and policies offered by different vendors. Bloomberg's quarterly New Energy Finance publishes a list of the most bankable solar PV manufacturers and is a reliable source for such information, as would be the recommendations of the EPC contractors employed for the Project.

Longi Solar mono-crystalline 144-cell, 4 busbar, PID-resistant, 430 Wp solar modules will be used for purposes of this feasibility study analysis (see Appendix B). However, it is strongly recommended that the technology options listed above are explored further during the RFP phase to determine the lowest possible LCOE possible for the sponsor

[1] Balance of system (BOS) encompasses all components of a photovoltaic system other than the photovoltaic panels. This includes wiring, switches, mounting systems, inverters, control instruments, batteries, chargers, etc.

[2] Potential induced degradation (PID) is an electric potential-induced (i.e., difference in electric potential between the encapsulated solar cells and the frame of the module) performance degradation in crystalline photovoltaic modules caused by so-called 'stray' currents. This effect may cause power loss of up to 30%.

2.4.2 Inverters

One of the key components of the solar PV system is the inverter. The function of a utility-scale inverter is to convert the DC power coming from the solar modules through the combiner boxes to three-phase AC power at 2500kW (AC) and to make sure that the AC output is in phase and synchronized with the grid supply at the given output point with unity power factor at the rated output. In terms of utility-scale grid-connected solar inverters, two types of inverters were evaluated for the 20 MWp solar plant:

- Central inverters
- String inverters.

Features based on which the inverter type for the Project should be selected include the following:

- 450-820 V DC-side input option with wide maximum power point tracking (MPPT)[3] range.
- Integrated anti-PID function
- Inverter load (or DC/AC) ratio (ILR)
- Should be mounted on easily installable skids, along with MV switchgear and transformer, in a transportable 20-ft. (6-m) container
- Should be outdoors-rated and include integrated ventilation
- Should incorporate measures for reducing downtime
- The number of DC inputs required
- The extent to which the inverter offers grid support functions, such as LVRT, HVRT, anti-islanding and power factor control,[4] and
- Cost per watt of the inverter.

[3] An MPPT, or maximum power point tracker is an electronic DC-to-DC converter that optimizes the match between the solar array (PV panels) and the battery bank or utility grid. Simply stated, it converts a higher voltage DC output from the solar panels down to a lower voltage required to maximize power extraction under all conditions.

Based on these technical and commercial parameters and considering the size of the Project, central inverters are deemed the most suitable option. The fundamental basis for selecting central inverters over string inverters is the 450-820 V input capability. A few string inverters also have this feature, but their availability is limited. Central inverters also result in reduced AC cabling, with an integrated MV transformer and switchgear on a skid right next to the inverter. Most importantly, there should be integrated mechanisms present for reducing downtime (i.e., maintaining plant availability, hence securing plant yield). Since there are no nearby sources of shade at the site, the advantage of having multiple MPPT points is also reduced. Integrated anti-PID function is also another advantage of using central inverters.

As per Pakistan Grid Code requirements,[5] the following mandatory features are required in a grid-connected utility-scale solar PV inverter:

- Data of voltage, current, frequency, active and reactive power and power quality-related issues of harmonics, flicker and unbalance should be available.
- Exempted from 'black start' and islanded operation for the span of the energy purchase agreement (EPA).
- In case of blackout, PV power plants will be required to be disconnected from the grid, i.e., should have anti-islanding protection built into the inverter.
- The inverter should inject small pulses slightly out of phase with the AC electrical system in order to cancel out any stray resonances when the grid shuts down.
- The inverter should be able to smoothly synchronize and de-synchronize from the grid.
- The inverter should be capable of increasing or decreasing active power output in steps of 10% of the rated plant installed power capacity per minute, i.e., ramp rate of 5 MW/min.
- There are can be four or five set points agreed with NTDC, such as 100%, 70%, 50%, 30% and 0%, etc., which the inverter must achieve from any instantaneous operating point in any operational mode. This will depend on the incidence of radiation required to reach that operating point.
- Reactive power control to maintain the power factor within the range of 0.95 (lagging) to 0.95 (leading) at full active power output according to dispatch instructions/voltage adjustment requirements.

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[4] LVRT, or low-voltage ride through, is the capability of electric generators to stay connected during short periods of lower electric network voltage (i.e., voltage dips). Similarly, HVRT, of high-voltage ride through, is the capability of a generator to stay connected during short periods of high electric network voltage (i.e., voltage surges). Anti-islanding protection is essential to ensure that grid-tied energy harvesting systems cut their connection to the grid when the grid itself loses power. Power factor control or correction brings the power factor of an AC power circuit closer to 1 by supplying or absorbing reactive power, adding capacitors or inductors that act to cancel the inductive or capacitive effects of the load, respectively.

[5] NEPRA, 2014. *Grid Code Addendum No. II for Grid Integration of Photovoltaic (PV) and Concentrated Solar Power Plants*, June 2014.

- Power quality parameters of power output will be governed by relevant IEC standards, such as IEC 60904 and 61850.
- Harmonic emissions shall comply with IEC standards.
- LVRT capability up to 30% voltage dip for 100 ms.
- Should be able to manage active power restoration after voltage recovery at a rate of least 20% of nominal output per second.

2.4.3 Inverter Sizing

While selecting the inverter, the objective is to reduce the number of inverters and transformer skids while coming as close as possible to the 20 MWp gross output mark, while maintaining the DC/AC ratio. Reducing the number of skids helps reduce eBOS cost and helps achieve a competitive EPC project cost ($/W).

The most common central inverter sizes in the market have been analyzed with a load factor of 1.25 to see which inverter size would result in the highest plant capacity. The inverter size selected was 2500 kW (AC). A total of 6 of these blocks therefore give a total solar plant capacity of 20 MWp (DC). As is the case with all components of a PV IPP, the bankability and reputation of the OEM is critical in the final brand selection.

Overload Losses

Determining the actual overload losses strongly depends on the granularity of data intervals and the quality of measurement. One of the advantages of using the selected TBEA inverter is that its output can go up to 2750KW at 40 °C. Variation of solar irradiance can happen in the span of seconds, with clear bright sun conditions providing considerable direct irradiance changing instantaneously to those with cloud cover and diffuse irradiance. Access to minute-wise data values can drastically improve the calculation of inverter overload losses, and hence help in getting to an optimum DC/AC ratio. Despite having access to 10-min interval data through World Bank data packages and Meteonorm 7.2 interpolated minute values, the limitation of the PVsyst software used to simulate plant yield is that it relies only on hourly data values (Exhibit **2.5**).

Exhibit 2.5: Power Sizing Characteristics

PV Array PNOM (STC)	20,010 kWp
PV Array (50 °C)	18,164 kWp (DC)
Inverter, PNOM (AC)	15,000 kW (AC)
Overload Losses	108 kWh
PNOM Array/Inv. Ratio	1.33
PNOM Ratio at 40 °C	1.13

2.4.4 Support Structure

The function of a supporting structure for the solar PV modules is to bear the drag, lift and distributed loads of winds and gusts, snow and seismic loads. Apart from this, the structure has to be designed to bear the weight of the solar PV modules. Several variables go into the design of the support structure, which include the weight of the solar PV modules, average and maximum local wind speeds, dead load of snow on the modules (if applicable) and potential seismic loads. Other important features which need to be incorporated into the structure include DC wire cable raceways for better cable management, corrosion protection, electrical grounding of structure, and orienting the solar modules at a certain designed tilt and azimuth. Properly sized raceways allows for DC cable management and eliminate the use of separate conduits and cable ties.

The structure comprises of two important elements: the ground pile and the frame supporting the solar modules. There are three different type of piles that are commonly used for different type of soils:

- Earth screw (required in areas with high refusal rates)
- Driven piles (generally for locations having good soil cohesion, e.g., dense sand, clay and gravel; installed in locations which offer good pullout resistance)
- Helical pile (generally for locations with poor soil cohesion, higher water tables, little pullout resistance)
- Ballasted (where penetration into the ground is not possible)

A structural engineer's recommendation is a prerequisite to finalizing the type of pile to be used.

2.5 Power Transmission Schematic

The proposed 20 MW solar plant has been divided into 6 power generating blocks. Each block has a DC capacity of 3.3 MW, taking the total maximum plant output to 20.01 MW (DC). Each block's AC generating capacity is 2.64 MW, with a DC/AC ratio of 1.248.

The single-line diagram (SLD) for this IPP has been divided into four parts:

2.5.1 DC-side SLD

Mono-crystalline 430 Wp solar panels have been chosen as energy generating units for the plant. Strings, comprises of 28 solar panels each per array, are consolidated into a single PV combiner. A total of 276 strings are used per each array. Each array thus having a capacity of 3.3 MW each, having a total of 6 arrays. Power collected through the combiners is terminated on the DC side of the inverters and converted into AC for onward transmission of power to the grid. The load flow of the circuit is from strings of solar panels to the DC portion of the inverters via combiner boxes.

2.5.2 AC-side SLD

Inverters used in the system are of central type and convert DC power into AC power at 0.315 kV voltage level. Output of the inverter is directly connected (via busbars) to the low voltage side of transformer. Output of inverters is in delta configuration, which eliminates the risks of harmonics travelling to the medium voltage side of transmission. Prepackaged skid-type Inverters are used in the system with built-in transformers and MV switchgear to reduce losses due to long cable lengths by immediately stepping up output voltage to the design level.

2.5.3 MV-side SLD

Medium voltage transformer is used for boxed type inverter packs. Oil and natural air ventilation has been adopted in the transformer design. The transformer steps up low voltage output of the system to 33 kV, within adjustable range from 10-35 kV. The reason for using a 33 kV intermediate voltage level is to reduce the size of long distance AC cables, and reduced Ferranti effect[8] (which can be even more pronounced in underground power cables). Blocks 1-4 are stepped up to 33 kV separately at their inverter skids and flow towards a centralized 4-way ring main unit (RMU) with 33 kV switchgear, terminated to a combined 33 kV, 0.16 kA busbar. There are a total of four 4-Way RMUs that are terminated at two separate buses of the 33 kV substation. RMUs 1 and 2 terminate at Busbar 1 and RMUs 3 and R4 at Busbar 2. These busbars are connected via a bus coupler to be able to completely shift loads to one bus in contingencies.

2.5.4 HV-side SLD

Plant 33 kV voltage levels are stepped up to 132 kV transmission required to connect to the utility grid. Here, the N + 1 configuration is adopted, as per the Pakistan Grid Code. The 33 kV Busbar 1 is connected to Main Transformer 1 and Busbar 2 is connected to Main Transformer 2. Both transformers have a capacity of 20 MVA and either can be used as a complete single unit, in case of failure or during maintenance of the other transformer. Outputs of the transformers are finally connected to the grid point of inter-connection (POI) via an air-insulated switchyard. A 132 kV double-circuit transmission line is proposed for the evacuation of power generated by the Project.

2.6 Electromechanical Design

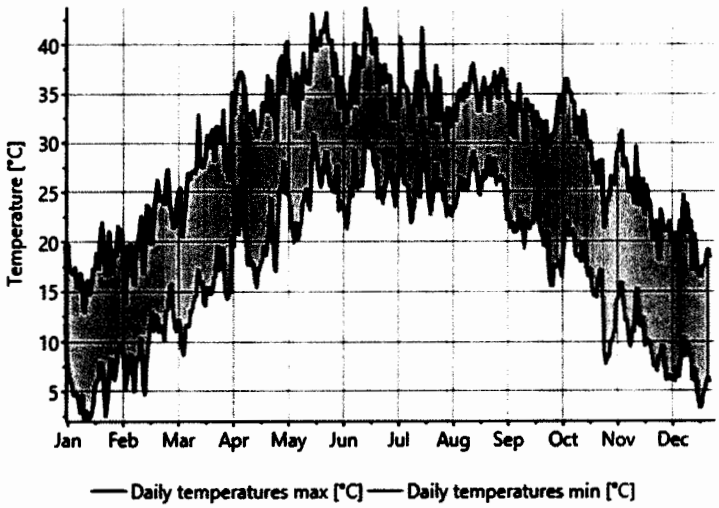
System voltage

Considering the advantages of 820 V inverter voltage compared to 1,000 V in utility-scale solar PV systems for reducing eBOS cost and improving energy generation, the former was selected for this study. However, during the detailed engineering phase of the Project, 1,000 V central inverters could also be considered, in light of the cost and availability of various inverter options.

Stringing

There are 28 modules in a string, given the average minimum temperature through the year in Attock, as temperature and irradiance are two factors which determine the maximum open-circuit voltage of a string. **Exhibit 2.6** shows the range of monthly temperature variation at the Project site.

Exhibit 2.6: Temperature Variation across a Year at the Project Site



[8] The Ferranti effect is an increase in voltage occurring at the receiving end of a long transmission line, above the voltage at the sending end. This occurs when the line is energized, but there is a very light load or the load is disconnected.

Inter-row spacing and solar angles

The solar PV modules face south at zero azimuth, and the tilt angle considering the Project's location is 30°. The inter-row distance is 5.7 m.

Arrangement of solar PV modules

Each table array has an arrangement of five modules across its width and six modules along its length for the single axis tracking system. The modules are arranged in a landscape orientation, making it easier to manage the DC cables as there are 28 modules in a string. One table array would thus represent one string (see detailed structure drawing in **Appendix C**). There is one solar PV module per row in landscape orientation. The number of motors used and their energy consumption depends significantly on the tracking system vendor selected.

Inverter placement and combiner boxes

There is one central inverter of 2.5 MWp (AC) for every block of 2.85 MW (DC) located in the block's center to reduce DC cable lengths. There is one combiner box with 20 inputs for every array (one complete row) right next to a DC cable trench, which would take the DC cables directly to the inverter skid (see **Appendix D** for the inverter and transformer details).

Power cable management

The DC cable connecting the modules together will run through the cable raceways integrated into the 5x6 structure (**Appendix C**). All DC cables will end at the combiner box. Each DC combiner box will have 20 inputs and a single output DC cable, which will run through an underground trench to the inverter skid. The output from the inverter will go directly to the MV transformer located right next to the central inverter on the same skid. The stepped-up power after the transformer will then move through underground armored cables connecting four different blocks via a ring main unit and terminating at a busbar of suitable rating.

Supervisory control and data acquisition (SCADA)

The SCADA is an important control interface between the solar PV system and the personnel operating it. Functions such as condition monitoring, evaluating generation performance, VAR control, and frequency regulation can be carried out remotely, as per grid requirement. Access to the SCADA system will be with the asset manager, O&M service provider, the power off taker and the project sponsors. The DAS (data acquisition system) single line will be illustrated during the detailed engineering phase by the EPC contractor. One of the important prerequisites of this system will be the high level of security that it must offer against cyber-attacks or interventions.**Preliminary SLD**

Refer to **Appendix E** for the preliminary single-line diagram (SLD) of the power plant. **Technical IRR kickers**

Single-axis N-S Tracking

Tracking is the process of moving the solar PV modules to follow the sun on its diurnal path across the sky, which results in increased power generation from the solar plant. A tracking mechanism which results in the highest generation is the north-south arrangement, where the solar PV modules follow the sun on its east-west path. For this, the single-axis support structure would need to include a tracking mechanism and therefore its design would be more complex and include moving parts, which would increase the O&M cost for the structure. Project generation increases to 35,357 MWh at P50 with single-axis tracking. The cost of the EPC installation goes up by US¢ 10/W and the cost of O&M is estimated to go up by 30%.

DC Optimizers

DC power optimizer with MPPT and output voltage and current limits acts to optimize system design and maximize performance. The DC optimizer doubles the string size, hence reduces combiner boxes and by 50% and reduces DC/AC cabling by 30%, improves energy generation of the system by increasing the number of MPPT points and reducing mismatch losses. String level performance monitoring is possible because of the DC optimizers, and this helps improve plant O&M. The number of inverters required will also decrease, resulting in better cost per wattage. One of the challenges of using DC optimizers is that the inverter must now work on a narrower MPPT range which requires special capability, and hence a different inverter design. There are only a handful of inverter manufacturers that can offer this feature, including:

- Bonfiglioli
- KACO
- LRI RE Energy, and
- Satcon.

One DC optimizer manufacturer, Ampt, which specializes in DC optimizers for utility-scale systems, should be further explored.

Passivated emitter rear cells (PERC)

PERC technology refers to a design where a dielectric passive layer is added at the back of the solar cell to improve performance and hence increase generation. The additional layer reduces electron recombination and improves light absorption as well. There are some experts who have also raised the issue of additional LID experienced by PERC-based solar PV modules, but this should be covered under the module's linear output production guarantee.

2.7 Preliminary Design of Civil Works

There are multiple aspects for a civil engineer/contractor to consider for the successful execution of a solar PV system. These are listed below:

Grading of solar field

It is imperative that water is not allowed to stand at the foundations of the modules' supporting structures. To ensure this, the site is graded to provide sloping sufficient to discharge precipitation runoff into a properly designed drainage system. Maximum effort should be made to use the existing slope/contours of the field to minimize cost. Some isolated trenches and elevations were identified at the site, which also need to be graded/filled in if they are to be utilized for solar PV panel placement. While placing the solar modules, it should be made certain that no such trenches and elevations exist below an array or near any foundation, which could later become a risk for water accumulation.

Power cable trenching

DC and AC power cable trenches are to be excavated and backfilled. Maximum effort should be made to minimize the length and width of the trenches. Cable sizes and runs should be kept in mind while sizing the trenches to avoid possible rework during the installation phase of the project.

Skid platform

The skid platform that holds the central inverter, the transformer and the MV protection will be of considerable weight. A concrete mounting pad should be constructed upon compacted soil in order to avoid settlement of the installation into the ground.

Pile foundations

A piling machine should be used to geo-locate the coordinates of the pile positions as per the design layout and penetrate them into the ground to support the frame. The type of piles employed will be determined by a structural engineer, based on site soil conditions. The piles will be hot dip galvanized in order to protect them from the long-term effects of corrosion.

Supporting frame

A combination of anodized aluminum channels, purlins and raceways are used to form the supporting frame. The supporting frame is in contact with the solar PV modules and hence it is important that the metals are same, as dissimilar metals with time can experience galvanic corrosion. All nuts and screws are either stainless steel or hot dip galvanized. The frame is for 5 modules in width and 6 modules in length. These modules have 144-cell in total. **Appendix C** provides a conceptual illustration of the supporting structure for a fixed tilt system.

Perimeter fencing

In order to maintain a secure perimeter around the solar PV project a wire mesh fence would have to be installed which would not only be grounded but would also be piled to the ground. This would depend on the proximity of the fence from the solar PV modules.

2.8 Construction Management

2.8.1 Project Construction

For effective construction management, it is a good practice to engage and get feedback from all related stakeholders as early as possible during the project development stake, including:

- EPC contractor
- O&M contractor
- Owner's engineer
- Asset manager, and
- Regulator/offtaker.

Though all inputs are locked in before the construction of the solar PV plant starts, it is important to keep all stakeholders in the loop during the construction phase. The EPC contractor will be sharing the detailed construction documents of the solar PV plant and a comprehensive timeline breakup of activities involved. The owners engineer will make sure all activities are preplanned by the contractors and subcontractors. Necessary flags will be raise to the sponsor's when

the contractor falls behind timelines, equipment specifications are not met, equipment quality tests/ benchmarks are not met or if installation is not carried out as per construction documents.

Any of the above reasons can result in delays in project execution and timely delivery. The owners engineer and EPC contractor play a key role in the timely delivery of the project. A term of reference document on quality levels, checks, standards and compliances should be agreed between the EPC contractor and the owners engineer to avoid surprises during project execution. These terms of references should be reflected in the EPC contractor's contract.

2.8.2 Power Transmission Construction

Renewable energy projects have the option to sell energy to the off taker even before the COD for the project is reached. This option has been available for all wind projects in Pakistan. Similarly, for all solar projects the construction planning should be such that the commissioning of the high voltage interconnection AC-side of the power plant should be prioritized along with the SCADA system of the power plant. The inverter blocks once installed can immediately start selling electricity to the grid and then the Bulk Power Consumer. As the project execution progresses more inverter blocks would be expected to come online and hence deliver more energy to the grid. This will overall improve the cash flow of the project.

2.8.3 Roads and Infrastructure Construction

In order to successfully move all project related equipment from the sea port to the point of installation at the project site, a series of roads need to be available. Internal roads within the power plant facility are within the scope of the project, however the availability and condition of roads connecting the project site to the nearby city and to the port of Karachi would be important for the safe logistics of all equipment. The central inverters skids which include the transformer and the MV switchgear are collectively considerably heavy and would preferentially require flat, load bearing roads. Local government should be briefed on the importance of these road connecting the solar project to nearby cities. Though national highways and motorways present in the country are capable enough for allowing the safe transportation of goods across the country, the roads connecting the city of Attock are also well maintained.

The construction of internal roads and project fencing will also be amongst the first construction activities that would be necessary before any other equipment can be moved to the site.

2.9 Firefighting Facilities

The solar PV module, inverter and structure installation should be Class-A certified. Fire-resistant cables should be used and, especially on the DC-side, TUV-certified DC cables should be used. Fire extinguishers should be located at regular spacing at the project site, as there is no fire station in the near vicinity

2.10 Operation and Maintenance (O&M) Management

The biggest factor differentiating a successful project which completes its design life and delivers the expected energy output and an underperforming project which is prone to equipment failure issues is how effectively the plant's O&M needs are managed. The international solar market is flooded with reputable O&M service providers with experience of a reasonably large portfolio of solar PV projects. There has been considerable research in the area of solar PV asset management and the costs for such contracts have gone down considerably in the last few years. Considering the incipient capability and capacity of local O&M firms with respect to such installations, the most effective model for such contracts would involve an international supervisory firm, with sufficient solar PV plant maintenance qualifications, as the main contractor and a local subcontractor to assist with daily supervision and onsite activities, thus providing a cost-effective O&M solution.

The owners' engineer and the O&M contractor will be the two main parties involved in successful project operation and maintenance management. The owners' engineer and the O&M contractor should agree to their mutual terms of reference well before the project execution and installation starts. The ToR should reflect all relevant activities, including:

- Solar PV module cleaning.
- Vegetation management at the project field.
- Water drainage management.
- Condition monitoring of the plant, which would involve monitoring factors such as PID, hotspots, micro cracks and delamination of solar PV modules. Condition monitoring of inverter performance will also need to be checked on a regular basis, including all other eBOS equipment.
- Transformer maintenance
- Grounding checks and power cable tests
- Monitoring corrosion buildup in the supporting structure piles and monitoring their load bearing integrity.
- Remotely executed control checks of voltage and frequency regulation.
- LID after project COD.
- Performance Ratio tests.

Cleaning schedules should be maintained and logged for these and all other activities that are necessary as per the O&M ToR, and a weekly log should be generated for the owners' engineer to validate on behalf of the project sponsors.

2.11 Environmental Management

While renewable energy projects are generally considered environmentally friendly, there are a few aspects that should be closely monitored and managed as they could otherwise have adverse impacts. These include:

- Oil-leaking transformers. There will be two 20 MV transformers installed at the Project, and dry type should be preferred.
- Preserving the agricultural land utilized for solar project installation. Native plant species which do not intervene with solar PV performance should be managed and retained.
- Adequate recycling program for broken or damaged solar PV modules. The manufacture should adhere to a recycling plan to reduce the environmental impact of disposing of solar PV modules.
- Some solar PV modules, such as thin film modules (CdTe), can also leak hazardous substances. A proper containment mechanism should be devised if such materials are used at site.
- A total of 35,357 MWh of energy will be produced by the single axis system on an annual basis at P50. All energy is to be offtake by the local power utility, IESCO, then wheeled to Islamabad and sold to the BPC and would displace a proportionate amount of fossil fuel-fired thermal generation. This would correspond to an annual maximum carbon footprint reduction of 15,124 metric tonnes of CO2e for a 20 MWp single axis tracking system.

For more details on the plant's environmental monitoring program (EMP), see **Environmental Study** of the Project Feasibility Study.

2.12 Health and Safety Management

An adequately designed solar system is one which caters to all safety considerations in its design. There are several codes and standards relating to safety practices, particularly in solar PV equipment manufacture and installation. Agencies with codes and standards relevant to solar PV systems include:

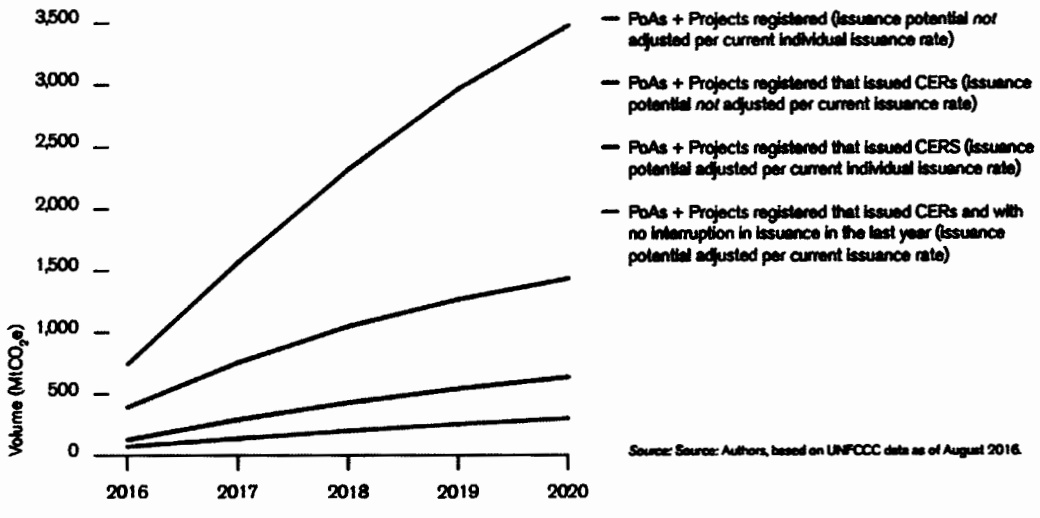
- National Fire Protection Agency (NFPA)
- Underwriters Laboratory (UL)
- Institute of electrical and electronics engineers (IEEE)
- International Electrotechnical Commission (IEC), and
- CEC (California Energy Commission)

The NFPA's 70 NEC (National Electric Code), Chapter 6, has been particularly developed for sizing and installing solar PV systems. NESC (National Electric Safety Code), updated by IEEE every five years, is another valuable source of information for devising health and safety protocols for the AB Solar Park PV project. All EPC contractors should be advised to conform to the relevant industry-standard safety codes, such as those mentioned above, and detailed guidelines should be developed by the owners' engineer.

2.13 Carbon Credits

A 'carbon credit' is a generic term for any certificate that is tradable and represents one tonne of carbon dioxide emission. The formation of this tradable credit represents a global initiative by economists to mitigate the production of greenhouse gases such as CO2. Greenhouse gas (GHG) emissions are capped to a certain threshold based on the type of industry and then markets are used to allocate allowable emissions amongst the group of regulated sources. Since renewable energy projects, such as solar PV-based power generation, are GHG mitigation sources, they add credits to the market that are bought by investment funds or carbon development companies and then sold on to carbon off-setters at market-determined prices (**Exhibit 2.7**). It is the job of the investment fund or carbon development company to ensure and confirm the authenticity of the traded carbon credit.

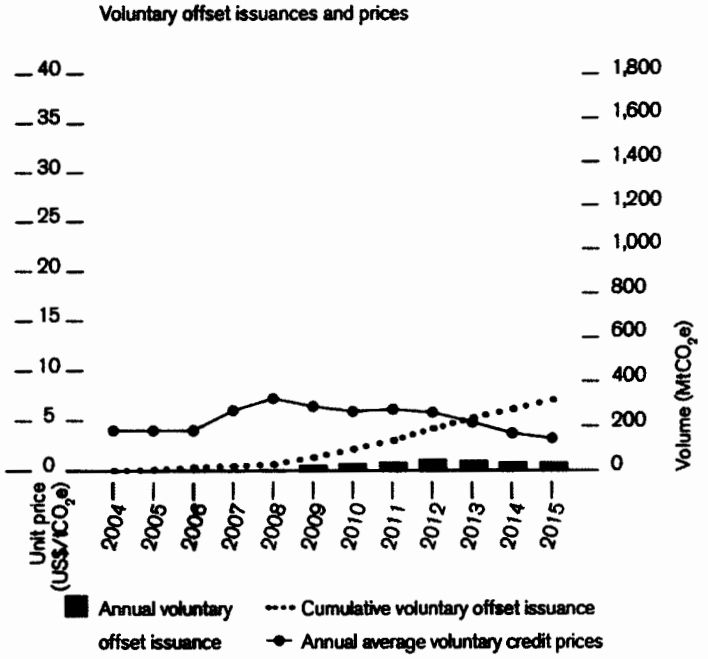
Exhibit 2.7: Volume of Carbon Credits Traded Globally



The price for carbon credits vary from country to country and different markets, depending on their carbon management plans. The price for credits has come down considerably in the last couple of years globally; however, it has been provided with a lifeline in the wake of the recent Paris Agreement on climate

change. Carbon credit prices fluctuate, depending on the type of project involved and the supply of these credits in the open market at any given time (**Exhibit 2.8**)

Exhibit 2.8: Carbon Credits Price Trend



Source: UNFCCC for CDM and JI data on issuances, Intercontinental Exchange ICE for CDM data on prices, Forest Trends' Ecosystem Marketplace for data on voluntary offsets.

2.14 Project Execution Milestones and Schedule

A detailed schedule of the installation and execution plant for the Project will be prepared in a comprehensive manner by the EPC contractor after thorough site investigations and logistical planning. The diagram in **Exhibit 2.9** below represents a general outline of the flow of activities typically involved in the installation and commissioning of a utility-scale solar PV power generation project. Specific activities can vary depending on site conditions and timelines provided by the OEMs for the delivery of plant equipment. The timeline for the execution of the project is taken to be 10-12 calendar months.

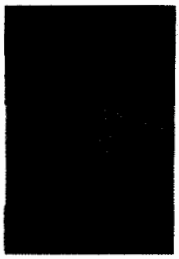
Exhibit 2.9: Solar PV IPP Project Execution Milestones

- Notice to Proceed and Site Mobilization
- Detailed Design Engineering
- Internal Roads, Temporary Accommodation & Fencing
- Construction Documents & Finalizing Detailed Engineering
- Trenching & Concrete Pad Formation
- Mounting Structure Installation & Concrete Pads for Skids
- PV Module Delivery
- Inverter & MV Transformer Delivery
- 132 kV Switchyard Delivery
- Solar PV Module Installation
- Inverter and MV Transformer Installation
- Cabling and Mechanical Completion
- Grid Interconnection (Civil & Mechanical Works)
- SCADA (DAS) Installation
- Performance Test
- Commercial Operation Date

2.15 Project Risk Identification and Mitigation

Identifying risks is one of the foremost activities that need to be determined as part of a project's technical and commercial feasibility study. **Exhibit 2.10** details the main risks, their level of impact on the project and possible mitigation measures relevant to the proposed AB Solar Park PV IPP Project.

Exhibit 2.10: Project Risk Identification and Mitigation



Deal breaker: high risk not possible to solve

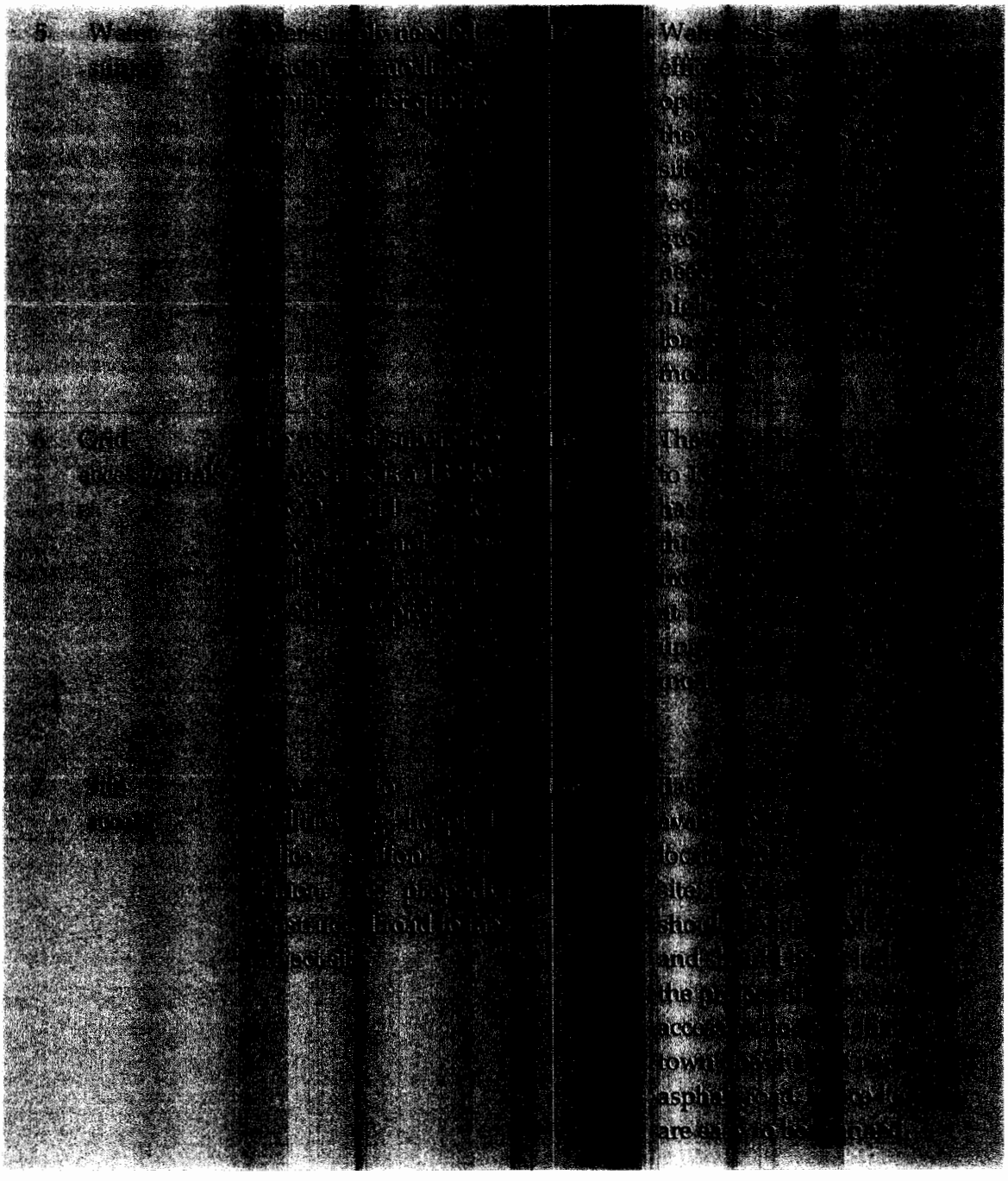
High risk, possible to solve

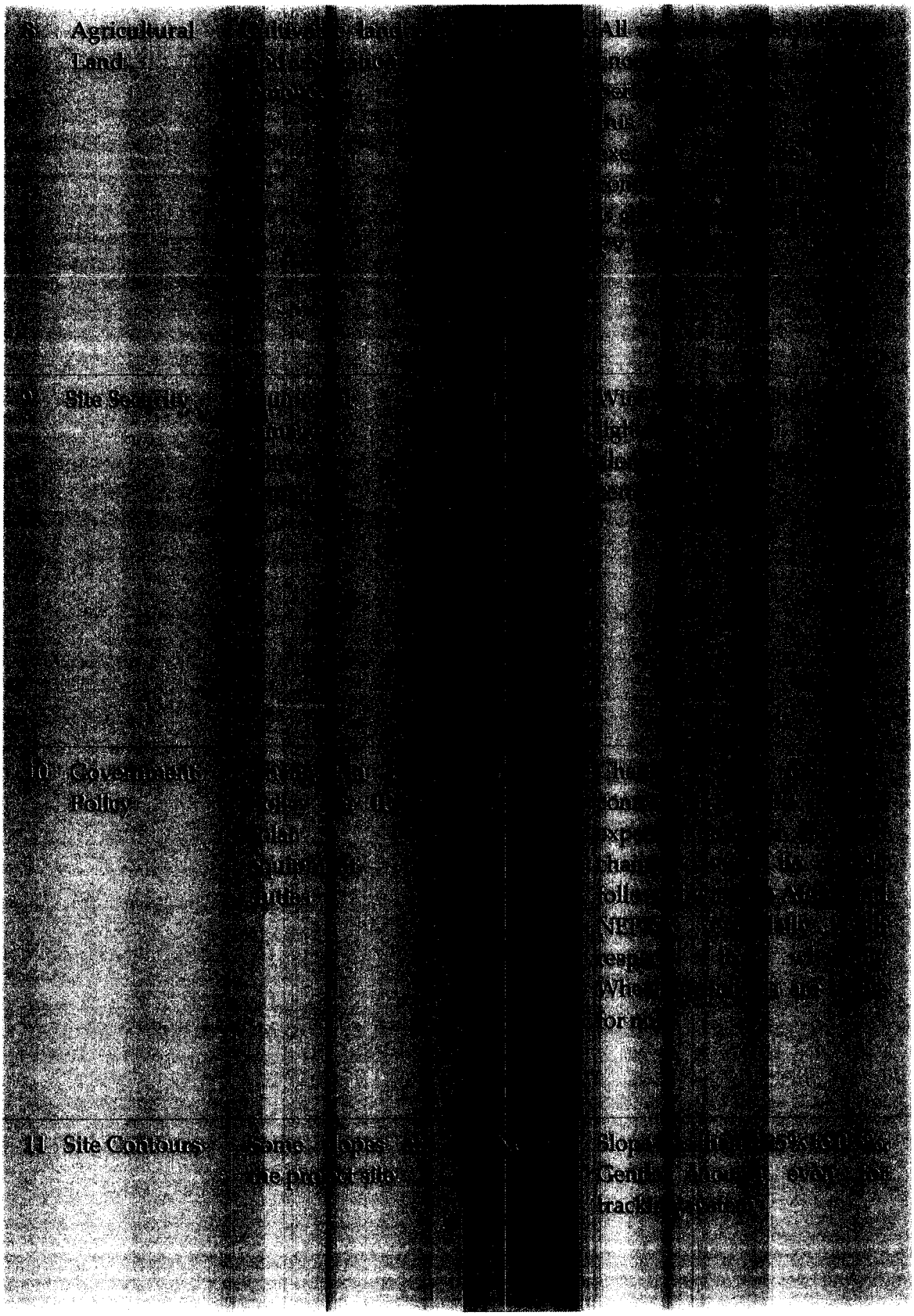
Medium risk, possible to solve

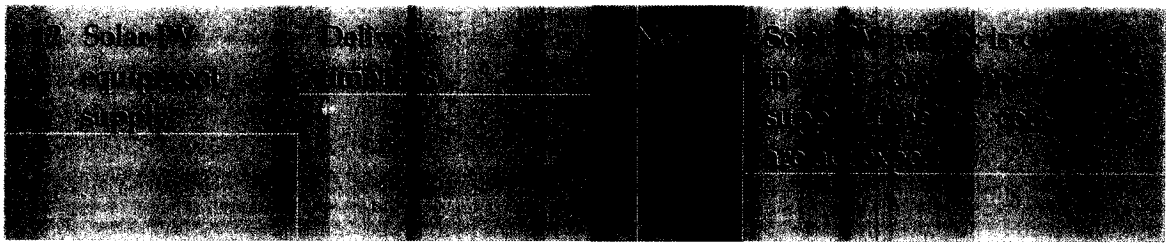
Low risk, possible to solve

No risk

No.	Topic	Risk	Risk Impact level	Mitigation Measures
2	Weather conditions	High-temperature zone; dust and sand resistant filters to be utilized to avoid		Component selection and detailed engineering to incorporate local/weather site conditions
4	Solar resource potential	Variation in measured solar data through different models.		It is suggested that P75 or P90 figures be used to determine returns in the Project's financial model; selection to be based on level of security the sponsor's require







3. Solar Resource Assessment and Energy Yield

3.1 Irradiance Conditions at Site

3.1.1 Data Sources

The primary data source used for the Project's detailed energy simulation using PVsyst is Meteonorm 7.2 and SolarGIS (attached). Data variables imported into PVsyst included:

- Global horizontal radiation (hourly)
- Diffused radiation (hourly)
- Ambient temperature (hourly), and
- Fill factors (hourly).

The SolarGIS irradiance data ranged from 1999 to 2018 and temperature data from 1999 to 2018.

The results obtained by the simulation were validated using PV yields reported in World Bank data from a recent exercise undertaken the Bank to map solar data in Pakistan using ground-level measurements. The World Bank data[9] were produced by measurement stations located in Lahore, Islamabad, Peshawar, Karachi, Khuzdar, Multan, Hyderabad and Quetta. The datasets represent 10 min interval values of PV output, global horizontal radiation, direct normal irradiance, diffused horizontal irradiance, temperature and elevation. Conditions at locations situated between measurement sites can be interpolated to determine an appropriate local data set (using both the real-time ground data and satellite-based data to obtain the interpolated data set). The World Bank dataset is from 2015 to 2017 (further data collection is ongoing).

The nearest weather stations of the Pakistan Meteorological Department to the Project site are listed in **Exhibit 3.1**.

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[9] For details, see the World Bank's Global Solar Atlas website at http://globalsolaratlas.info.

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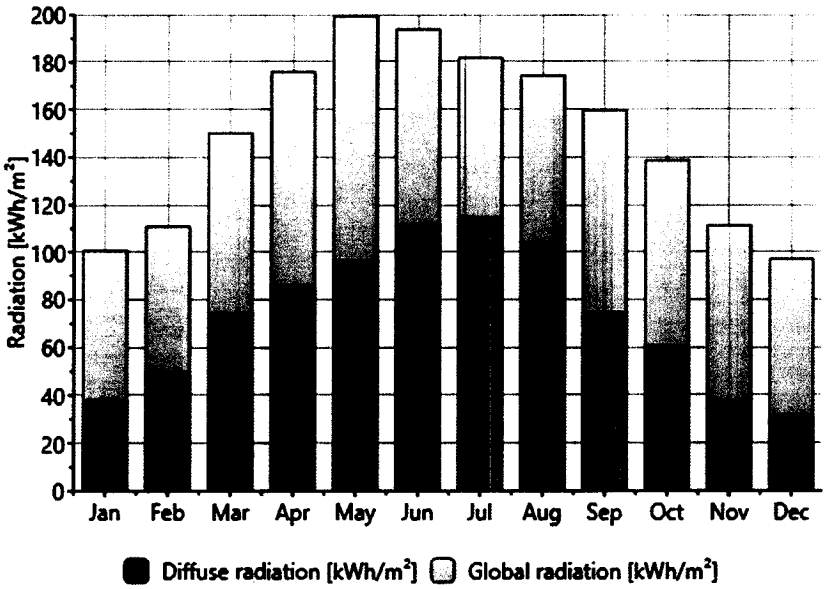
An illustration of the breakup of direct and diffused radiation for the Chab site is given in **Exhibit 3.2**, while **Exhibit 3.3** provides monthly temperature ranges and **Exhibit 3.4** shows daily hours of sunshine.

Exhibit 3.2: Breakup of Global and Diffused Radiation at the Project Site



Source: Data illustration from SolarGIS (site lat. 33°/long. 71°).

Exhibit 3.3: Ranged Temperature Variation across the Year at the Project Site

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Grid-Connected System: Main results

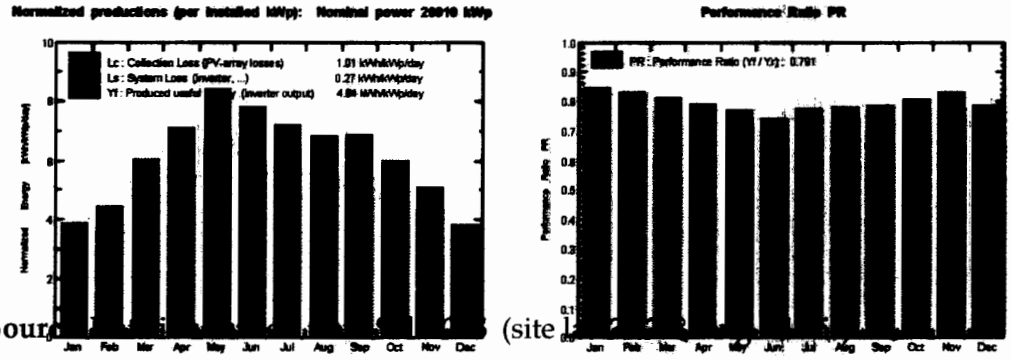
Project : **New Project**

Simulation variant : **New simulation variant**
Simulation for the 1st year of operation

Main system parameters	System type	**Tracking system with backtracking**		
Near Shadings	Detailed electrical calculation	(acc. to module layout)		
PV Field Orientation	tracking, tilted axis, Axis Tilt	0°	Axis Azimuth	0°
PV modules	Model	LR4-72HPH-430M	Pnom	430 Wp
PV Array	Nb. of modules	46586	Pnom total	**20010 kWp**
Inverter	Model	TC2500KF	Pnom	2500 kW ac
Inverter pack	Nb. of units	6.0	Pnom total	**15000 kW ac**
User's needs	Unlimited load (grid)			

Main simulation results

System Production	**Produced Energy**	**35357 MWh/year**	Specific prod.	1767 kWh/kWp/year
	Performance Ratio PR	79.06 %		



Source: (site)

Exhibit 3.4: Month-wise Daily Sunshine Hours at the Project Site

New simulation variant
Balances and main results

	GlobHor kWh/m²	DiffHor kWh/m²	T_Amb °C	GlobInc kWh/m²	GlobEff kWh/m²	EArray MWh	E_Grid MWh	PR
January	88.4	31.80	10.36	120.0	112.7	2150	2030	0.846
February	95.0	42.80	13.53	123.6	116.5	2198	2056	0.831
March	146.1	65.10	19.12	187.5	175.4	3186	3009	0.810
April	168.1	71.20	24.12	212.5	199.2	3611	3355	0.789
May	204.8	83.10	29.91	261.5	245.4	4217	4041	0.772
June	192.4	97.20	30.99	254.5	218.7	3775	3482	0.742
July	185.1	94.80	30.30	223.9	208.7	3619	3486	0.774
August	173.4	91.80	29.08	269.0	195.4	3424	3277	0.780
September	161.7	71.70	26.85	206.0	192.7	3388	3238	0.786
October	139.0	49.80	22.64	185.2	173.9	3124	2980	0.804
November	108.2	32.70	15.94	151.8	142.7	2654	2528	0.832
December	85.7	29.70	11.81	118.6	111.3	2110	1987	0.787
Year	1747.9	761.50	22.09	2234.9	2091.6	37327	35357	0.791

Legends:
GlobHor — Horizontal global irradiation
DiffHor — Horizontal diffuse irradiation
T_Amb — Ambient Temperature
GlobInc — Global incident in coll. plane
GlobEff — Effective Global, corr. for IAM and shadings
EArray — Effective energy at the output of the array
E_Grid — Energy injected into grid
PR — Performance Ratio

PVsyst Licensed to TBEA Xinjiang Sunoasis Co.Ltd (China)

Source: Data illustration from SolarGIS (site lat. 33.21°/long. 71.85°).

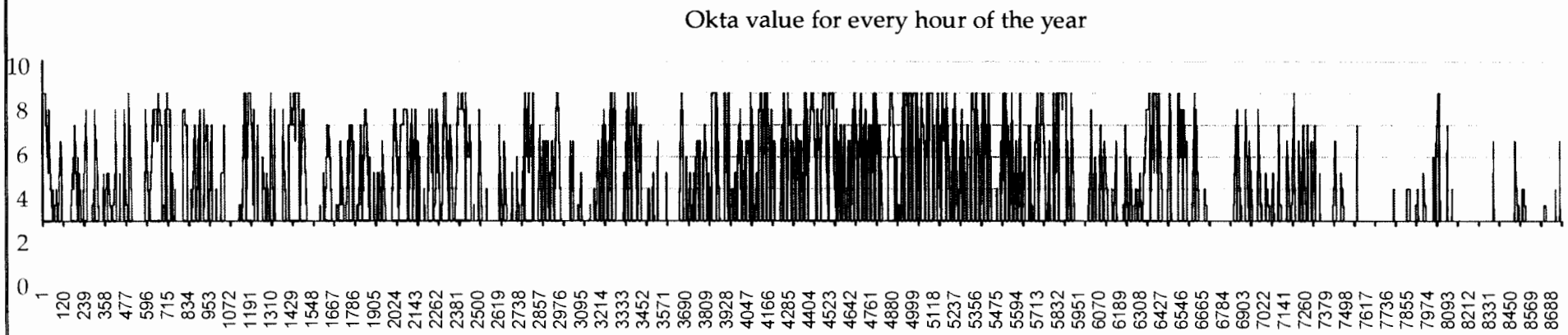
3.1.2 Cloud Cover/Okta Scale

Exhibit 3.5 shows Okta values for every hour of the year for the Attock Project site. Okta value (N) represents the fraction of the sky that is covered with clouds. The scale varies from 0 to 8, where 0 represents a completely clear sky and 8 represents completely overcast conditions.

The output of a solar PV system is strongly dependent on the fraction of the sky that is covered with clouds, i.e., the proportion of direct and diffuse irradiance reaching the modules. It can be observed that the clearest days are experienced during November-December and February-March.

In general, selecting solar modules which operate well in low light, diffused radiation condition improves the performance of a solar PV system. Maximum irradiance at any instant is experienced between 4 to 6 on the Okta scale, where direct irradiance is incident on the solar PV modules and there is diffused irradiance from nearby clouds as well. However, overall generation (kWh) is lower in this Okta range compared to 0 Okta, but there are more power peaks experienced.

Exhibit 3.5: Hourly Okta Values for the Year at the Project Site



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3.1.1 Shading at Site

There are two types of shading of the solar modules that have been considered in the plant's energy simulation:

Horizon Losses

Horizon losses are the same for fixed and tracking systems (**Exhibit 3.6**).

Latitude = 33.21°, Longitude= 71.85°

Source: Obtained from Meteonorm 7.2 for the site location.

Near Shading Losses

Near shading losses primarily include inter-row shading losses. It is assumed that there are no other nearby obstructions, such as trees or buildings, which will result in near shading on the solar PV modules at the Attock site. A near shading model was also developed for a single-axis tracking system under the same site conditions. All near shading was simulated in PVsyst 6.3.9 for single axis is given (**Exhibit 3.7**).

Exhibit 3.7: Shading Model for 20 MWp Single Axis Tilt System

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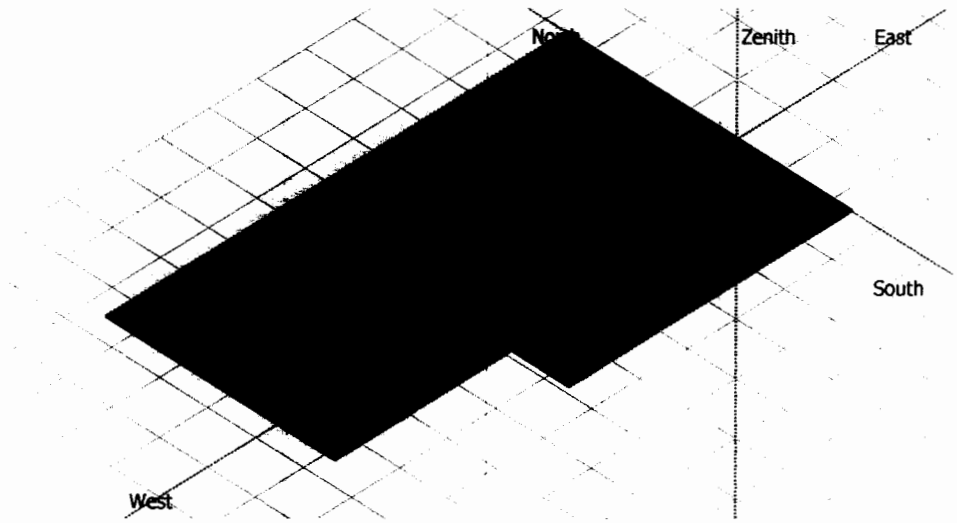
Grid-Connected System: Near shading definition

Project : **New Project**

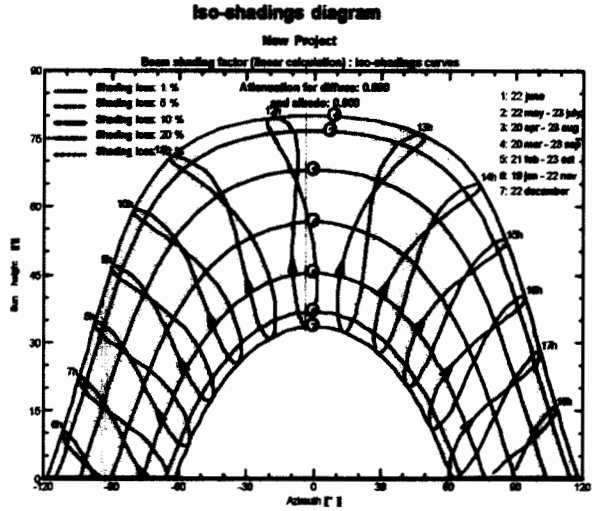
Simulation variant : **New simulation variant**
Simulation for the 1st year of operation

Main system parameters	**System type**	**Tracking system with backtracking**		
Near Shadings	**Detailed electrical calculation**	**(acc. to module layout)**		
PV Field Orientation	tracking, tilted axis, Axis Tilt	0°	Axis Azimuth	0°
PV modules	Model	LR4-72HPH-430M	Pnom	430 Wp
PV Array	Nb. of modules	46536	Pnom total	**20016 kWp**
Inverter	Model	TC2500KF	Pnom	2500 kW ac
Inverter pack	Nb. of units	6.0	Pnom total	**15000 kW ac**
User's needs	Unlimited load (grid)			

Perspective of the PV-field and surrounding shading scene



Iso-shadings diagram



PVsyst Licensed to TBEA Xinjiang Sunoasis Co.Ltd (China)

3.2 Resource Data Variation

There are a number of different data sources and models available that combine measurements from ground stations and satellite-based interpolated data for the final data set. These include:

- Meteonorm
- Solar GIS
- NASA
- PVGIS 4
- Swera SUNY, and
- Swera NREL.

Two models, Meteonorm and Solar GIS, gave results which were closest to actual solar PV output results for Karachi, Islamabad and Lahore. Therefore, the latest version of Meteonorm 7.2 dataset for the Attock site was used for the Project simulation study and the results obtained from the simulated plant yield was validated against the World Bank's solar atlas and other solar PV projects in the region. In addition, the variances shown in **Exhibit 3.10** were observed based on terrain types.

Exhibit 3.10: Variation of Data in Different Terrain Conditions

Model Uncertainty Yearly Estimates	Region	GH I [illegible]	GTI DNI [illegible]	
Low	[illegible]	[illegible]	[illegible]	[illegible]
Medium	Mountains and western Pakistan, large urban areas	<6	<7	<14
High (exceptional)	High mountains	8+	[illegible]	[illegible]

3.3 PV System Simulation Basis and Assumptions

The basis of assumptions used for the plant energy yield simulations can be found in the PVsyst report in **Appendix F** tracked systems, respectively. **Exhibit 3.11** and summarize the basis of assumptions for the N-S tracking system.

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Grid-Connected System: Simulation parameters

Project :	**New Project**				
Geographical Site	**Tehsil JAND**			Country	**Pakistan**
Situation		Latitude	33.21° N	Longitude	71.85° E
Time defined as		Legal Time	Time zone UT+5	Altitude	415 m
		Albedo	0.20		
Meteo data:	**Tehsil JAND**	Meteonorm 7.2, Sat=56% - Synthetic			

Simulation variant :	**New simulation variant**				
		Simulation date	04/11/19 17h29		
		Simulation for the	**1st year of operation**		

Simulation parameters		System type	**Tracking system with backtracking**		
Tracking plane, tilted Axis		Axis Tilt	0°	Axis Azimuth	0°
Rotation Limitations		Minimum Phi	-60°	Maximum Phi	60°
		Tracking algorithm	Astronomic calculation		
Backtracking strategy		Nb. of trackers	554	Identical arrays	
		Tracker Spacing	6.00 m	Collector width	2.12 m
Backtracking limit angle		Phi limits	+/- 69.1°	Ground cov. Ratio (GCR)	35.3 %
Models used		Transposition	Perez	Diffuse	Perez, Meteonorm
Horizon		Free Horizon			
Near Shadings	Detailed electrical calculation		(acc. to module layout)		
User's needs :	Unlimited load (grid)				

PV Array Characteristics					
PV module	Si-mono	Model	**LR4-72HPH-430M**		
Original PVsyst database		Manufacturer	Longi Solar		
Number of PV modules		In series	28 modules	In parallel	1662 strings
Total number of PV modules		Nb. modules	46536	Unit Nom. Power	430 Wp
Array global power		Nominal (STC)	**20010 kWp**	At operating cond.	18164 kWp (50° C)
Array operating characteristics (50° C)		U mpp	1023 V	I mpp	17763 A
Total area		Module area	**103542 m²**		
Inverter		Model	**TC2500KF**		
Custom parameters definition		Manufacturer	TBEA Xi'an Electric		
Characteristics		Operating Voltage	900-1300 V	Unit Nom. Power	2500 kWac
				Max. power (=>40° C)	2750 kWac
Inverter pack		Nb. of inverters	12 * MPPT 50 %	Total Power	15000 kWac
				Pnom ratio	1.33

PV Array loss factors					
Array Soiling Losses				Loss Fraction	3.0 %
Thermal Loss factor		Uc (const)	29.0 W/m² K	Uv (wind)	0.0 W/m² K / m/s
Wiring Ohmic Loss		Global array res.	0.96 mOhm	Loss Fraction	1.5 % at STC
LID - Light Induced Degradation				Loss Fraction	2.0 %
Module Quality Loss				Loss Fraction	0.0 %
Module Mismatch Losses				Loss Fraction	1.0 % at MPP
Strings Mismatch loss				Loss Fraction	0.10 %
Module average degradation		Year no	1	Loss factor	0.6 %/year
Mismatch due to degradation		Imp RMS dispersion	0.4 %/year	Vmp RMS dispersion	0.4 %/year

Grid-Connected System: Simulation parameters

Incidence effect (IAM): User defined profile

0°	20°	30°	40°	50°	60°	70°	80°	90°
1.000	1.000	1.000	1.000	1.000	1.000	0.950	0.760	0.000

System loss factors

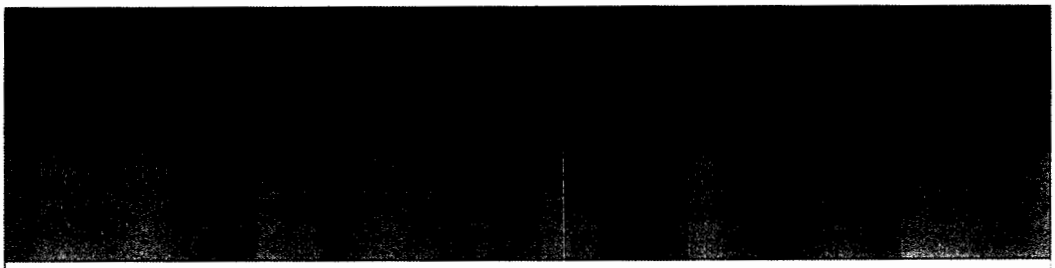
AC loss, transfo to injection	Grid Voltage	11 kV		
	Wires: 3x300.0 mm²	1467 m	Loss Fraction	1.5 % at STC
External transformer	Iron loss (24H connexion)	19743 W	Loss Fraction	0.1 % at STC
	Resistive/Inductive losses	73.5 mOhm	Loss Fraction	1.2 % at STC
Unavailability of the system	4.4 days, 3 periods		Time fraction	1.2 %

Auxiliaries loss	Constant during operation	15.0 kW	... from Power thresh.	15.0 kW
	Night auxiliaries consumption	100.0 kW		

3.4 Selected Main Solar PV Components

The main data sources utilized for the selection of the solar PV power plant components for this feasibility study are listed in **Exhibit 3.13.**

Exhibit 3.13: Data Sources Used for Component Specifications



Central inverter http://en.tbeapower.com/show.php?id=9031

3.5 Auxiliary Consumption and System Losses

Loss flow charts for single-axis tracked solar PV system are shown in **Exhibit 3.14.**

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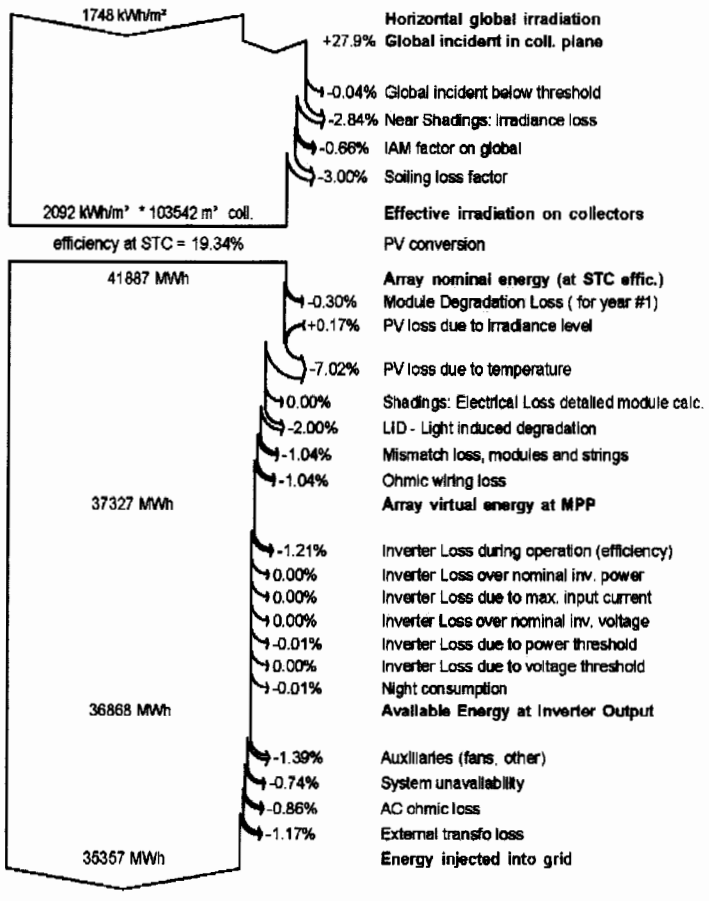
Grid-Connected System: Loss diagram

Project : **New Project**

Simulation variant : **New simulation variant**
Simulation for the 1st year of operation

Main system parameters	System type	**Tracking system with backtracking**		
Near Shadings	Detailed electrical calculation	(acc. to module layout)		
PV Field Orientation	tracking, tilted axis, Axis Tilt	0°	Axis Azimuth	0°
PV modules	Model	LR4-72HPH-430M	Pnom	430 Wp
PV Array	Nb. of modules	46536	Pnom total	**20010 kWp**
Inverter	Model	TC2500KF	Pnom	2500 kW ac
Inverter pack	Nb. of units	6.0	Pnom total	**15000 kW ac**
User's needs	Unlimited load (grid)			

Loss diagram over the whole year



3.6 Plant Electricity Generation Profile

3.6.1 Probability Distribution for Annual Energy Generation

Exhibit 3.11: Yield and Capacity Utilization for Single-Axis Tracked System at Attock

Case	Generation	CUF MWh
P75	34,911	19.50%

3.6.2 Plant Energy Yield and Expected Availability

For a solar PV system, the term 'performance ratio' refers to the relationship between the system's actual and target yields:

Performance Ratio (PR) of a plant for a period of time = Energy Measured (kWh)/[Irradiance (kWh/m^2) on the Panel x Active Area of PV Module (m^2) x PV Module Efficiency]

Single Axis System

Monthly performance ratios for a 20 MWp fixed tilt solar PV system at the Attock site are shown in **Exhibit 3.20**.

Exhibit 3.20: Monthly Performance Ratio for Single Axis System at Attock

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Grid-Connected System: Main results

Project : New Project

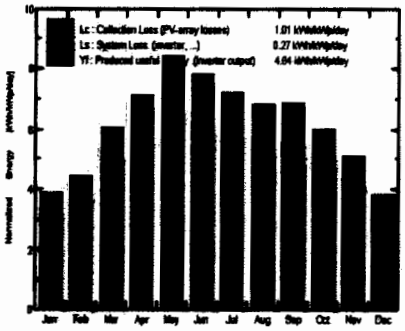
Simulation variant : New simulation variant
Simulation for the 1st year of operation

Main system parameters	System type	Tracking system with backtracking			
Near Shadings	Detailed electrical calculation	(acc. to module layout)			
PV Field Orientation	tracking, tilted axis, Axis Tilt	0°	Axis Azimuth	0°	
PV modules	Model	LR4-72HPH-430M	Pnom	430 Wp	
PV Array	Nb. of modules	46536	Pnom total	20010 kWp	
Inverter	Model	TC2500KF	Pnom	2500 kW ac	
Inverter pack	Nb. of units	6.0	Pnom total	15000 kW ac	
User's needs	Unlimited load (grid)				

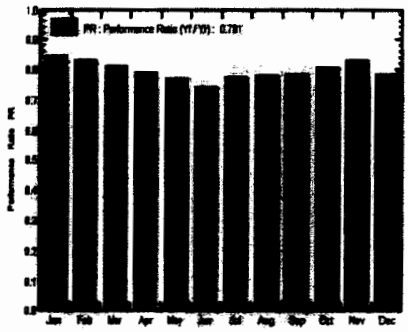
Main simulation results

System Production — Produced Energy 35357 MWh/year — Specific prod. 1767 kWh/kWp/year
Performance Ratio PR 79.06 %

Normalized productions (per installed kWp): Nominal power 20010 kWp



Performance Ratio PR



New simulation variant
Balances and main results

	GlobHor kWh/m²	DiffHor kWh/m²	T_Amb °C	GlobInc kWh/m²	GlobEff kWh/m²	EArray MWh	E_Grid MWh	PR
January	88.4	31.80	10.36	120.8	112.7	2150	2080	0.846
February	95.0	42.80	13.83	123.6	115.5	2168	2098	0.851
March	148.1	65.10	19.12	187.5	175.4	3186	3088	0.810
April	188.1	71.20	24.12	212.5	198.2	3611	3355	0.789
May	204.8	85.10	28.81	231.5	216.4	4217	4041	0.772
June	192.4	87.20	30.98	234.5	218.7	3775	3482	0.742
July	185.1	84.60	30.30	223.9	208.7	3619	3488	0.774
August	173.4	91.80	29.08	208.9	195.4	3424	3277	0.780
September	161.7	71.70	26.85	206.0	192.7	3388	3238	0.786
October	139.0	49.80	22.64	186.2	173.9	3124	2980	0.804
November	108.2	32.70	16.84	151.8	142.7	2654	2528	0.832
December	85.7	29.70	11.81	118.8	111.3	2110	1987	0.787
Year	1747.9	781.50	22.09	2234.8	2091.6	37327	35367	0.791

Legends: GlobHor Horizontal global irradiation — GlobEff Effective Global, corr. for IAM and shadings
DiffHor Horizontal diffuse 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 — PR Performance Ratio

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Exhibit 3.21: Normalized Monthly Average Production for Single Axis System at Attock

Normalized Production per Installed kWp
Nominal Ouptut 20,010 kWp (Single Axis)

PVSYST V6.79	TBEA Xinjiang Sunoasis Co.Ltd (China)	04/11/19	Page 4/7

Grid-Connected System: Main results

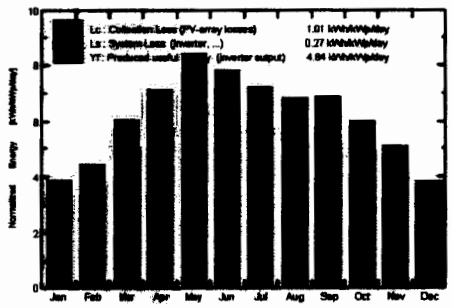
Project : New Project
Simulation variant : New simulation variant
Simulation for the 1st year of operation

Main system parameters		System type	**Tracking system with backtracking**		
Near Shadings		Detailed electrical calculation	(acc. to module layout)		
PV Field Orientation		tracking, tilted axis, Axis Tilt	0°	Axis Azimuth	0°
PV modules		Model	LR4-72HPH-430M	Pnom	430 Wp
PV Array		Nb. of modules	46536	Pnom total	**20010 kWp**
Inverter		Model	TC2500KF	Pnom	2500 kW ac
Inverter pack		Nb. of units	6.0	Pnom total	**15000 kW ac**
User's needs		Unlimited load (grid)			

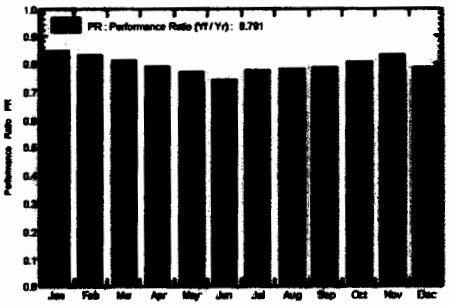
Main simulation results

System Production	**Produced Energy**	**35357 MWh/year**	Specific prod.	1767 kWh/kWp/year
	Performance Ratio PR	79.06 %		

Normalized productions (per installed kWp): Nominal power 20010 kWp



Performance Ratio PR



New simulation variant
Balances and main results

	GlobHor kWh/m²	DiffHor kWh/m²	T_Amb °C	GlobInc kWh/m²	GlobEff kWh/m²	EArray MWh	E_Grid MWh	PR
January	88.4	31.80	10.36	120.0	112.7	2150	2030	0.846
February	95.0	42.80	13.63	123.6	116.5	2168	2056	0.831
March	146.1	65.10	19.12	187.5	176.4	3186	3039	0.810
April	168.1	71.20	24.12	212.5	198.2	3611	3355	0.788
May	204.8	83.10	29.81	261.5	245.4	4217	4041	0.772
June	192.4	97.20	30.99	254.5	218.7	3775	3482	0.742
July	185.1	94.50	30.30	223.9	208.7	3619	3486	0.774
August	173.4	91.90	29.08	209.9	195.4	3424	3277	0.780
September	161.7	71.70	26.85	206.0	192.7	3388	3238	0.786
October	139.0	49.80	22.64	185.2	173.9	3124	2980	0.804
November	108.2	32.70	15.94	151.8	142.7	2654	2526	0.832
December	85.7	29.70	11.81	118.6	111.3	2110	1987	0.787
Year	1747.9	761.50	22.09	2234.9	2091.6	37527	35867	0.791

Legends:
GlobHor Horizontal global irradiation
DiffHor Horizontal diffuse irradiation
T_Amb Ambient Temperature
GlobInc Global incident in coll. plane
GlobEff Effective Global, corr. for IAM and shadings
EArray Effective energy at the output of the array
E_Grid Energy injected into grid
PR Performance Ratio

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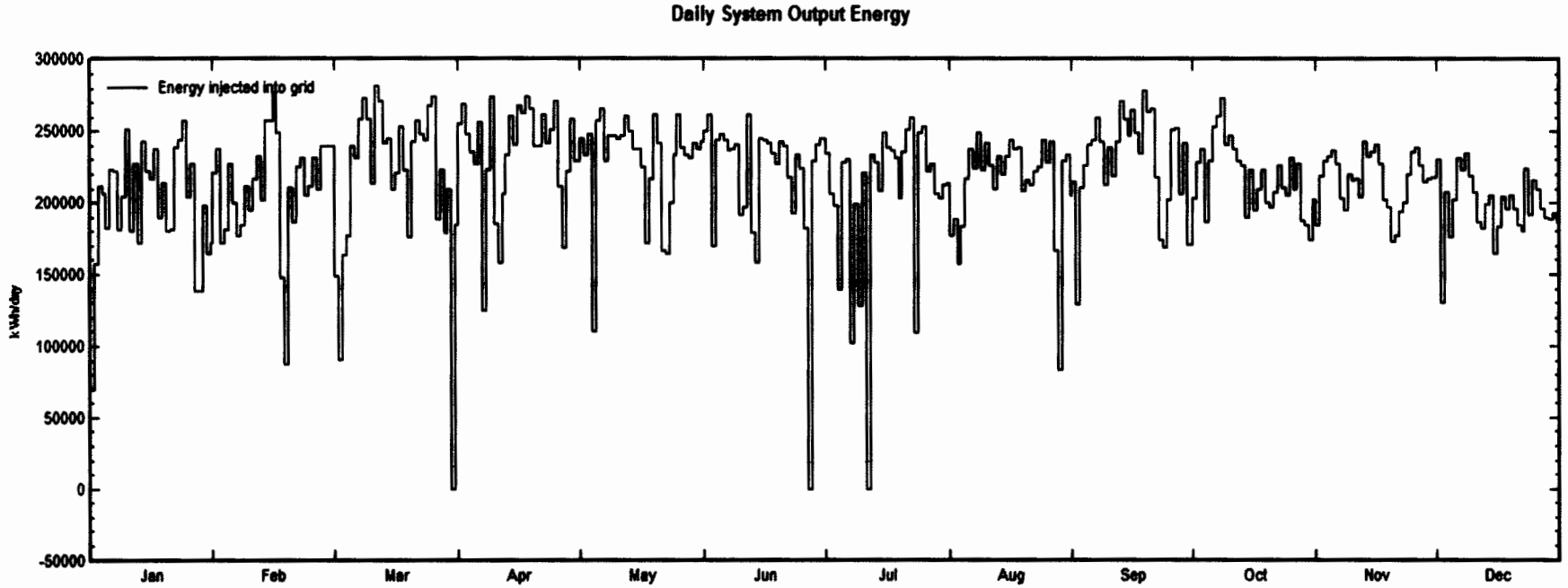
Exhibit 3.22: Daily System Output for Single Axis System at Attock



4. Project Implementation

4.1 Power Station Control System

A SCADA system will be an integral part of the project EPC scope and would be accessible to the sponsor, O&M operator, grid operator and asset manager. This operating system will help monitor energy generation in detail, report and troubleshoot faults, and help evaluate asset performance, component degradation and other important variables that need to be regularly assessed for ensuring effective solar PV and plant performance. The SCADA interface will also be accessible to local operator at the plant's control room for operational command and control purposes. All ancillary services and functions which the inverter is capable of will be operable through the control system. In case of a tracking system, the control system will also allow changing panel orientations based on specific requirements, if and when required.

4.2 Project Implementation Plan

A detailed breakdown of activities will be sought from the EPC contractor. The plan should be organized such that the sponsor could gain advantage from selling extra energy before the Project COD. Contractual clauses should be incorporated to reward or penalize the EPC contractor for early or delayed completion, respectively, of the solar PV plant installation, testing and commissioning. These could be percentage-based, tied to weekly and monthly work plan milestones.

4.3 Implementation Schedule

The timeline for the Project commissioning is estimated to be twelve months from initial ground breaking. A detailed construction and commissioning Gantt chart will be developed by the EPC contractor which would list the sequence and duration of each activity and phase. The owners' engineer shall make sure that project implementation activities can run in parallel as much as possible and equipment and material delivery schedules are closely synchronized with on-site construction needs. **Exhibit 4.1** shows the sequence of main project implementation activities and tentative timeline for completion of each. Some of these activities would overlap each other. Total project execution will take from 150 to 180 days, or a maximum of 5-6 calendar months, which will be clearly defined in the EPC implementation agreement.

Exhibit 4.1: Project Implementation Timeline

Activity	Duration Days
[illegible]	[illegible]
Detailed design	10
[illegible]	[illegible]
Site mobilization	45
[illegible]	[illegible]
SCADA and security	20
[illegible]	[illegible]
Commissioning	40
[illegible]	[illegible]

5. Project Financial Feasibility

5.1 Approach and Methodology

In order to develop projected financials of the 20 MW (DC) Wheeling Solar Power IPP Project planned to be set up in the Punjab province, expected installation costs, plant energy yield, annual operating costs and standard financing assumptions were used to develop an expected 'cost-plus' tariff whereby the RE IPP is paid its actual cost plus an agreed profit. Projected financials for the Project were then developed assuming a minimum expected equity IRR for the sponsor. As per methodology, a constant ROE (return on equity) component is added to the tariff for the life of the project, ensuring a certain return and achieving the required IRR. All dollar transactions are taken at the current exchange rate of Rs. 157/US$ for the entire life of the project.

One basic design options for the solar plant have been assumed: single-axis tracking system. Appropriate energy production assumptions for O&M and EPC cost have been incorporated to estimate sponsors' returns.

5.2 Project Assumptions

5.2.1 Investment Cost

Equity sponsor returns are based on addition of an ROE component to the energy price at a current rate of 20% per annum on the invested equity. The ROEDC (ROE during construction) has not been calculated separately in the draft model. The ROE component results in an equity IRR of 19% for the project.

An EPC cost of US¢ 0.625/W was assumed for a single axis N-S tracking system.

5.2.2 Financing Plan

The planned equity contribution is 20% of the total project cost, while the remaining 80% will be financed from local borrowing from the State Bank of Pakistan's (SBP) renewable energy financing facility[11] at an annual interest of 6%. The debt is assumed to be acquired at a financing cost of 5.5% of the total loan facility acquired.

11 http://www.sbp.org.pk/smefd/circulars/2019/C10.htm

5.2.3 Financing Assumptions

For the draft report, all financing costs, including IDC (interest during construction) have been taken to be the same as in the latest FIT (feed-in tariff) determination by NEPRA of December 15, 2016. For the operating phase, a repayment tenor of 12 years has been assumed, in line with the SBP's RE financing facility.

5.2.4 Operations and Maintenance Cost

The annual O&M cost assumed for the single-axis tracking system is taken as US$ 15,000 USD/Mega Watt. Insurance cost of 1% per annum of the EPC cost has been assumed for the life of the project. Annual SPV operating cost is taken as USD 7,500/MW.

5.2.5 Annual Solar Production

For the single axis system, the annual plant energy generation is computed at 35,357 MWh at P50. These P50 production figures have been used in the Project's financial model.

5.2.6 Duties and Taxes

No tax on sale of energy or income from generation of solar energy to the grid has been factored in.

5.2.7 Depreciation

Straight-line depreciation for the entire life of the project is assumed with zero salvage value.

5.2.8 Return on Equity

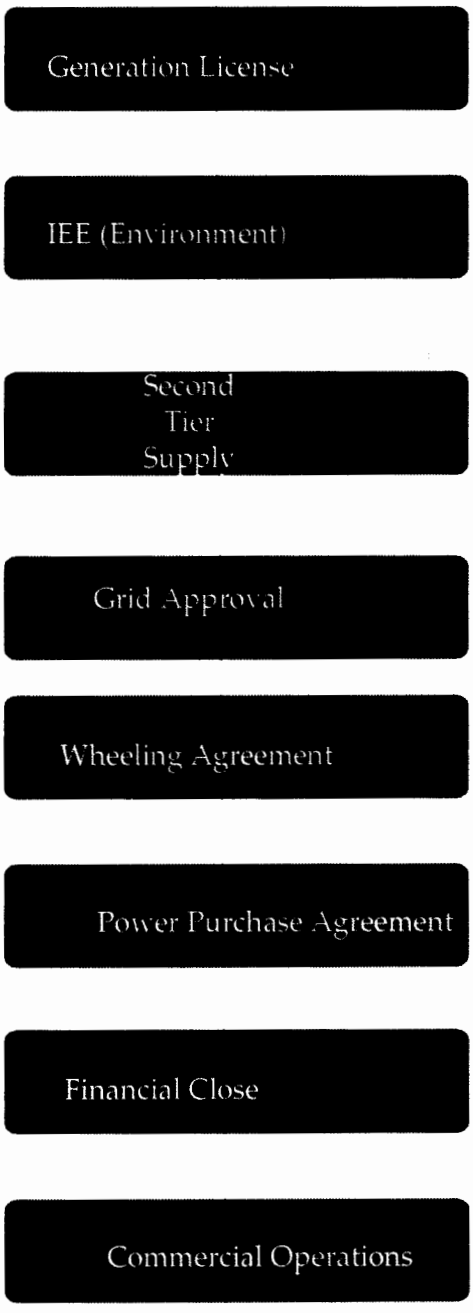
Project ROE is based on a 20% equity IRR specified by the sponsors. The assumed benchmark plant yield has been taken as 17% as specified by NEPRA for solar PV IPPs based in Pakistan's northern regions.

6. Licensing, Permitting and Security

6.1 Project Development Milestones

The flowchart in **Exhibit 6.1** summarizes key development milestones and their sequence required for the implementation of the Project on which various regulatory licenses, permits and consents will depend.

Exhibit 6.1: Project Permitting Milestones



6.2 Company Registration

AB Solar Park (Pvt.) Ltd has been incorporated specifically for the purpose of this wheeling project. The company is incorporated with Securities and Exchange Commission of Pakistan. Mr. Abdul Basit Javed is the 90% shareholder of this project company.

6.3 Acquisition of Land

Land has been identified in village Chab, Tehsil Jhand, District Attock in Punjab Province. The land was previously owned by locals. Land lease and purchase agreement shall be signed with the locals. The lease shall be for a period of 1 year and after the expiry of one year, the lease shall transform into sale/purchase of the land. The total land requirement for this project is 75 acres.

6.4 Regulatory Requirements

The following main regulatory consents will be required for the Project before the project can reach financial close and kick-off construction:

6.4.1 Building Permissions

The EPC contractor will need to be registered with the Pakistan Engineering Council (PEC) and certified under the relevant professional and project size (based on the monetary value of the contract) categories necessary for to engage in the engineering design and construction of the Project.

6.4.2 Generation License

An application will be filed by AB Solar Park (Pvt.) Ltd with the National Electric Power Regulatory Authority (NEPRA) for the Project's generation license under (SRO 549(I)/2016 dated 13-06-2016) regarding NEPRA (Wheeling of Electric Power) Regulations, 2016.

6.4.3 Tariff Determination

Tariff determination for a wheeling project is unlike any other IPP. Both the power generation company, AB Solar Park (Pvt.) Ltd and the BPCs have to agree on the mutually agreed tariff and sign it off in the Power Purchase Agreement. NEPRA has no involvement in the tariff determination. However once the entire agreements are signed with the Power Purchaser, then we shall submit a copy of them to NEPRA.

6.4.4 Environmental Approvals

The Project IEE has been submitted in November, 2019 on behalf of AB Solar Park (Pvt.) Ltd to the Punjab Environmental Protection Agency (P-EPA) for the necessary environmental 'no objection certificate' (NOC).

6.5 Security Package

The following security documents are required for the Project before plant construction can commence. These legally binding agreements specify the terms, fees and conditions under which project development approval and subsequent operation must take place, while providing protection against various risk factors over the project's lifetime backed up by a guarantee mechanism:

6.5.1 Letter of Interest

Letter of Interest is not required from any Governmental agency since this is a wheeling project. And we are applying directly to NEPRA under (SRO 549(I)/2016 dated 13-06-2016) regarding NEPRA (Wheeling of Electric Power) Regulations, 2016

6.5.2 Letter of Support

Unlike normal IPPs in energy sector of Pakistan, the wheeling project doesn't require a Letter of Support from the Government of Pakistan. AB Solar Park (Pvt.) Ltd. The major agreement is to be done with IESCO in the form of Wheeling Agreement.

6.5.3 Energy Purchase Agreement

An energy Purchase Agreement (EPA) will be signed with the Bulk Power Consumers guaranteeing power evacuation and bulk sale of power by AB Solar Park (Pvt.) Ltd at the mutually-determined tariff, subject to the Project achieving financial close.

6.5.4 Implementation Agreement

AB Solar Park (Pvt.) Ltd shall sign a guarantee agreement with the Bulk Power Consumer in order to safeguard itself from any non-payment of the monthly bills.

6.5.5 Wheeling Agreement

AB Solar Park (Pvt.) Ltd shall sign a Wheeling Agreement with IESCO as per (SRO 549(I)/2016 dated 13-06-2016) regarding NEPRA (Wheeling of Electric Power) Regulations, 2016. The agreement shall at a minimum contain the following provisions:

I. Detailed description of parties along with addresses and authorized representatives
II. Effective Date and Term
III. Interconnection Work
IV. Transport of Energy
V. Conditions with respect to shortfall in the committed capacity
VI. Provisions related to transfer of title and ownership of the Input Energy
VII. Arrangement related to metering
VIII. Procedures relating to meter reading and attendance
IX. Provisions relating to tempering , testing of meters, use of check meters and matters relating to inaccuracies
X. Provisions related to costs and expenses associated with the repair, testing, commissioning, calibration and recalibration of meters.
XI. Use of system payments
XII. Invoicing and payments
XIII. Arrangement in case of failure of transport
XIV. Payment disputes
XV. Treatment of Banked Energy
XVI. Operational provisions including but not limited to manner and form of wheeling notice and revised wheeling notice.
XVII. Provisions ensuring compliance of the regulations
XVIII. Establishment and manner of functioning of the coordination committees
XIX. Notice of Force Majeure Events
XX. Representations and Warranties
XXI. Provisions related to events of defaults
XXII. Termination Notice
XXIII. Remedies upon termination and obligations upon termination
XXIV. Liquidated damages
XXV. Restriction on Assignment
XXVI. Relation and arrangement with third party contractors and financiers
XXVII. Provisions related to notices and service address
XXVIII. Procedure of amendment to the Agreement
XXIX. Methodology of calculation of use of system charges and list of BPCs

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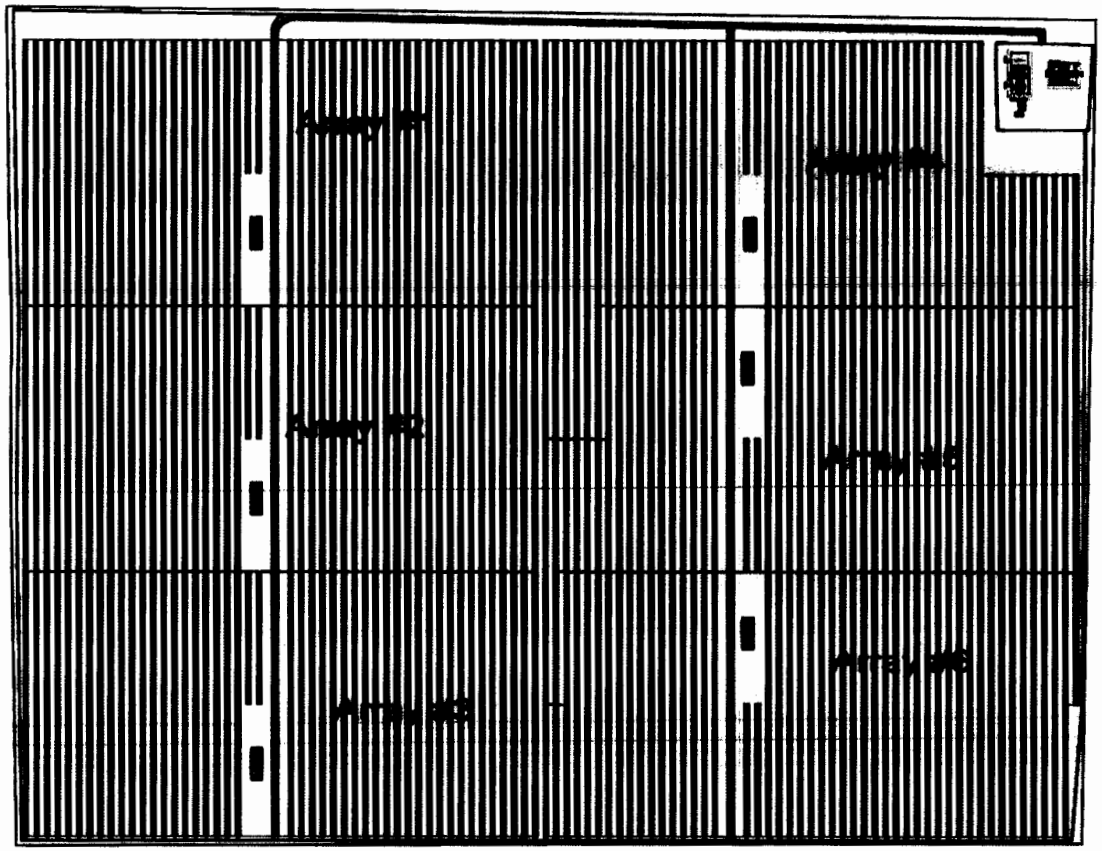
Appendix A: Solar PV Module Datasheet

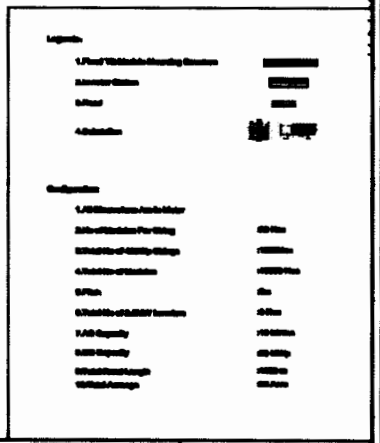
See following pages.

Appendix B: Conceptual Diagram of 5x6 Fixed Tilt Supporting Structure

See next page.

Array	DC Capacity	Number of modules per string	Number of strings	Module		Inverter	Module mounting structure	
				Specs	Quantity	Quantity	Specs	String
B1	3.32364	26	276	430	7728	1	26	276
B2	3.32364	26	276	430	7728	1	26	276
B3	3.32364	26	276	430	7728	1	26	276
B4	3.30816	26	276	430	7714	1	26	276
B5	3.32364	26	276	430	7728	1	26	276
B6	3.30816	26	276	430	7714	1	26	276
	39.81618		1662		46536	6		1107





Notes:

1. This drawing is only for Javed 20MWdc Solar Project.
2. The design is merely preliminary design, no permission to be used for construction.

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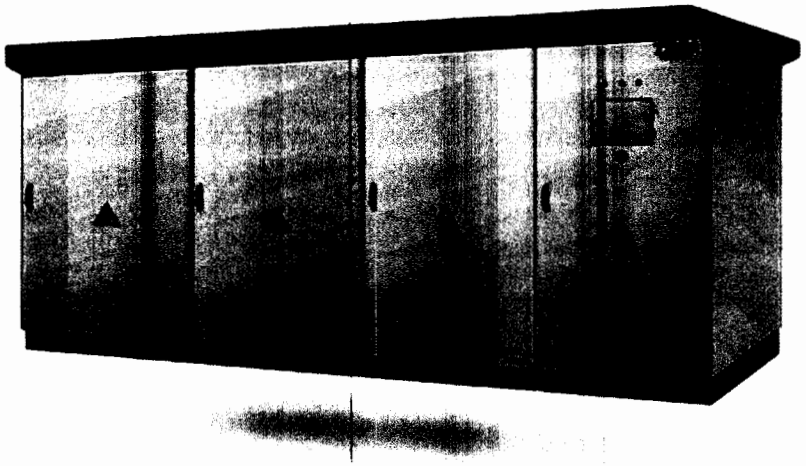
Appendix C: Inverter and Transformer Datasheet

See following pages.

EXCELLENT GREEN AND SMART ENERGY SERVICE PROVIDER

TBEA

NEW

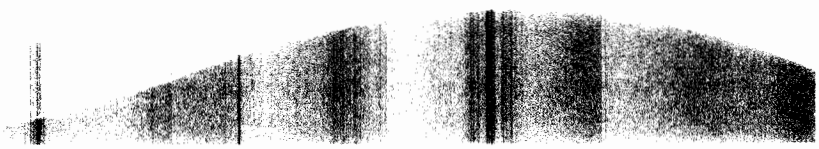


TC2500KF/TC3125KF
TC3750KF/TC5000KF

- Super power and outdoor non-container design, reducing the civil engineering cost and shortening the construction period;
- Perfect night reactive compensation function;
- Supporting 1.4 times high capacity ratio system design, possessing 1.1 times overloading capacity for AC output, fully utilizing the inverter performance and improving the generating capacity;
- DC 1500V, AC 630V, reducing the loss and improving the efficiency;
- Mature modular design, improving the operation and maintenance reliability and reducing the maintenance cost;
- Protection level: IP54 for whole machine and IP65 for electronic parts, adapting to the rough environments;

Company Website

Wechat Platform



TBEA

Model	TC2500KF	TC3125KF	TC3750KF	TC5000KF
Maximum recommended PV power(P_{PVmax})	3600kW	4375kW	5250kW	7000kW
Max.DC Voltage	1500V			
MPPT Voltage Range	900V~1300V	900V~1300V	900V~1300V	900V~1300V
Max.DC Current	3118A	3898A	4677A	6236A
Independent MPPT Number	2	3	3	4
Max. Number of Inputs	16*400A or 20*250A	24*400A or 30*250A	24*400A or 30*250A	32*400A or 40*250A
Rated AC Power	2500kW	3125kW	3750kW	5000kW
Max. AC Power*	2750kVA@40℃	3438kVA@40℃	4125kVA@40℃	5500kVA@40℃
Rated AC Voltage	630V	630V	630V	630V
Rated output current	2291A	2864A	3437A	4582A
Max.output current	2520A	3150A	3780A	5040A
Rated Grid Frequency	50Hz			
THD of AC Current	<3%			
Adjustable Power Factor	0.8(leading)-0.8(lagging),adjustable			
Max. Efficiency	99%			
European Weighted Efficiency	98.7%			
Ambient Temperature Range	-25℃ to 60℃(Above 50℃,derating)			
Ambient Humidity Range	0% to 95%(no condensation)			
Max. Operating Altitude	4000m,without derating <2000m			
Cooling Method	Forced air cooling			
Protection Rating	IP54/IP65(electronics)			
Over-voltage/under-voltage Protection	Yes			
Over-frequency/under-frequency Protection	Yes			
ZVRT	Yes			
Anti-islanding Protection	Yes			
Stand-alone Grid Detection	Yes			
Over-current Protection	Yes			
Anti-discharge Protection	Yes			
Overload Protection	Yes			
Lightning Protection	Yes			
Display	LCD			
Communication Interface	RS485,Ethernet(optional)			
Communication	Modbus			
Dimension(L/W/H)	2150mm*1678mm *2274mm	3225mm*1678mm *2274mm	3225mm*1678mm *2274mm	4300mm*1678mm *2274mm
Weight	3000kg	4600kg	4600kg	6000kg

TBEA XI'AN ELECTRIC TECHNOLOGY CO., LTD. | Address:No. 70, Shanglinyuan Road 4, High-tech Zone, Xi'an, China
Tel:+86-29-68780886 | Service line:400-606-6029 | Fax:+86-29-68780500-066 | E-mail:tbeapower@tbea.com | Website:www.tbeapower.com

Technical Parameters

Inverter Model	TC2500KF
Input (DC)	
Max. Allowable Input voltage	1500V
MPP voltage range [@ 25°C/@ 40°C/@ 60°C]	900V to 1300V
Maximum DC Current	3118A
Rated Input Voltage	900V
Max. Number of Inputs	16*400A or 20*250A
Output (AC)	
Max. AC power @ 40°C	2,750kVA
AC frequency operation range	48/52Hz
Rated power frequency/rated grid voltage	50 Hz / 630 V
Power factor at rated power/ Displacement power factor, adjustable	1 / 0.8 leading to 0.8 lagging, adjustable
Feed-in phases/ connection phases	3/3
Efficiency	
Max. efficiency/ European efficiency/ CEC efficiency	99% / 98.7%
Protective Devices	(a). Input-side disconnection device (b). Output-side disconnection device (c). DC overvoltage protection (d). Stand-alone grid detection active/passive (e). Grid monitoring (f). Ground fault monitoring (g). Insulation monitoring

	(h). Surge arrester for auxiliary power supply	
Environmental Enclosures	Operating Temperature Range	-25C - +60C (above 50C, derating)
	Maximum permissible value for relative humidity (non-condensing)	0% - 95% (non-condensing)
	Noise emission	68 dB(A)
	Operating Elevation	4000m, without derating ≤ 2000m (according to GB/T3859.2)
Grid Operation Protection	(a).	Over-voltage/undervoltage Protection
	(b).	Over-frequency/under frequency protection
	(c).	Anti-island protection strategy
	(d).	Over-current protection
	(e).	Anti-discharge protection
	(f).	Overload protection
	(g).	Low voltage ride through
	(h).	Lightning protection
	(i).	ZVRT
	(j).	Anti-discharge protection
	(k).	Stand-alone Grid detection
Data Collection System		
Weather Data	(a).	Pyranometer – Sets (Incline to record irradiation level) [Yes]
	(b).	Thermometer – Sets (to record ambient temp) [Yes]
System Data	(a).	DC input voltage (V) & current (A) of each inverter (phase, line) [Yes]

	(b).	Total DC power (kw) generated by PV array [Yes]
	(c).	AC output voltage (V) and current (A) of each Inverter (Phase, Total) [Yes]
	(d).	AC output power (kW) and energy (kwh) of each inverter [Yes]
	(e).	Frequency (Hz) [Yes]
	(f).	Power Factor (PF) [Yes]
	(g).	Temperature inside inverter station [Yes]
Isolating Transformer		
Model	Siemens	
Medium Voltage Side		
Rating	630V // 33kV step-up	
Type of Transformer	Oil and Natural Air	
Input voltage	630V	
Output Voltage	33kV	
Purpose of Transformer	Step-up	
Low-Voltage Side		
Nominal Input Voltage	630 V	
Outdoor Cubicle Control Room		
Data record	Continuous logging with data logging software [Yes]	
Control room system	Computerized data acquisition system [Yes]	
Control room system detail	Interfacing hardware & software, Industrial type PC, which will be robust & rugged suitable to operate in the control room environment [Yes]	

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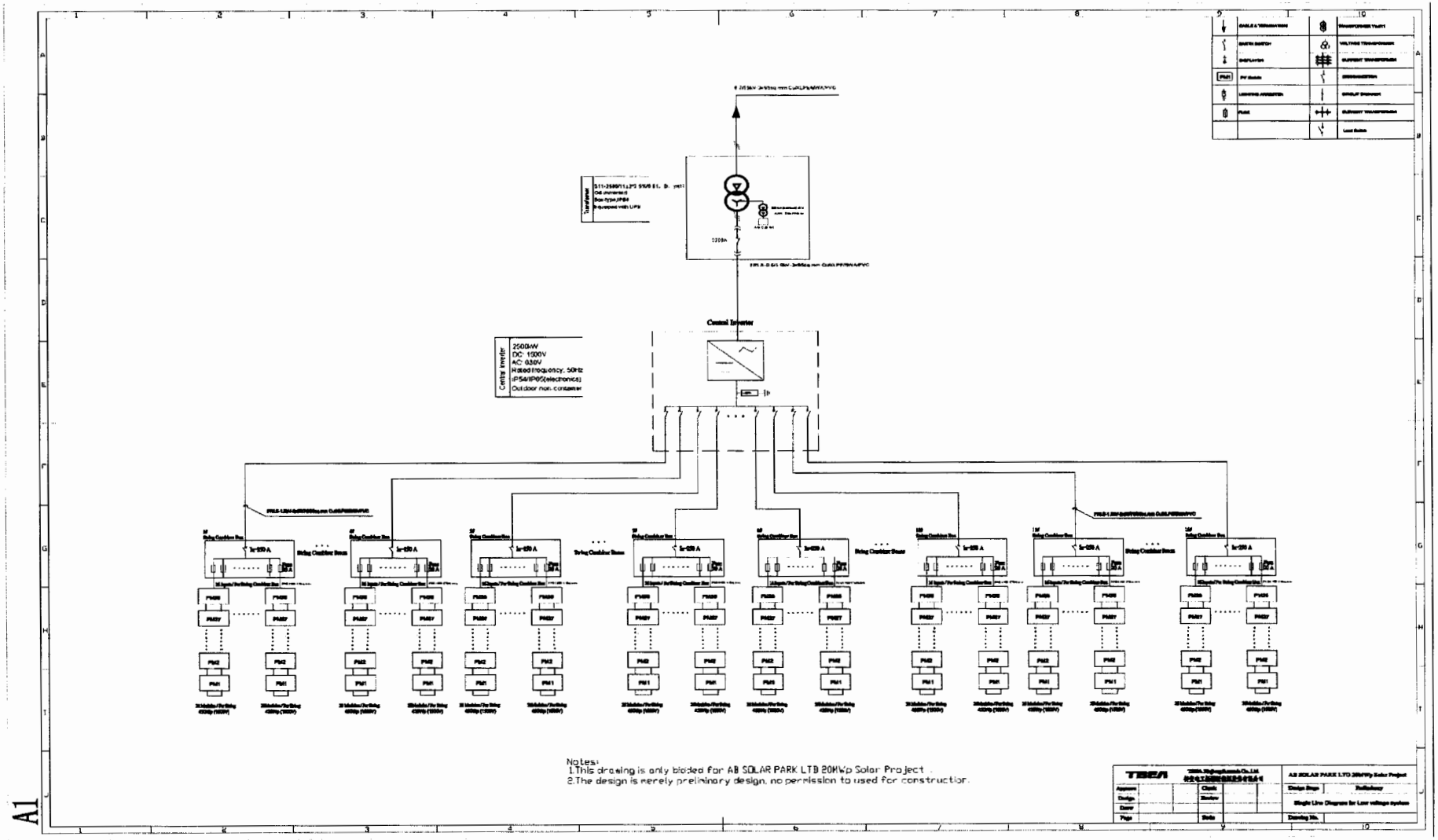
Appendix D: Conceptual Plant Single Line Diagram for Low Voltage

See next page.


Central Inverter
2500kW
DC: 1500V
AC: 630V
Rated frequency: 50Hz
IP54/IP65(electronics)
Outdoor non-container
Notes:
1.This drawing is only bloded for AB SOLAR PARK LTD 20MWp Solar Project .
2.The design is merely preliminary design, no permission to used for construction.
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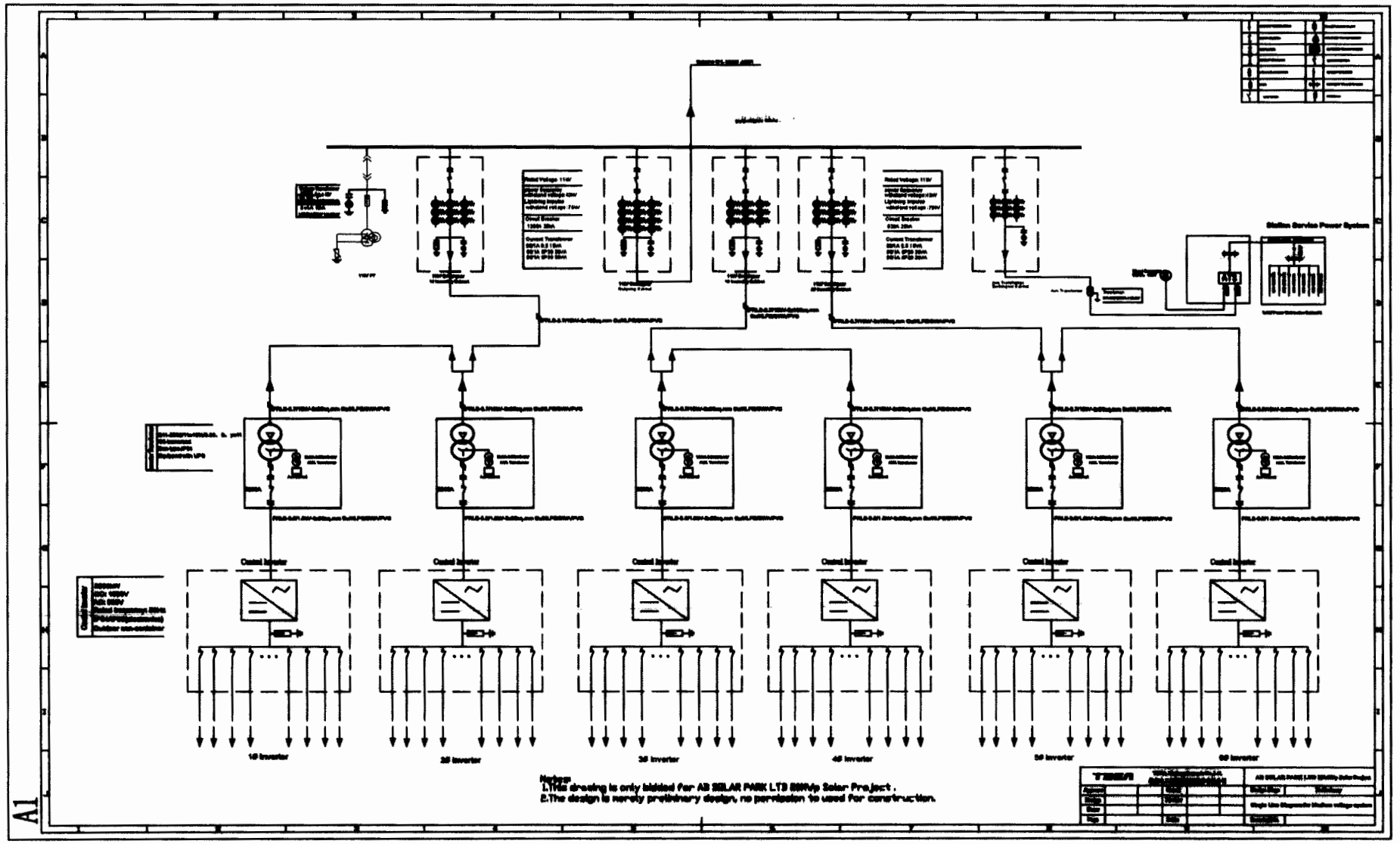
Appendix D: Conceptual Plant Single Line Diagram for Medium Voltage

See next page.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Notes:
1.This drawing is only bidded for AB SOLAR PARK LTD 20MWp Solar Project .
2.The design is merely preliminary design, no permission to used for construction.

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Appendix E: PVsyst Simulation Results for Single Axis System

PV Module Characteristics	

Inverter Characteristics	

System Configuration	Longi Solar

	LR4-72HPH-430M

Loss Factors	

Year	Energy at Various Confidence Levels [MWh/a]			Capacity Factor At Various Confidence Level [%]		
	P50	P75	P90	P50	P75	P90
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
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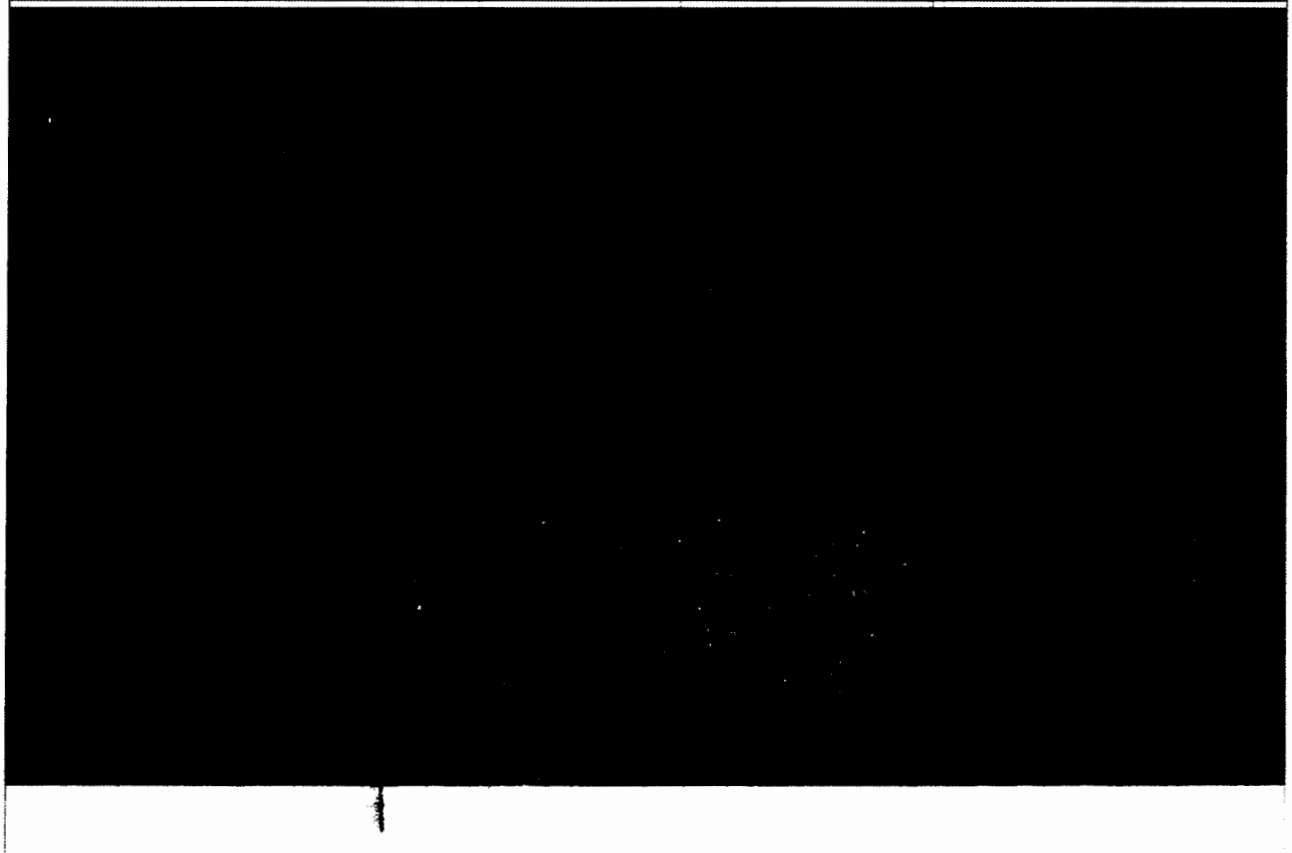

20 MW AB Solar Park

INITIAL ENVIRONMENTAL EXAMINATION

VILLAGE CHAB – TEHSIL JHAND, ATTOCK, PUNJAB

Proponent:

AB Solar Park (Pvt.) Ltd.
Office 28, Street 2, Sector E-11/1,
MPCHS, Islamabad
Contact: 051-8734203

Contents

EXECUTIVE SUMMARY

A. INTRODUCTION

20 MW AB Solar Park, is initiative of AASAL Solar Power (Pvt.) Ltd which owns another 49.5 MW Solar Power Project in D.I.Khan, KPK. The 49.5 MW Solar Power Project is one of the first ever Solar IPP of Khyber Pakhtunkhwa Province. The 20 MW AB Solar Park is based on the concept of Captive/Wheeling Power Plant. Pakistan has many Captive Power Projects now, however a project specifically designed on Wheeling basis, will be the first of its kind. The concept is as follows; to produce electricity at project site in District Attock, input it at Lakkarmar 132 kV Grid Station, wheel it via IESCO network to main Islamabad city and take the output from I-9 132 kV Grid Station. In this case, AB Solar Park shall be the Power Generation Company, IESCO shall be the wheeler of electricity and Bulk Power Consumers shall be the Power Purchasers. The project is based on the SRO. 549(I)/2016 dated June 13, 2016, "NEPRA (Wheeling of Electric Power) Regulations, 2016. Lakkarmar 132 kV Grid Station of IESCO has been shortlisted as the respective Grid Station as per NEPRA Grid Code, through which the electricity shall be injected into the IESCO network. Grid Interconnection Study has been awarded to Power Planners International for completing the Load Flow, Stability, Dynamic Analysis and Transient Stability tests.

The project site is near Chab village, approximately 30 km from Jhand City. It is located at 33°12'48.53"N 71°51'14.52"E at an altitude of 238 meters having a distance of approximately 150 km from Islamabad.

The Project site consists of approximately 70 acres of land. The site selected for the project is generally flat, with a minor slope towards the southeast, with the slope increasing towards the southern end of the site boundary.

The Project shall have an installed capacity of 20 MWp. The scheme of interconnection with IESCO grid has been determined in the Grid interconnection studies.

PROJECT AT A GLANCE

Particulars	**Descriptions**
Project site	Village-Chab
Tehsil	Jhand
District Name	Attock
Name of the Province	Punjab
Latitude:	33°12'48.53"N

Longitude:	71°51'14.52"E
Road Accessibility:	Asphalt Motor able road is attached to the Site. Motor able Asphalt road is 2.1 km away from the site.
Nearest airport:	120 KM of Islamabad International
Nearest City:	Attock – 30 km
Land available:	70-75 Acre.
Water Requirement:	Low Level
Daily Global Solar Irradiance	4.75 kWh/m^2
Daily Diffuse Solar Irradiance	2.08 kWh/m^2
Annual Global Solar Irradiance	1747 kWh/m^2
Annual Diffuse Solar Irradiance Land availability Type of system	761 kWh/m2 70 Acre Single Axis (30 degree)
Type of PV modules	Mono crystalline
Proposed capacity	20 MW
Capacity of each module proposed	430 Wp / any other compatible size
Model of solar PV module	LR4-72HPH-430M
Total number of PV Modules	46,536
Inverter Model	TC2500KF
Annual electricity supplied to grid	35,357 MWh
Plant load factor (%)-First Year	20.01%
Project Cost	Rs. 1,884,000,000

PROJECT OBJECTIVE

The overall objectives of the project are;

- Production of cheap, affordable and green energy through Solar Power and provision of that electricity to Bulk Power Consumer at rebated price.
- By using indigenous renewable resources of power generation, avoid depletion of natural resources for future generation and environmental stability.
- Employment generation for local skilled and unskilled labor during construction and operation of the Project.
- Improve 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.

- Improve the local physical infrastructure such as roads and transmission network in the project area.

OBJECTIVE OF IEE STUDY

The objective of Initial Environmental Examination (IEE) is to prepare a document based on anticipated Environmental Impact due to setting up of 20 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 project due to limited adverse social or environmental impacts and these are limited to site-specific, largely reversible and readily addressed through mitigation measures.

B. PROJECT DESCRIPTION

The plot size for the proposed project site is approximately 70 acres. The site is located at approximately 150 KM, south of Islamabad city. The route to access the site from Islamabad starts from the Islamabad-Fatehjang road, which connects to Attock road and then goes all the way to Tehsil Jhand. The route continues along Attock-Khushalgarh road to Khushalgarh city. There are two roads at Khushalgarh, one goes towards Kohat at right side and other goes to Village Chab on the left side. For our project we take the left road and travel for another 25 KM from this bypass. After 25 KM, Village Chab comes on the main road. 2 KM to the left of this road, is the Lakkarmar 132 kV Grid station. This Grid station is proposed for power evacuation. The access road is fully black bituminous and accessible.

ROAD ACCESS

The route to access the site from Islamabad starts from the Motorway M-1 at Tarnol exit. This exit then connects with Fatehjang at approximately 2.5 KM from Tarnol exit. With this entry into Fatehjhang, District Attock starts. 25 KM on this Fatehjhang-Attock road, a three way diversion comes. The left route goes to Pindigheb, the middle one goes to main Attock city and the right one goes to Kohat. We shall continue along the Kohat route. After another 40 KM, another two way diversion comes where the right one enters KPK Province to Kohat and the left continues in Punjab up-till Village Chab and forward. We shall continue towards Village Chab. The project site is located right in the start in Village Chab on the main road.

PROJECT JUSTIFICATION

Pakistan's major electricity sources are thermal and hydro generation, meeting approximately 68% and 24% (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. With each passing month, tariffs are getting higher and higher for Industrial, Commercial and Household user. Therefore it is becoming very imminent to think about cheap, affordable and clean sources of energy

C. LEGAL POLICIES & INSTITUTIONAL FRAMEWORK

This chapter describes the relevant:

i. national and international policies;

ii. legal and administrative framework; and

iii. 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 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 environment. Pakistan Environment Protection Agency was established in 1984. No significant environmental policy, guidelines and regulations were made till 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

The most important Pakistani environmental legislation is the PEPA, 1997 and the PIEE-EIA Regulations, 2000. After devolution through the 18th Constitutional Amendment 2010, the provinces have sole authority and responsibility to legislate on 'environment and ecology'.

In this respect Punjab Environmental Protection Agency (Amended), enforced in 2012, and IEE/ EIA Regulations 2000, issued by Pakistan Environmental Protection Agency (PAK-EPA) and adopted by the EPA Punjab are the relevant environmental act and regulations that will apply to this Project. Under the Act, all decisions made under PEPA, 1997 are protected and applicable. Hence the environmental approval and conditions of approval which were conferred before the enforcement of this Act are fully valid and applicable and refer to the same regulations for determining whether projects require an IEE or an EIA.

PUNJAB ENVIRONMENTAL PROTECTION (AMENDMENT) ACT, 2012

Section 12 of the Punjab Environmental Protection (Amendment) Act 2012 makes it mandatory for the proponent of a project to file with the Environmental Protection Agency either an Environmental Impact Assesment (EIA) or Initial Environmental Examination (IEE), as the case may be, in respect of the project.

As per definition given in the Punjab Environmental Protection (Amendment) Act 2012, Environmental Impact Assessment (EIA) means an environmental study comprising collection of data, prediction of qualitative and quantitative impacts, comparison of alternatives, evaluation of preventive, mitigatory, and compensatory measures, formulation of environmental management & training plans & monitoring arrangements, and framing of recommendations and such other components as may be prescribed. The provision of Section 12 has been incorporated "as it is" in the new Punjab Environmental Protection (Amendment) Act, 2012. The IEE means Initial Environmental Examination. No proponent of a project shall commence construction and operation unless he has filed with the 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 Agency, environmental approval in respect thereof.

NATIONAL ENVIRONMENTAL POLICY 2005

Government of Pakistan has notified National Environmental Policy 2005, for different projects/aspects in which guidelines/priorities have been given to undertake/commence the projects having significant environmental impacts.

The National Environmental Policy (2005) provides a framework for addressing the environmental issues (particularly pollution of fresh water bodies and coastal waters, air pollution, lack of proper waste management, deforestation, loss of bio diversity, desertification etc.) confronting Pakistan. It recognizes the goals and objectives of the Pakistan National Conservation Strategy (PNCS, 1992), National Environmental Action Plans, and other existing environment related national policies, strategies, and action plans. It also provides broad guidelines to the Federal Government, Provincial Governments, federally administrated territories and local governments to address their environmental concerns and to ensure effective management of their environmental resources.

REVIEW OF IEE/EIA REGULATIONS

The Pak EPA has issued Review of the Initial Environmental Examination and Environmental Impact Assessment Regulations 2000, to review the Initial Environmental Examination (IEE) / Environment Impact Assessment (EIA) reports. Categorization of the projects for IEE and EIA is one of the main components of the Regulations. Projects have been classified on the basis of expected degree of adverse environmental impacts. Projects type listed in Schedule I are designated as potentially less adverse effect, schedule I projects require an IEE and projects given in schedule II require EIA to be conducted.

Salient features of the Regulations are listed below:

- Categories of project requiring IEE and EIA are issued through two schedules attached with the regulations.
- A fee depending on the cost of the project has been imposed for the review of IEE and EIA.
- The submittal is to be accompanied by an application in prescribed format included as Schedule IV of the Regulation.
- The EPA is required to issue conformation of compliance within 15 days of receipt of request and complete documentation.
- The IEE / EIA approval for construction of the project will be valid for three years from date of accord.

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 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 provincial level.

GUIDELINES FOR THE PREPARATION OF IEE/EIA REPORT

The Pak EPA has also framed Guidelines for the Preparation of IEE / EIA of projects in various developmental sectors.

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 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 confirmation of compliance within 15 days of the receipt of request and complete documentation.
- The EIA approval is valid for three years from the date of accord.

PUNJAB LOCAL GOVERNMENT ORDINANCE, 2001

Schedules 4 and 8 of this Ordinance pertain to environmental pollution. There are not withstanding any specific provisions, every local government may perform functions conferred by or under the Punjab Local Government Ordinance, 2001, and in performance of such functions may exercise such powers, which are necessary and appropriate. Under the ordinance, the local councils are authorized

to restrict projects causing pollution to air, water or land. They may also initiate schemes for improving the environment.

PAKISTAN PENAL CODE, 1860

This defines the penalties for violations concerning pollution of air, water bodies and land. Sections 272 and 273 of this Act deal with the adulteration of food or drink. Noise pollution has been covered in section 268, which defines and recognizes noise as a public nuisance. "A person is guilty of a public nuisance who does any act or is guilty of an illegal omission which causes any common injury, danger of annoyance to the public or the people in general who dwell or occupy property in the vicinity, or which must necessarily cause injury, obstruction, danger or annoyance to persons who may have occasion to use any public right".

THE LAND ACQUISITION ACT, 1860

The Land Acquisition Act (1894) deals with the acquisition of private properties for public purposes. There are 55 sections in this Act mainly dealing with area notification, surveys, acquisition, compensation, apportionment awards, disputes resolution, penalties and exemptions. Although quite old, this act laid out the legal basis for any property affected by a project and for compensating the effected owners of the land.

FACTORIES ACT, 1934

The clauses relevant to the project are those that concern the health, safety, and welfare of workers, disposal of solid waste and effluent and damage to private and public property. The Factories Act also provides regulations for handling and disposal of toxic and hazardous materials. Given that construction activity is classified as 'industry', these regulations will be applicable to the project contractors.

LABOR LAWS

Construction and operational activities during the course of construction may affect occupational health of workers. Employers are required to abide by labor laws in respect of their own employees and also to ensure that contractors to follow the relevant labor laws and rules relating to safety of the workforce and creating a healthy working environment. The proponents shall ensure that the labor force engaged at the project site is not exposed to any danger by monitoring the contractor's work frequently.

D. EXISTING ENVIRONMENTAL & SOCIAL CONDITION

GENERAL

Attock situated on the left bank of the River Indus is the divisional headquarters of the northern districts of Punjab. It borders KPK and the region is called Potohar. Total area of Attock district is 6,857 (sq km), with population density of 275 persons per sq km. While the total population of Attock district is 1,883,556 in 2017-18.

STUDY AREA

An area with in 2 km around the project can be considered as influence zone and hence it has been taken as study area to understand even setting 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.

SOIL

The results (Table 2) showed that 21.15 percent soils in Attock district were sandy loam and 78.70 percent soils were loam in texture. Heavy textured soils (clay loam) were noticed at few sites (0.15 %). In tehsil Attock, 11.92 percent soils are sandy loam and 87.78 percent soils are loam. In tehsils Fateh Jang and Hassan Abdal, 99.93 and 99.40 percent soils are loam, respectively. In Pindi Gheb, 32.50 percent soils were sandy loam and 67.31 percent soils were loam. In tehsil Jand, 49.17 percent soils were sandy loam while 50.83 percent soils were loam. This shows that soils are quite heterogeneous and variable in texture. Regarding ranges (Table 3a & b), minimum saturation percentage (18%) appeared in tehsil Jand while maximum (86 %) was found in tehsil Attock.

LAND USE

The proposed project area is privately owned and is barren in nature. There are few shrub thickets near the project site. There are no settlements near 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 porous comprising of more of gravel and less silt and clay content. There are some sand dunes in small area. Overall the area is plain with gentle slope.

E. ENVIROMENTAL AND SOCIAL IMPACTS AND MITIGATION MEASURES

The proposed project may have 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.

The environmental impact during 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.

Identification Of Activities & Probable Impacts (Construction Phase)		
Construction Activities	**Environment Attribute**	**Probable Impacts**
Land Acquisition	Land	✓ No significant impact on land-use is expected.
	Socio-economics	✓ 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	✓ Run-off from construction area
	Land	✓ Loss of top soil
	Ecology	✓ Minimal loss of vegetation / habitat as the site is 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	✓ Run-off from Construction Areas
Mech. and Elec. Erection Activities	Air	✓ Air Emissions from Machines / activities
Influx of Labour and construction of temporary houses	Socio-economics	✓ Employment opportunities shall increase ✓ tress on infrastructure
	Land	✓ Change in land use pattern of the area
	Water	✓ Sanitary effluents from labour 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
Transportation and Disposal of Construction Debris	Water	✓ Run-off from Disposal Areas
	Soil	✓ No Conversion of land into waste land as already barren land.

F. ENVIRONMENTAL & SOCIAL MANAGEMENT PLAN

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. 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 AND SOCIAL MANAGEMENT PROCESS

The ESMP has been designed within the framework of requirement under Pakistan's 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

G. CONSULTATION, PARTICIPATION AND DISCLOSURE

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. .

H. 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 sub-projects 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 correction in work practices at the construction sites, or through the careful selection of sites and access routes.

The proposed project will have 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 generation of direct and indirect employment opportunities.
- There is 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 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 owner of project to cover the environmental mitigation and monitoring requirements, and their associated costs.

CONCLUSION

An environment and social analysis has 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 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 construction phase and can be mitigated through a set of recommended measures and adequate provision for 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.

1 INTRODUCTION

20 MW AB Solar Park, is initiative of AASAL Solar Power (Pvt.) Ltd which owns another 49.5 MW Solar Power Project in D.I.Khan, KPK. The 49.5 MW Solar Power Project is one of the first ever Solar IPP of Khyber Pakhtunkhwa Province. The 20 MW AB Solar Park is based on the concept of Captive/Wheeling Power Plant. Pakistan has many Captive Power Projects now, however a project specifically designed on Wheeling basis, will be the first of its kind. The concept is as follows; to produce electricity at project site in District Attock, input it at Lakkarmar 132 kV Grid Station, wheel it via IESCO network to main Islamabad city and take the output from I-9 132 kV Grid Station. In this case, AB Solar Park shall be the Power Generation Company, IESCO shall be the wheeler of electricity and Bulk Power Consumers shall be the Power Purchasers. The project is based on the SRO. 549(I)/2016 dated June 13, 2016, "NEPRA (Wheeling of Electric Power) Regulations, 2016. Lakkarmar 132 kV Grid Station of IESCO has been shortlisted as the respective Grid Station as per NEPRA Grid Code, through which the electricity shall be injected into the IESCO network. Grid Interconnection Study has been awarded to Power Planners International for completing the Load Flow, Stability, Dynamic Analysis and Transient Stability tests.

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The Project shall have an installed capacity of 20 MWp. The scheme of interconnection with IESCO grid has been determined in the Grid interconnection studies.

1.1 THE PROJECT

PROJECT AT A GLANCE

Particulars	Descriptions
Project site	Village-Chab
Tehsil	Jhand
District Name	Attock
Name of the Province	Punjab
Latitude:	33°12'48.53"N
Longitude:	71°51'14.52"E

Road Accessibility:	Asphalt Motor able road is attached to the Site. Motor able Asphalt road is 2.1 km away from the site.
Nearest airport:	120 KM of Islamabad International
Nearest City:	Attock – 30 km
Land available:	70-75 Acre.
Water Requirement:	Low Level
Daily Global Solar Irradiance	4.75 kWh/m^2
Daily Diffuse Solar Irradiance	2.08 kWh/m^2
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Type of PV modules	Mono crystalline LID Half Cut 144 Cells
Proposed capacity	20 MW
Capacity of each module proposed	430 Wp / any other compatible size
Model of solar PV module	LR4-72HPH-430M
Total number of PV Modules	46,536
Inverter Model	TC2500KF
Annual electricity supplied to grid	35,357 MWh
Plant load factor (%)-First Year	20.01%
Project Cost	Rs. 1,884,000,000

The project is located near Chab village, about 20-25 km from Jhand town in Jhand Tehsil, Attock District. The project has assessed 70 acres of land in Moza Chab. The project shall be developed as an Independent Power Producer "IPP", to be connected with the Islamabad Electric Supply Company "IESCO" at 132 kV grid connection at Lakkarmar, which is 2 KM away from the project site. Sale of the Power shall be made to the Bulk Power Consumer and this is going to be first ever Wheeling Power Project for Punjab Province based on Solar Power.

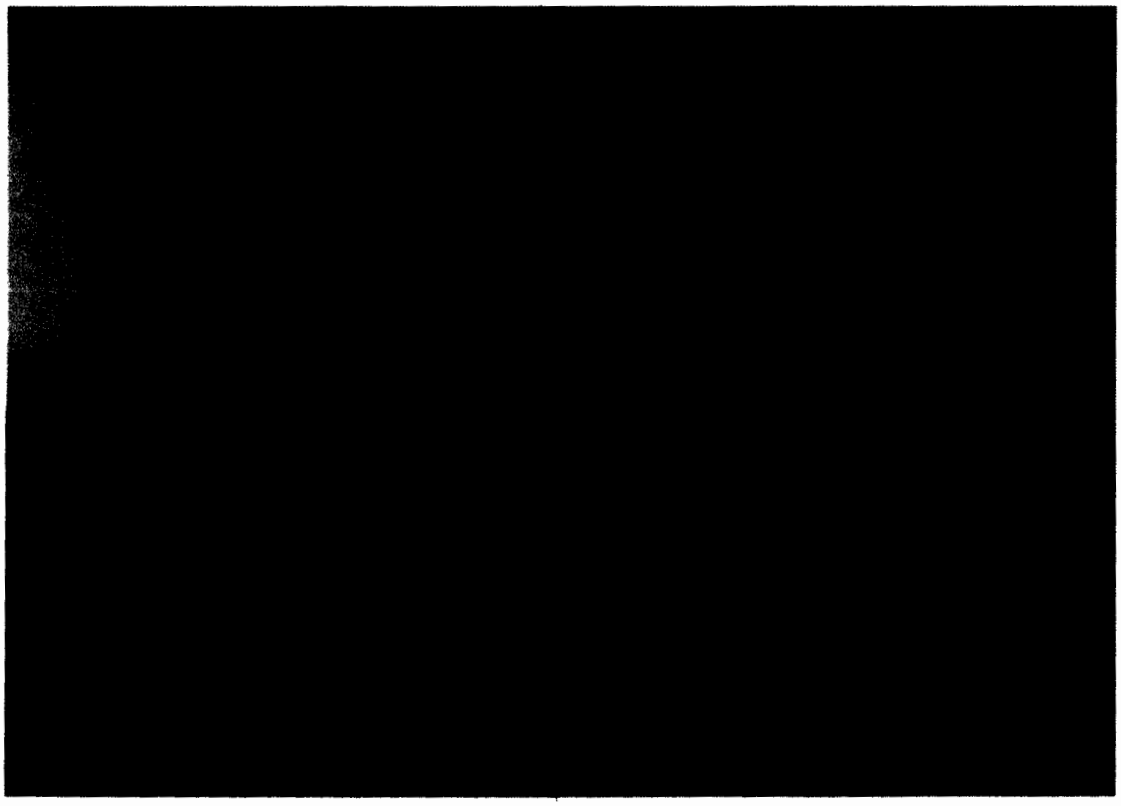

Figure: Project Area

Following are key features of proposed "20 MW AB Solar Park" project:

- The location falls under the 'Hot and Dry' climatic zone of the area and comprises extreme weather conditions of hot desert.
- The project location comprises well accessibility as the motorable/jeepable asphalt road is 2 km away from the Grid.
- There are no shading elements like mountains, large sand dunes, trees available on the site. Entire area is shadow free.
- NHA is located on 4 km from selected project location. After 4 km the road links with newly asphalt road from Jhand to Talagang.
- Nearest Airport is in Islamabad which is about 120 km from the projected location.
- Nearest City to the site is Fatehjhang and Jhand which is 70 km and 20 km away respectively from the project location.
- Khushalgarh is the nearest railway station from the location which is 25 km away from the project location. However railway is not the most used-for transport system in that part of the province
- Soil condition at site is hard sandy and surface is almost flat; hence limited land work is needed to make land flat as per the requirements of solar PV power

plant.

- Two Grid stations are nearby from the project site. One is Lakkarmar 132 KV Grid station, which is 2 km from project location, second is Jhand 132 KV Grid Station, which is 20 km away from project location. AB Solar Park shall be doing the power evacuation in the Lakkarmar 132 KV Grid station.

1.2 PROJECT JUSTIFICATION

Pakistan's major electricity sources are thermal and hydro generation, meeting approximately 65.5% 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

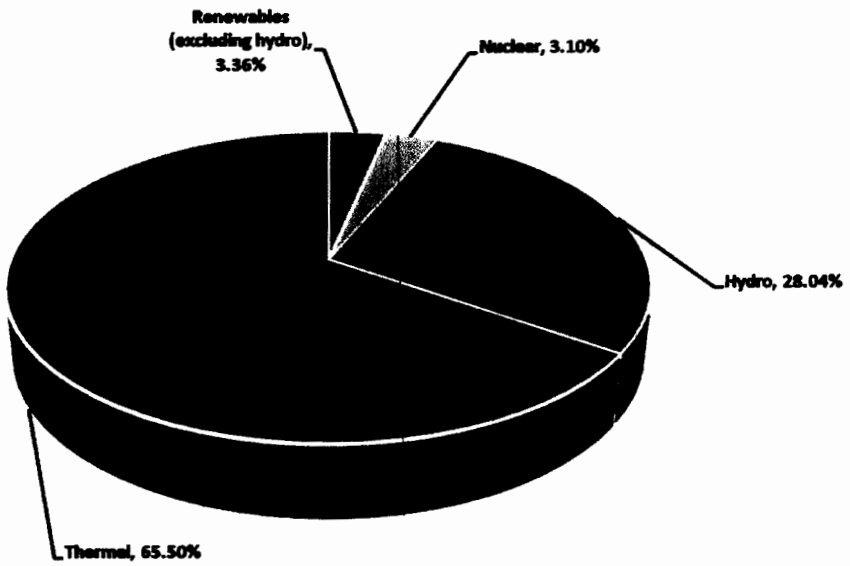

Figure: Electricity Mix of Pakistan

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 hydro-electric power, or other renewable sources, such as 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 hydro-electric 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 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 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.

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 environmental 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.

1.2.1 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 being 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 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 insolation of 19 to 20 MJ/sqm per day with 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 average sun shine hours of 8-10 per day. This gives 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 USA shown in Figure 2-2.

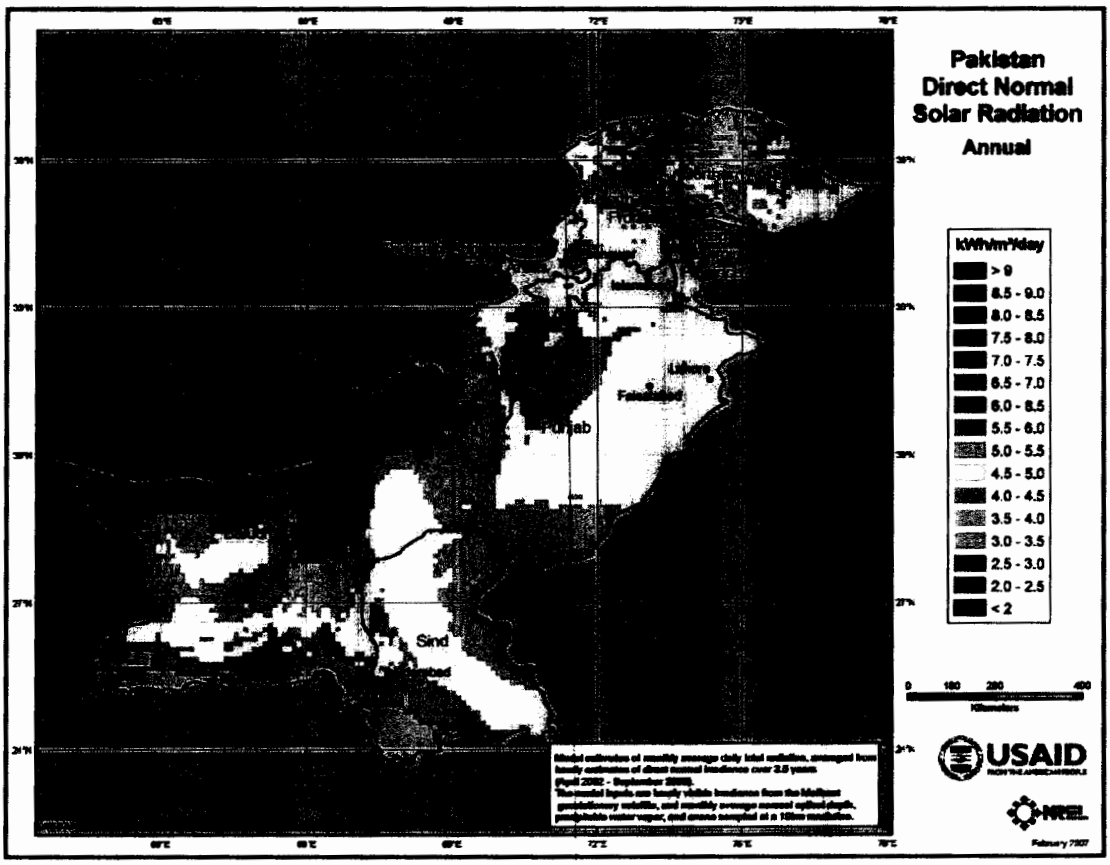

Figure: NREL Solar Map of Pakistan[1]

1.3 PROJECT OBJECTIVES

The overall objectives of the project are;

- Provision of much-needed electricity to the National Grid and to the Bulk Power Consumer.
- By using indigenous renewable resources of power generation, avoid depletion

[1] [2] http://www.nrel.gov/international/ra_pakistan.html

of natural resources for future generation and environmental stability.

- Employment generation for local skilled and unskilled labor during construction and operation of the Project.
- Improve 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.
- Improve the local physical infrastructure such as roads and transmission network in the project area.

1.4 OBJECTIVE OF INITIAL ENVIRONMENTAL EXAMINATION STUDY

This report has been prepared to meet the following key requirement of Punjab-EPA:

Complying with the Section 12 of Punjab Environmental Protection (Amendment) Act, 2012, which makes it mandatory for the proponent of a project to file with the Environmental Protection Agency either an Environmental Impact Assessment (EIA) or Initial Environmental Examination (IEE), as the case may be, in respect of the project.

As per definition given in the Punjab Environmental Protection (Amendment) Act 2012, Environmental Impact Assessment (EIA) means an environmental study comprising collection of data, prediction of qualitative and quantitative impacts, comparison of alternatives, evaluation of preventive, mitigatory, and compensatory measures, formulation of environmental management & training plans & monitoring arrangements, and framing of recommendations and such other components as may be prescribed. The provision of Section 12 has been incorporated "as it is" in the new Punjab Environmental Protection (Amendment) Act, 2012.

Pakistan Environmental Protection Act 1997 (PEPA 1997) requires the proponents of every development project in the country to submit and get approved 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 proposed project is less than 200 MW, therefore IEE study is performed. Also in 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.

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
- Socio-economic impacts; Land use: Land acquisition; Involuntary resettlement
- Impacts on indigenous peoples and communities; if applicable
- Cumulative impacts of existing, proposed and anticipated future projects
- Pollution prevention and waste minimization, pollution controls (liquid effluent and air emissions) and solid and chemical waste management.
- GHG reduction potential.

1.5 PROJECT CATEGORY

Pakistan Environment Protection Act:

In Pakistan, under the Pakistan Environmental Protection Act, 1997 (PEPA, 1997), the Pakistan Environmental Protection Agency Review of Initial Environmental Examination and Environmental Impact Assessment Regulations (IEE-EIA Regulations 2000) provide the pertinent project categorization. The IEE-EIA Regulations 2000 are silent on solar power plants specifically; these are included neither in Schedule I nor in Schedule II of the regulations. In addition, the same regulations also state that irrespective of the nature or size of the project, a project located in an environmentally sensitive area—areas protected under wildlife laws, areas near cultural heritage sites and ecological sensitive areas—require an EIA.

For the purpose of the proposed Project, the environmental assessment study recommended is an initial environmental examination (IEE). This is because the proposed Project is not located in an environmentally sensitive area and the fact that the expected impacts from the Project will most likely be site-specific; few, if any of them, will be irreversible; and the proposed mitigation measures are expected to have a high rate of effectiveness.

International Finance Corporation:

IFC employs an environmental and social categorization scheme to appropriately reflect the magnitude of potential risks and impacts. Projects are assigned category A, B or C, in descending order of environmental and social sensitivity.[2]

These categories are:

Category A: Business activities with potential significant adverse environmental or social risks and/or impacts that are diverse, irreversible, or unprecedented.

Category B: Business activities with potential limited adverse environmental or social risks and/or impacts that are few in number, generally site-specific, largely reversible, and readily addressed through mitigation measures.

Category C: Business activities with minimal or no adverse environmental or social risks and/or impacts.

Based on environmental and social review summaries and project information for solar power projects available on the IFC website, solar power projects are categorized as Category B projects. The projects were assigned this category because of the limited number of specific associated environmental and social impacts,

[2] *Policy on Environmental and Social Sustainability*. January 2012, International Finance Corporation (IFC). www.ifc.org/wps/wcm/connect/7540778049a792dcb87efaa8c6a8312a/SP_English_2012.pdf?MOD=AJPERES (accessed: June 2, 2017)

which can be avoided or mitigated by adhering to the generally recognized IFC performance standards, guidelines or design criteria.

1.6 STRUCTURE OF REPORT

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

2.	Legal Policies and Institutional Framework	Complete review of the applicable legal, regulatory and policy instruments
3.	Project Description	Technical features of the project
4.	Baseline Status	Environmental and Socioeconomic baselines
5.	Environmental Impacts and Mitigation Measures	Assessed impacts on physical, biological and socioeconomic environment along with their mitigation measures
6.	Environmental Management Plan	Implementation and Monitoring of the mitigation measures
7.	Public Consultation	Conduction and Outcomes of public consultation
8.	Conclusion and Recommendations	Findings and Recommendation of the IEE Study

1.7 IMPLEMENTATION OF THE PROJECT

Client	*AB Solar Park (Pvt.) Ltd.*
Environment Consultant	*AB Solar Park (Pvt.) Ltd - (in-house)*
Technical Consultant	*AB Solar Park (Pvt.) Ltd - (in-house)*
Financial Expert	*AB Solar Park (Pvt.) Ltd - (in-house)*
Legal Advisor	*Kundi & Kundi Legal Associates*

1.8 CONTACT DETAILS

- **AGENCY**

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Environment Protection Agency
Gate No. 8, National Hockey Stadium, Gaddafi Stadium,
Ferozepur Road, Lahore
Contact: 042-99232230, Fax: 042-99232278
Email: dg.epa@punjab.gov.pk

- **PROPONENT**

Name
Abdul Basit Javed - CEO
AB Solar Park (Pvt.) Ltd.
Address: Office 28, Street 2, Sector E-11/1, MPCHS, Islamabad
Contact: 051-8734203

2 LEGAL POLICIES AND INSTITUTIONAL FRAMEWORK

The development of statutory and other instruments for environmental protection & management has steadily gained priority in Pakistan since the late 1970s. The Pakistan Environmental Protection Ordinance, 1983 was the first piece of legislation of its kind designed specifically for the protection of the environment. The promulgation of this ordinance was followed, in 1984, by the establishment of the Pakistan Environmental Protection Agency (Pak-EPA), the primary State institution dealing with environmental issues. Significant work on developing environmental policy was carried out in the late 1980s, which culminated in the drafting of the Pakistan National Conservation Strategy.

Establishment of Pak-EPA was followed by the establishment of Provincial EPAs at about the same time. The National Environmental Quality Standards (NEQSs) were established in 1993. The enactment of the Pakistan Environmental Protection Act (PEPA) 1997 conferred broad-based enforcement powers to the environmental protection agencies. The publication of the Pakistan Environmental Protection Agency Review of Initial Environmental Examination and Environmental Impact Assessment Regulations (IEE-EIA Regulations) 2000 provided the necessary details on the preparation, submission, and review of initial environmental examinations (IEE) and environmental impact assessments (EIA). In addition to the PEPA 1997, Pakistan's statute books contain a number of other laws that have clauses concerning the regulation and protection of the environment.

Similar statutory developments took place in AJ&K in 90s as well on the same line and sequence as happened in Pakistan but apparently independently given to its unique political status. The Azad Jammu & Kashmir Environmental Protection Act was promulgated in 2000 whereas, the review of IEE and EIA Regulations were enacted in 2009.

This section summarizes the applicable regulatory and institutional framework applicable to this Project for protection of the environment with specific focus on hydropower projects. This includes the Strategies, Policies, Laws, Regulations and Standards applicable to Project construction and operations.

2.1 NATIONAL ENVIRONMENTAL LAWS

The most important Pakistani environmental legislation is the PEPA, 1997 and the PIEE-EIA Regulations, 2000. After devolution through the 18th Constitutional Amendment 2010, the provinces have sole authority and responsibility to legislate on 'environment and ecology'.

In this respect Punjab Environmental Protection (Amendment) Act, enforced in 2012, is the relevant environmental act that will apply to this Project. Under the Act,

all decisions made under PEPA, 1997 are protected and applicable (Section 40(2)). Hence the environmental approval and conditions of approval which were conferred before the enforcement of this Act are fully valid and applicable and refer to the same regulations for determining whether projects require an IEE or an EIA.

2.2 PUNJAB ENVIRONMENTAL PROTECTION (AMENDMENT) ACT, 2012

The Punjab Act, 2012 is applicable to a broad range of issues and extends to air, water, industrial liquid effluent, and noise pollution, as well as to the handling of hazardous wastes. The articles of Punjab Act, 2012 that have a direct bearing on the proposed Project are listed below and discussed further in the following sections:

- Article 11 deals with the Punjab Environmental Quality Standards and their application.
- Article 11 deals with discharges, emissions and waste disposal
    i. *no person shall discharge or emit or allow the discharge or emission of any effluent or wastes or air pollutant or noise, load, concentration or level which is in excess of the Punjab Environmental Quality Standards or, where applicable, the standards established under sub clause (l) of clause (g) of sub-section (1) of section 6; and*
    ii. *no person shall discharge effluents, emissions or wastes in excess of load permitted in the conditions of environmental permit or environmental approval or license.*
- Article 12 deals with the IEE and EIA review and approval process

    "No proponent of a project shall commence construction and operation unless he has filed with the 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 Agency, environmental approval in respect thereof."
- Article 13 deals with Prohibition of Import of hazardous waste

    "No person shall carry, import, bring, transport or deliver hazardous waste or cause to carry, import, bring, transport or delivery of hazardous waste into the territorial jurisdiction of the Province of the Punjab."
- Article 14 provides rules for handling of hazardous substances

    "Subject to the provisions of this Act, no person shall generate, collect, consign, transport, treat, dispose of, store, handle, deal in and use or import any hazardous substance except---

    (a) under a license issued by the Agency and in such manner as may be prescribed; or

    (b) in accordance with the provisions of any other law for the time being in force, or of any International Treaty, Convention, Protocol, Code, Standard, Agreement or

other instrument to which Pakistan or the Province of the Punjab is a party."

- Article 15 relates to regulation of motor vehicles
- Article 16 relates to Environmental Protection Order

2.3 PUNJAB & NATIONAL ENVIRONMENTAL QUALITY STANDARDS

Punjab-EPA has formulated Punjab Environmental Quality Standards (PunjabEQS), as per clause (c) of sub-section (1) of section 4 of Punjab Environmental Protection Act, 1997. PunjabEQS has made the following Standards

- Muncipal and Liquid Industrial Effluents
- Drinking Water
- Motor Vehicle Exhaust and Noise
- Ambient Air
- Noise
- Treatment of Liquid and Disposal of Bio-medical Waste
- Industrial Gaseous Emission

The National Environmental Quality Standards (NEQS), Article 11(1) of the PEPA, 1997 states that:

> *"Subject to the provisions of this Act and the rules and regulations made thereunder, no person shall discharge or emit or allow the discharge or emission of any effluent or waste or air pollutant or noise in an amount, concentration or level which is in excess of the NEQS."*

NEQS have been established for gaseous emission, liquid effluent, ambient air quality, noise and drinking water. From the date of enforcement of the NEQS, all projects, whether in operation on the date or constructed later, are required to comply with these standards.

2.4 REVIEW OF IEE/EIA REGULATION, 2000

The Pakistan Environment Protection Agency Review of IEE and EIA Regulations provide the necessary details on 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 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 confirmation of compliance within 15 days of the receipt of request and complete documentation.
- The EIA approval is valid for three years from the date of accord.

2.5 Other Environmental Laws

Punjab Local Government Ordinance, 2001

Schedules 4 and 8 of this Ordinance pertain to environmental pollution. There are not withstanding any specific provisions, every local government may perform functions conferred by or under the Punjab Local Government Ordinance, 2001, and in performance of such functions may exercise such powers, which are necessary and appropriate. Under the ordinance, the local councils are authorized to restrict projects causing pollution to air, water or land. They may also initiate schemes for improving the environment.

PAKISTAN PENAL CODE, 1860

This defines the penalties for violations concerning pollution of air, water bodies and land. Sections 272 and 273 of this Act deal with the adulteration of food or drink. Noise pollution has been covered in section 268, which defines and recognizes noise as a public nuisance. "A person is guilty of a public nuisance who does any act or is guilty of an illegal omission which causes any common injury, danger of annoyance to the public or the people in general who dwell or occupy property in the vicinity, or which must necessarily cause injury, obstruction, danger or annoyance to persons who may have occasion to use any public right".

THE LAND ACQUISITION ACT, 1860

The Land Acquisition Act (1894) deals with the acquisition of private properties for public purposes. There are 55 sections in this Act mainly dealing with area notification, surveys, acquisition, compensation, apportionment awards, disputes resolution, penalties and exemptions. Although quite old, this act laid out the legal basis for any property affected by a project and for compensating the effected owners of the land.

FACTORIES ACT, 1934

The clauses relevant to the project are those that concern the health, safety, and welfare of workers, disposal of solid waste and effluent and damage to private and public property. The Factories Act also provides regulations for handling and disposal of toxic and hazardous materials. Given that construction activity is classified as 'industry', these regulations will be applicable to the project contractors.

LABOR LAWS

Construction and operational activities during the course of construction may affect occupational health of workers. Employers are required to abide by labor laws in respect of their own employees and also to ensure that contractors to follow the relevant labor laws and rules relating to safety of the workforce and creating a healthy working environment. The proponents shall ensure that the labor force engaged at the project site is not exposed to any danger by monitoring the contractor's work frequently.

WILDLIFE PROTECTION, PRESERVATION, CONSERVATIONAL AND MANAGEMENT ACT, 1975

This law was enacted to protect the province's wildlife resources directly and other natural habitats indirectly. It classifies wildlife by degree of protection, i.e., animals that may be hunted on a permit or special license, and species that are protected and cannot be hunted under any circumstances. The Act specifies restrictions on hunting and trade in animals, trophies, or parts. The Act also defines various categories of wildlife-protected areas, i.e., National Parks, Wildlife Sanctuaries, and Game Reserves.

Applicability: The Project area does not include any protected wildlife species; therefore, this law is not relevant to the Project.

2.6 INSTITUTIONS RELATED TO PROTECTION OF ENVIRONMENT AND ENVIRONMENT BASED RESOURCES

The basic responsibility for protecting & conserving environment, control of pollution and to ensure that the proposed project will be implemented on the basis of fundamental principles of sustainable development lies with Punjab-EPA. However, the Wildlife & Fisheries aspects primarily supposed to be managed and regulated by Punjab Wildlife and Fisheries Department. To ensure that the proposed project execution will not disturb or destroy forests and forest based ecological resources and biodiversity, Forest Department holds the mandate. The project proponent, contractor and environmental management committee or cell will to ensure close coordination with these departments and agencies.

2.6.1 PUNJAB-ENVIRONMENT PROTECTION AGENCY

The functions of the Agency are:

- administer and implement the provisions of this Act and the rules made thereunder;
- prepare, in co-ordination with the appropriate Government Agency or local council and in consultation with the concerned sectorial Advisory Committees where established, environmental policies for the approval of the Council;
- take all necessary measures for the implementation of the environmental policies approved by the Council;
- prepare and publish an annual Environmental Report on the state of the environment in the Province;
- prepare, revise Punjab Environmental Quality Standards with the approval of the Council:

  Provided that before seeking approval of the Council, the Agency shall publish the proposed Punjab Environmental Quality Standards for public opinion in

accordance with the prescribed procedure;

- ensure enforcement of the Punjab Environmental Quality Standards;
- establish standards for the quality of the ambient air, water and land, by notification;
- establish different standards for discharge or emission from different sources and for different areas and conditions as may be necessary:
- co-ordinate with other Provinces, Federal Government, National and International Organizations for the implementation of environmental policies, issues concerns and programmes as may be prescribed;
- co-ordinate and facilitate the Government departments, agencies, organizations and institutions in the Punjab in adaptation to address the impacts of climate change;
- establish systems and procedures for surveys, surveillance, monitoring, measurement, examination, investigation, research, inspection and audit to prevent and control pollution, and to estimate the costs of cleaning up pollution and rehabilitating the environment in various sectors;
- take or cause to be taken all necessary measures for the protection, conservation, rehabilitation and improvement of the environment, prevention and control of pollution and promotion of sustainable development;

2.6.2 ENVIRONMENT PROTECTION COUNCIL

The Council Shall:

- co-ordinate, supervise and support enforcement of the provisions of this Act and the rules made thereunder;
- approve comprehensive environmental policies, action plans and ensure their implementation;
- approve the Punjab Environmental Quality Standards;
- liaise and co-ordinate with other Provinces and Federal Government, through appropriate inter-provincial forums, or Government Agency regarding formulation and implementation of standards and policies relating to environmental matters with an inter-provincial impact;
- co-ordinate integration of the principles and concerns of sustainable development into development plans and policies at the provincial, district and local levels by formulating / prepare district and provincial conservation strategies;
- consider the Provincial Environment Report and give appropriate directions, thereon; and
- formulate a mechanism for implementation of Multilateral Environmental

Agreements (MEAs) signed by the Government of Pakistan.

2.7 INTERNATIONAL LAW

International law pertinent to the environment and sustainable development comprises:

- customary international law, which is applicable to all states and results from general and consistent practice followed by states out of a sense of legal obligation;
- judicial decisions of international courts and tribunals, and the teachings of highly qualified publicists, including articles by eminent lawyers' decisions of the International Law Commission and other United Nations organizations, decisions of the conference of parties to a treaty and also decisions and directives of the European Union; and
- treaties (the term "treaty" encompasses "agreements, covenants, conventions, pacts, protocols, and statutes") that are generally intended to be implemented through enactment and enforcement of laws at national levels.

Several declarations profoundly influence accepted international approaches to environmental management and sustainable development. Declarations are generally not immediately legally binding, but can acquire the force of international customary law if they continue to express an international consensus which states adhere to over time. The key declaration that influences environmental management and sustainable development is the 1992 Declaration on Environment and Development (or "Rio Declaration). The Rio Declaration and Agenda 21, which were both products of the 1992 United Nations Conference on Environment and Development, effected the introduction and/or revision of environmental legislation in countries throughout the world resulting in the EIA process becoming established as a key tool for environmental decision making. According to the United Nations Environment Programme or UNEP (UNEP 2005), many of the Rio Declaration principles are acquiring the force of international customary law, including: transparency, public participation and access to information and remedies; precaution, prevention of environmental harm and polluter pays principles; and good governance.

Important international environmental treaties that have been signed by Pakistan and may have relevance to the Project are listed in Exhibit 2.3. They concern: climate change and depletion of the ozone layer; biological diversity and trade in wild flora and fauna; desertification; waste and pollution; and cultural heritage.

Exhibit 2.3: International Environmental Treaties Endorsed by Pakistan

Climate change and the ozone layer	United Nations Framework Convention on Climate Change - the primary objective is the stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system.	1992	1994
	Kyoto Protocol to the United Nations Framework Convention on Climate Change - enabled by the above Convention on Climate Change. It has more powerful and legally binding measures. It sets binding targets for 37 industrialized countries and the European community for reducing greenhouse gas emissions.	1997	2005
	Vienna Convention for the Protection of the Ozone Layer - acts as a framework for the international efforts to protect the ozone layer with a primary objective to protect human health and the environment against adverse effects resulting from human activities that modify or are likely to modify the ozone layer.	1985	1993
	The Montreal Protocol on Substances that Deplete Ozone Layer and associated amendments - enabled by the Vienna Convention, it is designed to protect the ozone layer by	1983	1993

	phasing out the production and consumption of a number of substances believed to be responsible for ozone depletion.		
Waste and pollution	Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal - regulates the transboundary movement of hazardous waste and other waste with a stated purpose to protect human health and the environment against the adverse effects from generation and management of hazardous waste and other waste. The Convention provides for three sets of measures with binding obligations. These are: Strict control of transboundary movement of hazardous waste; Environmentally sound management of hazardous waste; Enforcement and implementation of the provisions of the convention at international and national levels.	1989	1994
	International Convention on Oil Pollution Preparedness, Response and Co-operation	1990	1995
	Stockholm Convention on Persistent Organic Pollutants - seeks to protect human health and the environment from Persistent Organic Pollutants, which are chemicals that remain intact in the environment for long periods, become widely distributed geographically and accumulate in the fatty tissue of humans and wildlife.	2001	2008

Desertification	International Convention to Combat Desertification – with an objective to combat desertification and mitigate the effects of drought. It is supported by international cooperation and partnership arrangements, with the aim of achieving sustainable use of land and water resources and sustainable development in affected areas.	1994	1997
Biodiversity and the protection of plants and animals	Convention on Biological Diversity – covering ecosystems, species, and genetic resources and also the field of biotechnology. The objectives are: conserve of biological diversity; sustainable use of its components; and fair and equitable sharing of benefits arising from genetic resources.	1992	1994
	Cartagena Protocol on Biosafety to the Convention on Biological Diversity - addresses potential risks posed by living modified organisms resulting from modern biotechnology.	2000	2009
	Bonn Convention on the Conservation of Migratory Species of Wild Animals - aims to conserve terrestrial, marine and avian migratory species throughout their range. It is concerned with the conservation of wildlife and habitats on a global scale.	1979	1987
	Memorandum of Understanding concerning Conservation Measures for the Siberian Crane - parties undertake to	1998	1999

[redacted]

provide strict protection to Siberian Cranes, and identify and conserve wetland habitats essential for their survival.		
Convention on International Trade in Endangered Species of Wild Fauna and Flora - to ensure that international trade in specimens of wild animals and plants does not threaten their survival.	1973	1976
International Plant Protection Convention (1997 Revised Text) - to prevent the international spread of pests and plant diseases. It requires maintenance of lists of plant pests, tracking of pest outbreaks, and coordination of technical assistance between member nations.	1951/52	1954
Agreement for the Establishment of the Near East Plant Protection Organization - to establish the Near East Plant Protection Organization (NEPPO), which promotes international co-operation with a view to implementing International Plant Protection Convention.	1993	2009
Plant Protection Agreement for the Asia and Pacific Region and amendments – establishes the Asia and Pacific Plant Protection Commission to review and promote the region's progress in the implementation of the Agreement. Trade in plants and plant products are regulated by certification, prohibition, inspection, disinfection, quarantine, destruction,	1955 (amendment 1967)	1958 (amendment 1969)

[redacted]

	etc., as necessary.		
	Convention on Wetlands of International Importance especially as Waterfowl Habitat and associated protocols and amendments - to promote conservation and sustainable use of wetlands. The Ramsar List of Wetlands of International Importance now includes almost 1,800 sites (known as Ramsar Sites). There are currently 19 Ramsar sites in Pakistan.	1971 (amended 1987)	1976 (amended 1994)
Cultural heritage	Convention concerning the Protection of the World Cultural and Natural Heritage - requires parties to adapt a general policy on the protection of the natural and cultural heritage, to set up services for such protection, to develop scientific and technical studies, to take appropriate legal, technical, scientific and administrative measures and to foster training and education for such protection.	1972	1976

3 PROJECT DESCRIPTION

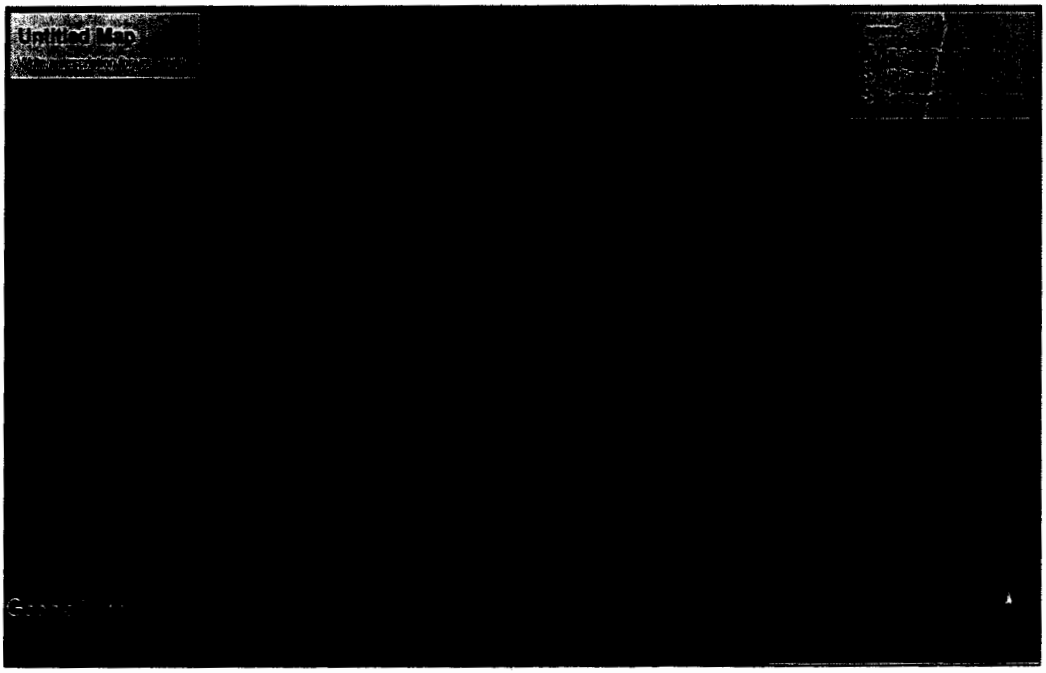
3.1 INTRODUCTION

20 MW AB Solar Park, is initiative of AASAL Solar Power (Pvt.) Ltd which owns another 49.5 MW Solar Power Project in D.I.Khan, KPK. The 49.5 MW Solar Power Project is one of the first ever Solar IPP of Khyber Pakhtunkhwa Province. The 20 MW AB Solar Park is based on the concept of Captive/Wheeling Power Plant. Pakistan has many Captive Power Projects now, however a project specifically designed on Wheeling basis, will be the first of its kind. The concept is as follows; to produce electricity at project site in District Attock, input it at Lakkarmar 132 kV Grid Station, wheel it via IESCO network to main Islamabad city and take the output from I-9 132 kV Grid Station. In this case, AB Solar Park shall be the Power Generation Company, IESCO shall be the wheeler of electricity and Bulk Power Consumers shall be the Power Purchasers. The project is based on the SRO. 549(I)/2016 dated June 13, 2016, "NEPRA (Wheeling of Electric Power) Regulations, 2016. Lakkarmar 132 kV Grid Station of IESCO has been shortlisted as the respective Grid Station as per NEPRA Grid Code, through which the electricity shall be injected into the IESCO network. Grid Interconnection Study has been awarded to Power Planners International for completing the Load Flow, Stability, Dynamic Analysis and Transient Stability tests.

The project site is near Chab village, approximately 30 km from Jhand City. It is located at 33°12'48.53"N 71°51'14.52"E at an altitude of 238 meters having a distance of approximately 150 km from Islamabad.

The Project site consists of approximately 70 acres of land. The site selected for the project is generally flat, with a minor slope towards the southeast, with the slope increasing towards the southern end of the site boundary.

The Project shall have an installed capacity of 20 MWp. The scheme of interconnection with IESCO grid has been determined in the Grid interconnection studies.

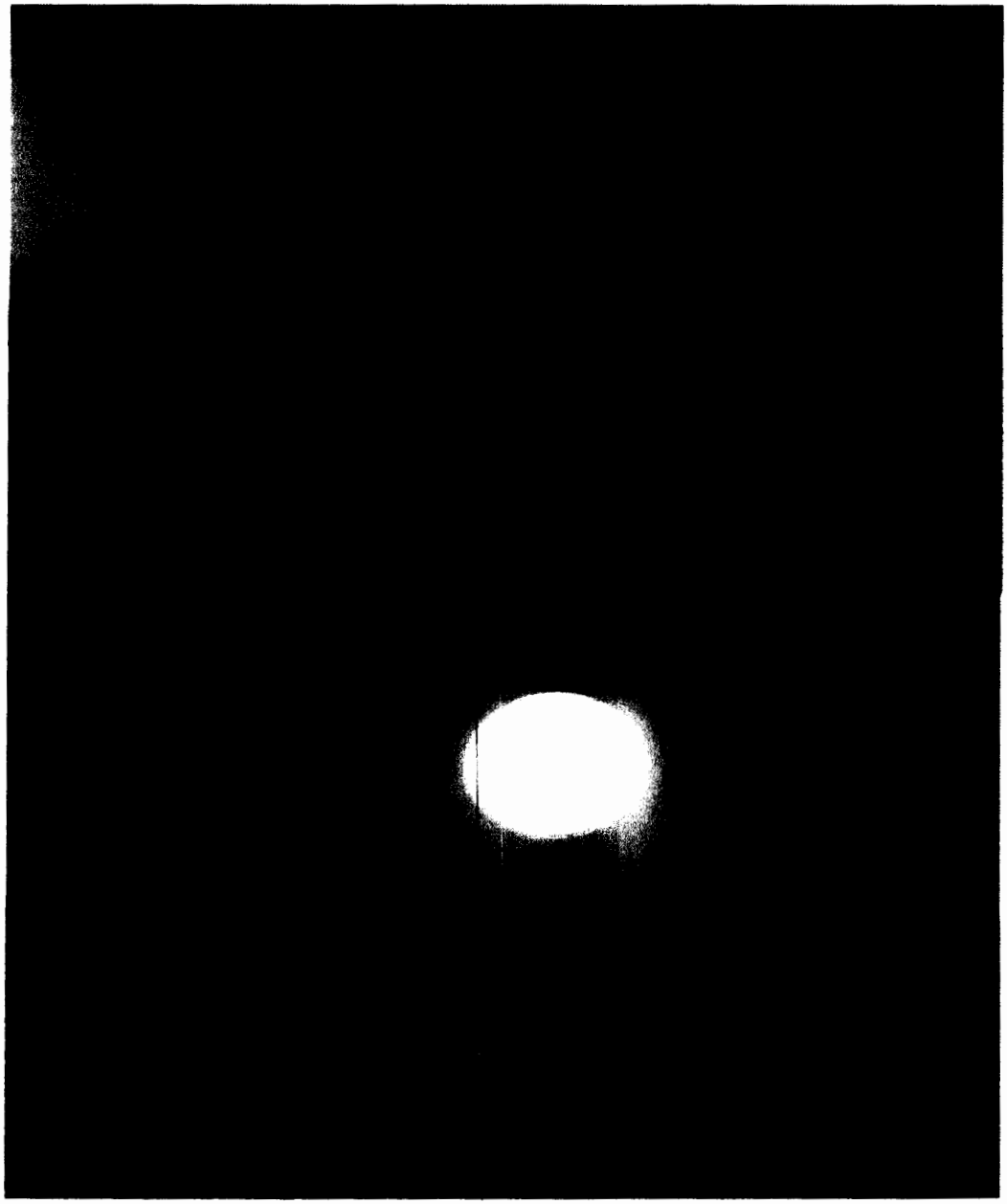


Project Location

3.2 ROAD ACCESS

The route to access the site from Islamabad starts from the Motorway M-1 at Tarnol exit. This exit then connects with Fatehjang at approximately 2.5 KM from Tarnol exit. With this entry into Fatehjhang, District Attock starts. 25 KM on this Fatehjhang-Attock road, a three way diversion comes. The left route goes to Pindigheb, the middle one goes to main Attock city and the right one goes to Kohat. We shall continue along the Kohat route. After another 40 KM, another two way diversion comes where the right one enters KPK Province to Kohat and the left continues in Punjab up-till Village Chab and forward. We shall continue towards Village Chab. The project site is located right in the start in Village Chab on the main road.

Figure: Project Site Access

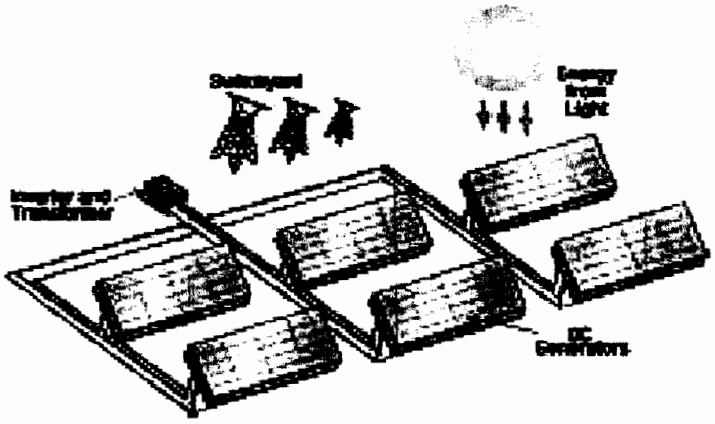


3.3 GRID LOCATION

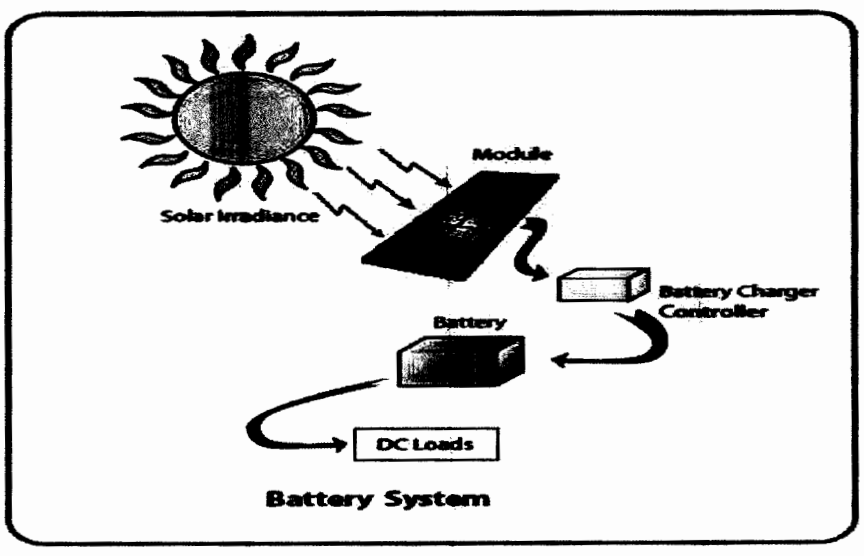
According to following information from Islamabad Electric Supply Company (IESCO), there are two Grid Stations projects which are newly constructed near to project site.

1. 132 KV Grid Station at Jhand which got converted from 66 KV to 132 KV (AIS) at Jhand Tehsil, Attock District with associated 132 KV D/C Transmission line (approx 20 KM from project site).
2. 132 KV Grid Station at Lakkharmar which got converted from 66 KV to 132 KV (AIS) at Lakkarmar, Jhand Tehsil, Attock District with associated 132 KV SDT Transmission line. (approx 2 KM from project site)

3.4 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.



3.5 LAYOUT

There are several configurations in which a grid-connected solar PV system can be designed, based on different site-specific variables and depending on the size of the project. The Project is intended to be close to the 20 MWp (DC) capacity mark and is categorized as a commercial utility-scale solar power project. Based on the preliminary design, the Project uses centralized inverter skids of 2.5 MW (AC) rated output capacity and each of these 6 central inverters. The total project capacity is thus 20 MWp (DC). The solar PV modules selected as power generators are standard 4-busbar 144-cell crystalline silicon (c-Si) modules. There will be a total of 46,536 solar PV modules of 430 Wp each, with a total of 6 arrays, with 28 modules per strings, and having 276 strings per module in parallel having module area 103,541 meter square. Therefore, there will 28 modules in series and 1,662 strings in parallel having module area 103,541 meter square making up a total plant capacity of 20 MWp (DC). For every 28 strings (also known as 'home runs'), there will be one combiner box and disconnect, and 6 DC combiner boxes of different capacities for every block. DC cables from each one of them terminate at the inverter. The inverters will produce three-phase 400V AC output, which will be then stepped up to 33 kV by a step-up transformer and transferred to the 132-kVSubstation through underground trenches. The objective of this configuration is to minimize the EPC cost for the sponsor while maintaining the 17% CUF benchmark at P90 that is determined by the national electricity regulator (NEPRA) for that location/region for utility-type grid-connected system typically employed in emerging solar markets, such as Pakistan's. However the CUF shall be more than 19% in our case due to efficient modules and inverters. All such IRR kickershave been listed, While there are other configurations and/or design modifications that can improve the eventual IRR for the project owners, the design configuration recommended for this opportunity is that of a standard however along with their merits and demerits, in the following sections to enable the sponsor to make an appropriate final determination.

(a).	**Solar Panels – PV Modules**	
(i).	Type of Module	PV Modules crystalline silicon (Mono-crystalline)
(ii).	Type of Cell	Low LID mono PERC half cut
(iii).	Dimension of each Module	Dimensions (L×W×H) (mm) 2115×1052×35
(iv).	Module Surface Area	2115x1052 (mm)

(v).	No. of Panel /Modules	46,536 Solar PV modules
(vi).	Total Module Area	103,541 sq. m
(vii).	Total Land Area Used	70 acres
(viii).	Panel's Frame	Anodized aluminium alloy frame.
(ix).	Weight of one Module	24 kg
(x).	Module Output Warranty	10 year product warranty
		25 years Linear power output warranty
(xi).	Number of Solar Cells in each module	144-cell (6x24)
(xii).	Efficiency of module	19.3%
(xiii).	Environment Protection System	ISO 14001:2004: ISO Environment Management System
(xiv).	Nominal Maximum Power (Pmax) at STC	430 W
(xv).	Power Tolerance at STC	0 - +5 W
(xvi).	Open circuit voltage (Voc) at STC	49.2 V
(xvii).	Short circuit current (Isc) at STC	11.19 A
(xviii).	Maximum system Voltage at STC	1500 DC (IEC/UL)
(b).	**PV Array**	
(i).	No. of PV modules	46,536
(ii).	Modules in a string	28 module
(iii).	Total number of strings	1662
(c).	**PV Capacity**	
(i).	Total	20 MWp
(ii)	Junction Boxes	IP 68, three diodes

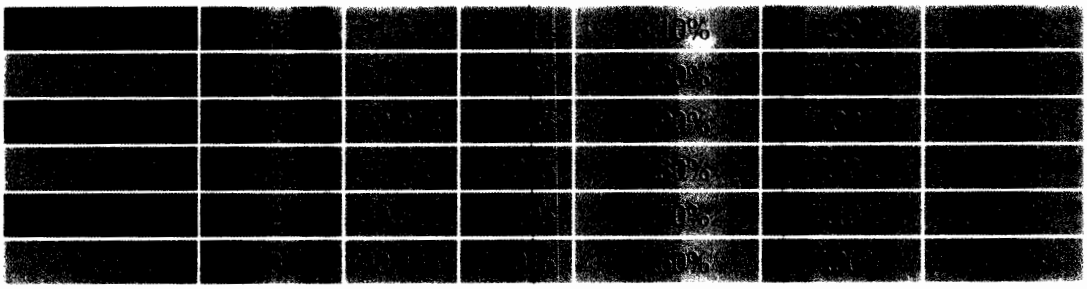
Solar PV Array: Thin Film Solar PV technology has been selected for the 20 MW Solar PV Power Project. It should perform satisfactorily in relative humidity up to 100% with temperatures between -10°C and +85°C and withstand gust up to 200 km/h from back side of the panel. This is qualified to IEC 61701.

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.

3.6 PERFORMANCE RATIOS AND NET ENERGY OUTPUTS (MWH)

Degradation of 0.3% per year

Year	Energy at Various Confidence Levels [MWh/a]			Capacity Factor At Various Confidence Level [%]		
	P50	P75	P90	P50	P75	P90
Year-19	32,159	31,509	31,094	18.20%	17.60%	17.30%



3.7 Plant Construction And Implementation

3.7.1 Project Implementation Schedule

An implementation schedule, outlining the sequence of major activities and the time required for engineering, construction, installation and commissioning of the 20 MW solar PV power plant.

3.7.2 Plant Operation and Maintenance

The operation of 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 overall performance of the system. The solar PV system requires the least maintenance among 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.

3.8 Power Transmission Line

The power generated from the proposed solar power plant should be evacuated through 132KV transmission line to Lakkarmar 132 KV Grid Station at Tehsil Jhand, District Attock.

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 132 kV level.

3.8.1 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 suitably 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.

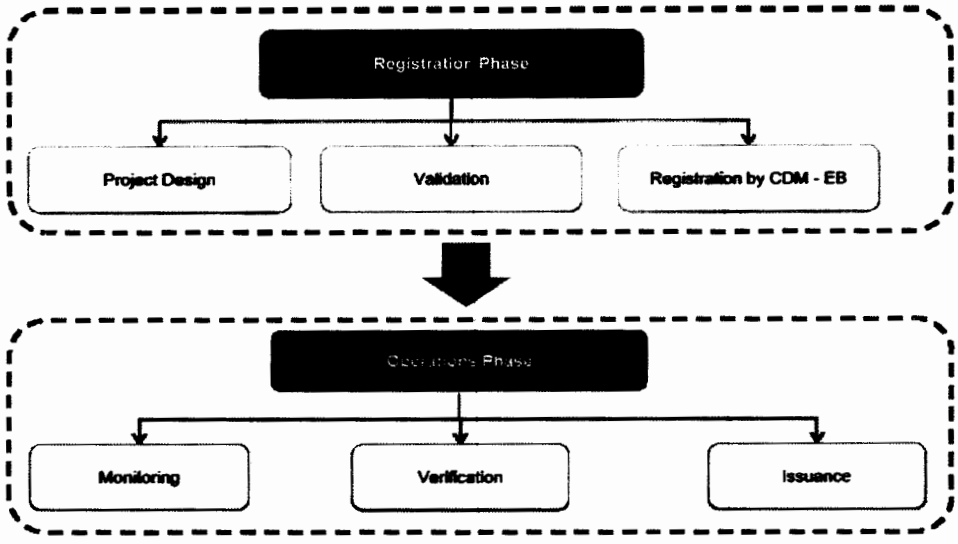
While selecting the inverter, the objective is to reduce the number of inverters and transformer skids while coming as close as possible to the 20 MWp gross output mark, while maintaining the DC/AC ratio. Reducing the number of skids helps reduce eBOS cost and helps achieve a competitive EPC project cost ($/W). The most common central inverter sizes in the market have been analyzed with a load factor of 1.25 to see which inverter size would result in the highest plant capacity. The inverter size selected was 2500 kW (AC). A total of 6 of these blocks therefore give a total solar plant capacity of 20 MWp (DC). As is the case with all components of a PV IPP, the bankability and reputation of the OEM is critical in the final brand selection..

3.8.2 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, preliminary survey shows that there is no forest land involved.

3.8.3 CDM PROJECT CYCLE

CDM Project cycle comprises of two major phases, registration and operation, to generate Carbon credits. These include:



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

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 weightages 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	tCO^2/MWh	0.9941
Weight of OM	WOM	75%
BM	tCO^2/MWh	0.8123
Weight of BM	WBM	25%
CM	tCO^2/MWh	0.9487

Electricity Generation:

As mentioned in the document earlier, Project will operate at a load factor of 20.01% which in turn would generate 35,357 MWh (Net).

4 BASELINE ENVIRONMENTAL & SOCIAL CONDITIONS

Attock situated on the left bank of the River Indus is the divisional headquarters of the northern districts of Punjab. It borders KPK and the region is called Potohar. Total area of Attock district is 6,857 (sq km), with population density of 275 persons per sq km. While the total population of Attock district is 1,883,556 in 2017-18.

4.1 STUDY AREA

An area within 5 km around the project can be considered as influence zone and hence it has been taken as study area to understand even setting 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.

4.2 PROJECT AREA

The plot size for the proposed project site is approximately 75 acres. The site is located at approximately 150 KM, south-west of Islamabad city. The route to access the site from Islamabad starts from the Motorway M-1 at Tarnol exit. This exit then connects with Fatehjang at approximately 2.5 KM from Tarnol exit. With this entry into Fatehjhang, District Attock starts. 25 KM on this Fatehjhang-Attock road, a three way diversion comes. The left route goes to Pindigheb, the middle one goes to main Attock city and the right one goes to Kohat. We shall continue along the Kohat route. After another 40 KM, another two way diversion comes where the right one enters KPK Province to Kohat and the left continues in Punjab up-till Village Chab and forward. We shall continue towards Village Chab. The project site is located right in the start in Village Chab on the main road..

The terrain is mostly flat and minimal grading will be required. Debris and waste is scattered across the site.

During the visit, no security force / squad escorted the visiting team. The local residents, when interviewed, also confirmed that there are no security issues in this area. Also no surrounding residents disturbed the visiting team.

There is no human habitation inside the plot. While the presence of free range livestock within the site area was observed during the site inspection, there were no signs that fauna and flora related issues would arise in the area.

The site contains natural trees and bushes. They are scattered across the site. These trees may need to be removed to prevent shading of the array. No mountain or hills were found within the proposed site / location.

Upon inquiry, the locals informed that there is no history of thunder or dust storm in the nearby vicinity. There were no ground indications of dry creek beds snaking through the terrain. The project points are

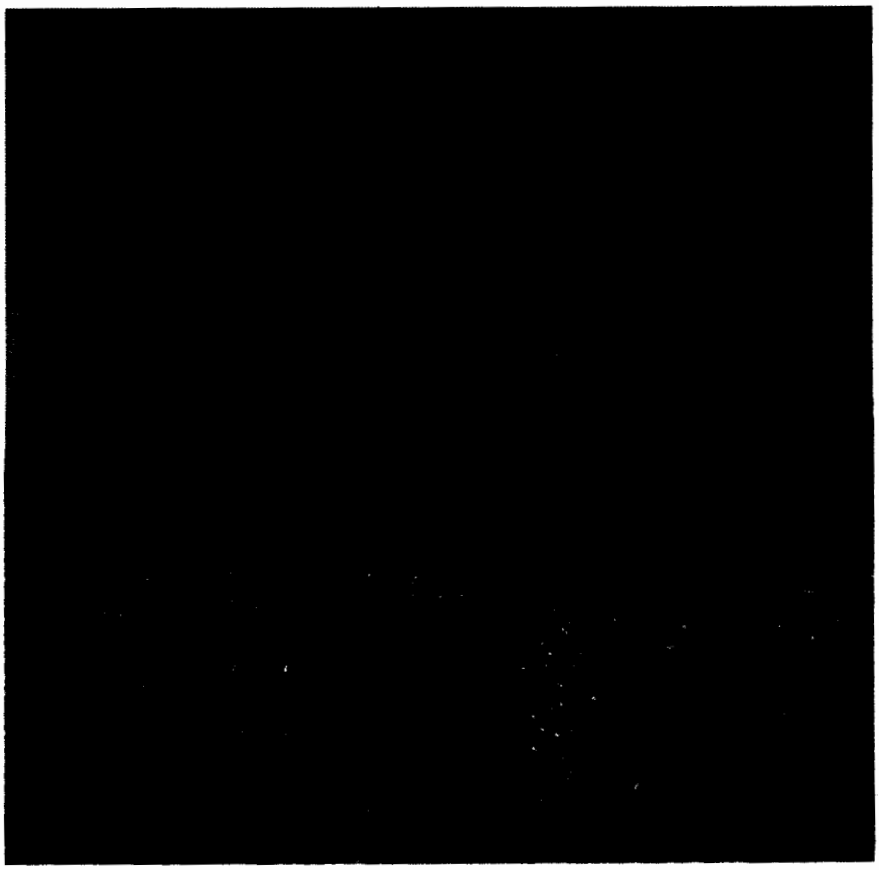
33°12'53.07"N 71°51'08.53"E
33°12'53.39"N 71°51'21.08"E
33°12'42.53"N 71°51'8.71"E
33°12'42.47"N 70°51'20.95"E

4.3 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 no accumulated water spots. Topographic study shall be conducted for this project.

Figure:



4.4 CLIMATOLOGY

The climate in Attock is referred to as a local steppe climate. During the year, there is little rainfall in Attock. This location is classified as BSh by Köppen and Geiger. The average annual temperature is 22.2 °C in Attock. In a year, the average rainfall is 783 mm.

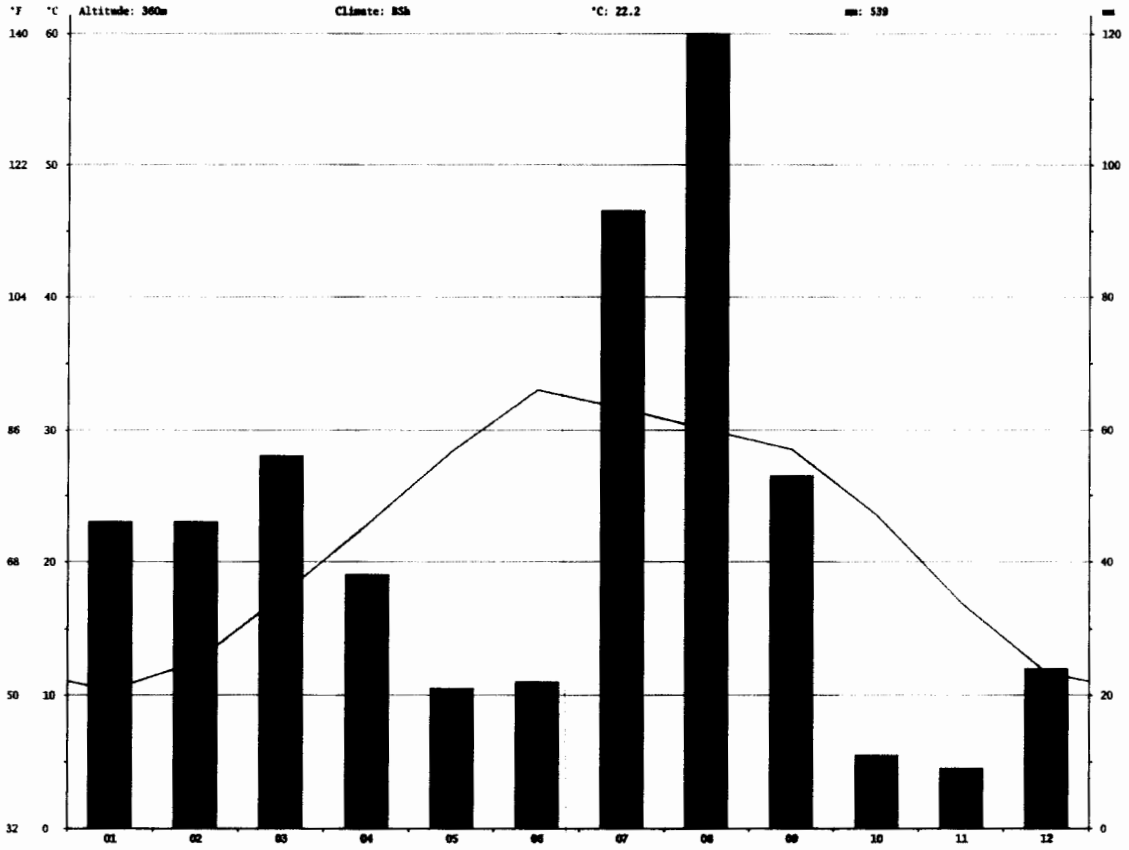
The temperatures are highest on average in June, at around 33.0 °C. In January, the average temperature is 10.4 °C. It is the lowest average temperature of the whole year.

The variation in the precipitation between the driest and wettest months is 111 mm. The average temperatures vary during the year by 22.6 °C.

4.5 ATTOCK WEATHER BY MONTH // WEATHER AVERAGES

	Jan	Feb					Jul			Oct		
Avg. Temp (°C)												
Min. Temp (°C)	2.9	5.8									8.4	3.7
Max. Temp (°C)												
Avg. Temp (°F)												
Min. Temp (°F)	37.2	42.4									47.1	38.7
Max. Temp (°F)												
Precipitation / Rainfall (mm)	46	46	56						53			

4.6 ATTOCK CLIMATE



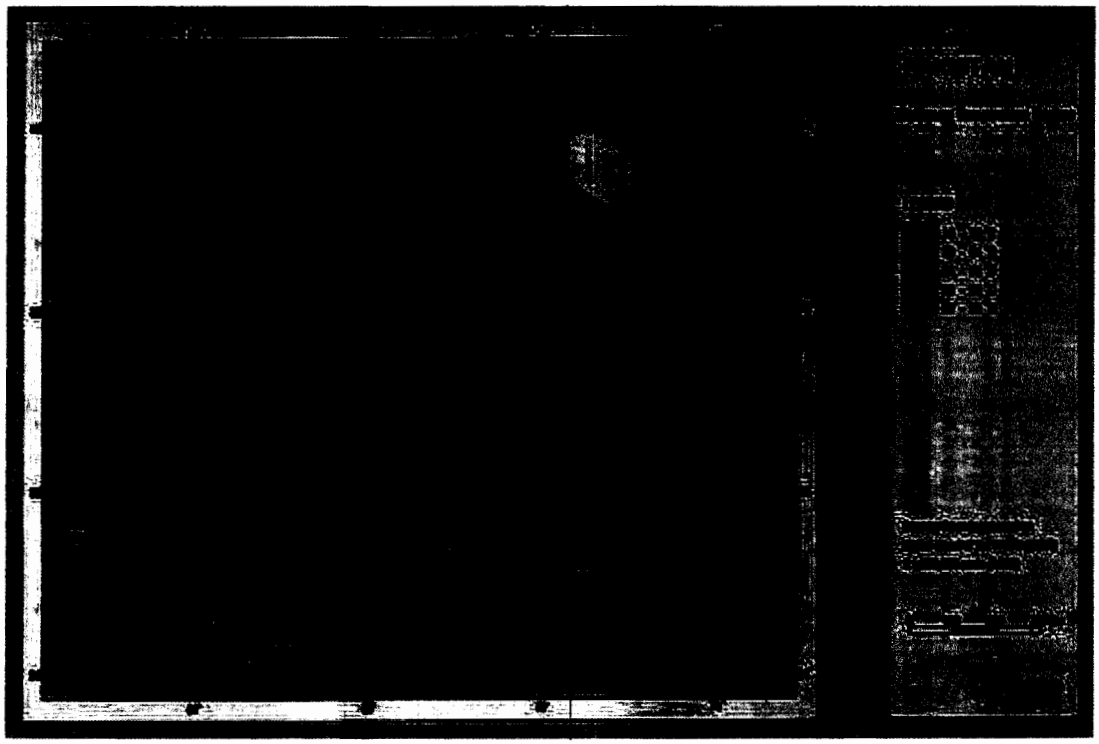


Figure: Maximum Temperature Regime Map of Pakistan

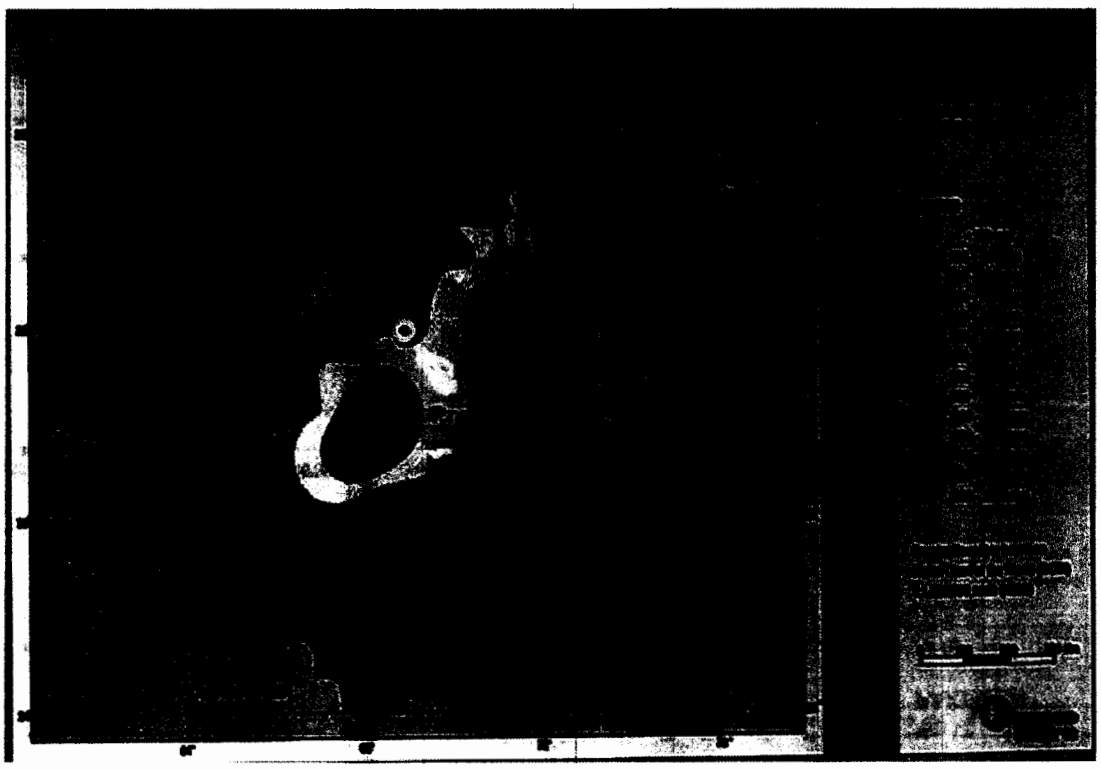


Figure: Rainfall Map of Pakistan

4.7 BIOLOGICAL ENVIRONMENT

4.7.1 FLORA

The physiographic diversity of Punjab attributes the province a unique status in the country with respect to its agricultural resources. The present study includes indigenous knowledge of selected medicinal wild plants of district Attock. A total of 49 species belonging to 29 families are reported from the study area. This study is mainly focused on traditional uses of plants of the area used by the local people. During the study 10 Hakims and about 80 local people were interviewed

In the context of the present day scenario of methods of ailment cures, it is very important to find some alternate medicine system for the treatment of ever changing nature of diseases, especially for those which do not need prolong treatment and may be cured by use of herbal products. In this connection indigenous knowledge play a reasonably good role in the treatment of not only everyday problems but also for the complex diseases to some extent. Ethnobotany is perhaps the most appropriate approach to study natural resources of indigenous people and the system of medicine specific to them although there is no provision anywhere for the protection of knowledge rights of native people and the knowledge gained from some specific areas proved to be of great importance to the world but of little or no benefit to the local people, but still the fact remains as it is, that the indigenous systems of cure do posses a lot of applications and acceptance in masses. In our study area i.e., district Attock, poverty is a major issue, people are usually dependant on agricultural activities which are restricted to some patches or on rain waters. Due to un-availability of better health facilities and higher prices of allopathic medicines people are very much dependent on the locals' herbal medicines. The diversity of medicinally important plants is important in the area as the area of Attock is semiarid but fertile in patches where streams and surface drains through the mountains, run across the fields and waste lands giving appropriate conditions for growth of wild and cultivated plants. These wet patches are having xerophytic indigenous flora.

Edible wild food plants often helps in preventing starvation during drought, while economically important species provide a buffer against unemployment during cyclical economic depressions. Despite the immense importance of these plant resources, their value is rarely taken into account specially; in land use planning, but in fact they are destroyed and lost forever from the area. Same is the case in our area and many parts of the country that the medicinally and economically important species are harvested unsustainably and hence destroying the biodiversity and loss of species from the area.

There are many medicinal plants which are growing naturally in different seasons of year in this area. The benefits of about 49 wild medicinal plants were studied and

described by local people and habitants. All these species are the main source of medicine and other requirements of the local communities, because of the shortage of trained manpower and resources, health authorities in Pakistan are not able to provide services to greater part of the rural population. Therefore, the wide spread use of folk herbal remedies appears to be not only a case of preference but also a situation without other native choices. Such a system of medical treatment on which the majority of the population has been relying upon for generations with considerable success, should not be overlooked for further medical investigation, specially on those plants which have not been looked at for medical research, although the same have been in use by local inhabitants over hundreds of years. So the indigenous knowledge, accordingly, continue to provide the building blocks for development in rural communities because the medicinal plants are the precious economic resources of the area and wild are used in the crude form locally or collected and transported into the drug markets inside the area and country.


The site does not have any protected flora. Only 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 environmental sensitive area.

The plant species recorded in the Study Area of Attock are:

- Aizoaceae
- Apiaceae
- Asteraceace
- Asclepiadiaceae
- Amaranthaceace
- Brassicaceae
- Cannabinnacea
- Caryophyllaceae
- Chenopodiacese
- Convolvulaceae
- Cuscutaceae
- Cyperaceae
- Euphorbiaceae
- Fumariaceae
- Lamiaceae
- Mimosacceae
- Moraceae
- Nyctaginaceae
- Oxalidaceae
- Papilionaceae
- Poaceae

- Rhamnaceae
- Rubiaceae
- Scrophulariaceaa
- Polygonaceae
- Solanaceae
- Urticac
- Zygophyllaceae

4.7.2 FAUNA

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.

- Canis aureus
- Vulpes vulpes
- Herpestes javanicus
- Hystrix indica
- Hemiechinus collaris
- Funambulus pennantii
- Corvus spelendens
- Passer domesticus
- Pavo cristatus
- Francolinus pondicarinus
- Pycnonotus cafer

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.

4.8 HUMAN SETTLEMENT PATTERN

Attock situated on the left bank of the River Indus is the divisional headquarters of the northern districts of Punjab. It borders KPK and the region is called Potohar. Total area of Attock district is 6,857 (sq km), with population density of 275 persons per sq km. While the total population of Attock district is 1,883,556 in 2017-18.

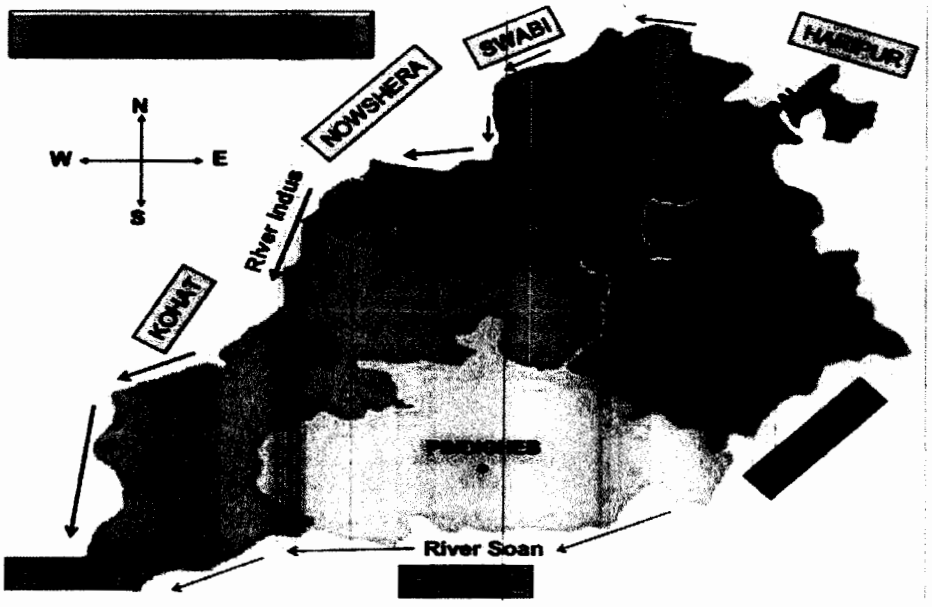
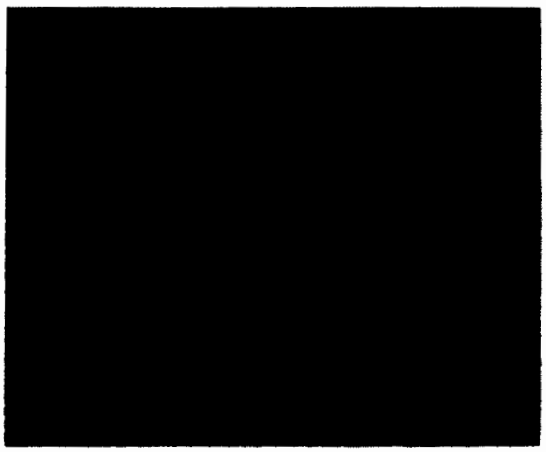


Figure: Population distribution in Attock District

Agriculture and fisheries are the main sources of livelihood of the rural population. The total cultivated area in Attock District is 386,802 hectares.

There is no human activity within the site limits. The nearest community "Chab village" is located 0.21km from the site area. The community consist of mostly Chab Residence. The biggest town "Jhand" is located around 15 km from site.



4.9 LAND USE

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

Jhand comprises maximum wasteland which is essentially desert area in the country as well as good solar radiation. Vicinity of project area is almost sandy & barren.

The Land points of project area are:

33°12'53.07"N 71°51'08.53"E
33°12'53.39"N 71°51'21.08"E
33°12'42.53"N 71°51'8.71"E
33°12'42.47"N 71°51'20.95"E

4.10 SOCIO-ECONOMIC ENVIRONMENT

4.10.1 OCCUPATIONAL PATTERN

Agriculture and fisheries are the main sources of livelihood of the rural population. The total cultivated area in Attock district is 386,802 hectares. Peanuts are grown here in abundance and are one of the major exports. The economy of the district is mainly agriculture-based with peanuts, wheat, maize, millets, grams, corn and pulses being the main crops. Peanuts are a major cash crop in Attock.

Around 90% of the water in Attock is used for agricultural purposes, although surface water supplies do not meet irrigation requirements, and Attock depends mostly on rainfall to meet these agricultural needs.

As one enters Attock through Tehsil Hazro (a smaller sub-unit of the district), newly grown orchards are refreshing to one's eyes, astonishing to see oranges in the land of peanuts. The main obstacle of low productivity from the otherwise highly productive land is the inadequate availability and the improper use of water

Distribution Canals of River Indus is the major canal that provides water for irrigation. Of the total land area planted to crops, about 17% were sown more than once.

4.10.2 EDUCATION AND HEALTH FACILITIES

Educational and health facilities are available in Jhand Tehsil along with other Tehsils in Attock.

Rank	District	OLR	Rank	District	OLR	Rank	District	OLR
1	Rawalpindi	78	10	Sargodha	56	18	Bahawalnagar	46
2	Jehlum	74	10	Sheikhpura	56	18	Bhakhar	46
3	Lahore	72	11	Hafizabad	53	18	Vehari	46
4	Gujrat	71	11	Khushab	53	19	Kasur	44
5	Chakwal	69	11	Mianwali	53	20	Pakpattan	43
5	Sialkot	69	12	Sahiwal	52	21	Balawalpur	42
6	Gujranwala	68	13	Khanewal	51	22	Lodhran	41
7	Narowal	63	14	Nankana Sahib	50	22	Muzaffargarh	41
8	Faisalabad	62	15	Multan	49	22	Rahim Yar Khan	41
9	Attock	59	16	Layyah	48	23	Dera Ghazi Khan	40

Attock has a total of 1,287 government schools out of which 51 percent (657 schools) are for girl students. The district has an enrolment of 224,487 in public sector schools, having literacy rate of 26.3%. Attock is considered as most under developed district of Punjab.

Facility level	Tehsil			
	Attock[a]	Fateh Jang	Pindi Ghep	Jand
Basic health units (BHU)	24	11	5	11
Rural health centres (RHC)	2	1	1	2
Tehsil head-quarters (THQ)	2	1	1	1
District head-quarters (DHQ)	1	0	0	0

[a] Includes sub-Tehsil Hazro.
Source: Office of the District Health Officer, Attock, Attock City.

The critical facilities considered are hospitals and schools. Hospital database in GIS format is collected from the World Health Organisation (WHO), and the type of attributed data available is health facility type and name, Province, District, health facility id, latitude and longitude. School database in GIS format is collected from the Education Management Information System (EMIS), Punjab.

4.10.3 DEMOGRAPHICS

According to the 1998 census of Pakistan the district had a population of 1,274,935 of which 20.45% were urban. In the 1998 census, 87% of the population identified their language as Punjabi. Pashto was the language of 8.3% and Urdu – of 1.1%. However the latest census was done in the year 2017. The result for Attock District are below:

DISTRICT AND TEHSIL LEVEL POPULATION SUMMARY WITH REGION BREAKUP

PUNJAB

DISTRICT / TEHSIL	REGION	POPULATION	NO OF HH
ATTOCK DISTRICT		**1,883,556**	**306,649**
	RURAL	1,393,550	228,435
	URBAN	490,006	78,214
ATTOCK TEHSIL		**434,705**	**69,049**
	RURAL	222,633	34,716
	URBAN	212,072	34,333
FATEH JANG TEHSIL		**325,970**	**51,792**
	RURAL	259,566	41,762
	URBAN	66,404	10,030
HASAN ABDAL TEHSIL		**216,566**	**32,680**
	RURAL	153,427	23,144
	URBAN	63,139	9,536
HAZRO TEHSIL		**339,238**	**53,496**
	RURAL	284,017	44,970
	URBAN	55,221	8,526
JAND TEHSIL		**295,483**	**53,121**
	RURAL	247,416	44,950
	URBAN	48,067	8,171
PINDI GHEB TEHSIL		**271,594**	**46,511**
	RURAL	226,491	38,893
	URBAN	45,103	7,618

Ethnicity

The major ethnic groups are *Bukharis* and *Saagrhi Khattaks*. However, there are various other groups also present within the Study Area:

- Punjabi
- Khattaks (Pashtuns)
- Hinkdo

4.11 WATER RESOURCES

Water is scares in the Attock district. The total number of water supply schemes in Attock are 239. Out of this, the functional schemes are 173 and non-functional schemes are 66. The population served by these water supply schemes is 0.523 Million. The sources for water supply schemes is ground water , which is 78% and surface water, which is 22% respectively.

4.11.1 SURFACE WATER

The Indus River passes in the southeast of the Project site. The river originates in Himalayas and enters into the Province from Attock near Harro. According to the various studies, it remains all year. There are some main channels (channels diverting water directly from the river) and some secondary channels (fed by the main channels) that are used to divert water from the river to the agricultural fields. As water flows through the channels, it is diverted to the adjacent fields. Once a field pools up, there are two possibilities—either further water intake is manually blocked at the inlet, or the pooled water at the field is further diverted to other adjacent fields located at lower elevations. The natural gradient of the land is from the northwest to the southeast.

4.11.2 GROUND WATER

The Study Area has very limited groundwater yield prospects because of several hundred meters thick unconsolidated deposits. The groundwater table is reported to be at 70 m below the surface. Clay is the dominant component, with presence of appreciable amounts of gravels, clayey silts, and minor sand. No groundwater extraction well was found in the Study Area.

4.12 AIR QUALITY

There are no major anthropogenic sources of gaseous emissions in the Study Area other than cookstoves in villages that use wood as a fuel and that produce insignificant emissions of sulfur dioxide (SO^2) and nitrogen dioxide (NO^2). The dry, desert conditions in the area result in significant amounts of windblown dust.

Air quality monitoring results for the Project Site is:

Carbon Monoxide (CO)	24 h	**5**	mg/m^3	1.530
Sulfur Dioxide (SO_2)	24 h	**120**	$\mu g/m^3$	103.45
Ozone (O_3)	24 h	**130**	$\mu g/m^3$	101.68
Nitrogen Dioxide (NO_2)	24 h	**80**	$\mu g/m^3$	62.14
Nitric Oxide (NO)	24 h	**40**	$\mu g/m^3$	20.39
Oxides of Nitrogen (NOx)	24 h	**120**	$\mu g/m^3$	99.54
Particulate Matter (PM_{10})	24 h	**150**	$\mu g/m^3$	105.7

4.13 NOISE LEVEL

The project area is a quite area. There is no traffic or industrial activity in the vicinity of the project, except for the north-west site perimeter where the Chab village is located. It is recommended to maintain the noise quality in the project area within the permissible levels.

The results of the noise sampling are:

Noise	Day-time	12h.53m	**65**	dB (A)	44.21	Noise Logger
	Night-time	11h.7m	**55**		32.25	Noise Logger

4.14 WATER RESOURCES

The Project site is located in a rain-fed agricultural farming area. Other than rain, the main source of water is precipitation runoff from the tributaries of River Indus. Torrential flows from the Indus River during the rainy season are diverted for agricultural use through a system of man-made earthen channels running through

cultivated plots, and retained on farmland by shallow dirt berms lining the periphery of each plot.

5 ENVIROMENTAL AND SOCIAL IMPACTS AND MITIGATION MEASURES

5.1 INTRODUCTION

The proposed project may have 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 ACTIVITIES

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 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 operation of large construction equipment like cranes, concrete mixers,

hoists, welding sets etc. There may be 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 Impacts During Construction Phase

The environmental impact during construction phase is localized and of short term magnitude. However, as this project land shall be private barren land, the change in land use will be minimum.

Impact is primarily related to the civil works and some intensive impact due to erection of the equipment. The details of the activities and probable impact are brought out in table below:

Identification Of Activities & Probable Impacts (Construction Phase)		
Construction Activities	**Environment Attribute**	**Probable Impacts**
Land Acquisition	Land	✓ No significant impact on land-use is expected.
	Socio-economics	✓ 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	✓ Run-off from construction area
	Land	✓ Loss of top soil
	Ecology	✓ Minimal loss of vegetation / habitat as the site is 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	✓ Increased flow of traffic

	Utilities	
Civil Construction Activities	Air	✓ Air Emissions from construction machinery ✓ Fugitive Dust Emissions
	Water	✓ Run-off from Construction Areas
Mech. and Elec. Erection Activities	Air	✓ Air Emissions from Machines / activities
Influx of Labour and construction of temporary houses	Socio-economics	✓ Employment opportunities shall increase ✓ tress on infrastructure
	Land	✓ Change in land use pattern of the area
	Water	✓ Sanitary effluents from labour 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 waste land as already barren land.

5.3.1 IMPACT ON LAND USE

The land required for the proposed expansion project will be about 75 acre. The construction activities attract a sizeable population and the influx of population is likely to be associated with construction of temporary hutments for construction work force, 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 labour 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 labour colonies shall be reverted back similar to preconstruction stage

Further, AB Solar Park (Pvt.) Ltd 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 project would be confined in the wasteland, the impact on soil will be minimal and confined. Only cutting and filling is 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 soil in the surrounding area is anticipated. However, in order to minimize such impacts, appropriate soil erosion control measures would be undertaken by AB Solar Park (Pvt.) Ltd 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 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 movement of equipment and vehicles at site. Equipment deployed during the construction phase is also likely to result in marginal increase in the levels of SO2, NOX, 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 over 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 insanitary conditions. Contractor will provide Soak pit with a depth of 2 meter to dispose 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 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 run-off 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 run-off including effluents may cause 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 environment are presented in table below.

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 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 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 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 plugs 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

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 proposed plant to conserve storm water and help in recharge of ground water.

Impact on Surface Water Impact due to Discharge

There shall be minimal discharge of wastewater from cleaning of Solar PV modules. The wastewater emanating from cleaning operations shall be recycled for plantation and greenbelt development around the plant. The rest of the wastewater will be deposited in rain water harvesting pond.

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 adoption of mitigation measures like paving and surface treatment and water sprinkling.

5.5 Social Impacts

5.5.1 Traffic Congestion

No overburden on the local transportation system is envisaged due to the proposed Project.

5.5.2 Labor Influence

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 labour 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 labour colonies shall be reverted back similar to preconstruction stage

AB Solar Park (Pvt.) Ltd 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, lay-off and retrenchment, leave and vacation, and superannuation, which follow Pakistann labour 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 contractual basis. Separate labour 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 AB Solar Park (Pvt.) Ltd in this area. The health areas and issues that requires attention by AB Solar Park (Pvt.) Ltd is as follows:

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; transportation 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/interaction of different groups		Housing inflation triggered crowding

Veterinary Medicine	Movement and migration of stock	Movement and migration of livestock due to influx of new groups	Creation and/or movement of livestock watering locations		Inadvertent water source contaminati 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	Overburdenin g existing services/syste ms; 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		marginalizin g 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 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				Shift to western medicine

		practices				
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

Operation Phase

The operation & maintenance staff will be accommodated in the AB Solar Park (Pvt.) Ltd Township, which will be located at Chab Village. Therefore no impact on the local life pattern is envisaged due to 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 labour co-operative of displaced families and giving priority to labour 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 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. 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.

6 ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN

6.1 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. 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.

6.2 ENVIRONMENTAL & SOCIAL MANAGEMENT PROCESS

The ESMP has been designed within the framework of 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 AB Solar Park (Pvt.) Ltd 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 Govt. of Punjab during 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 on-going 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.

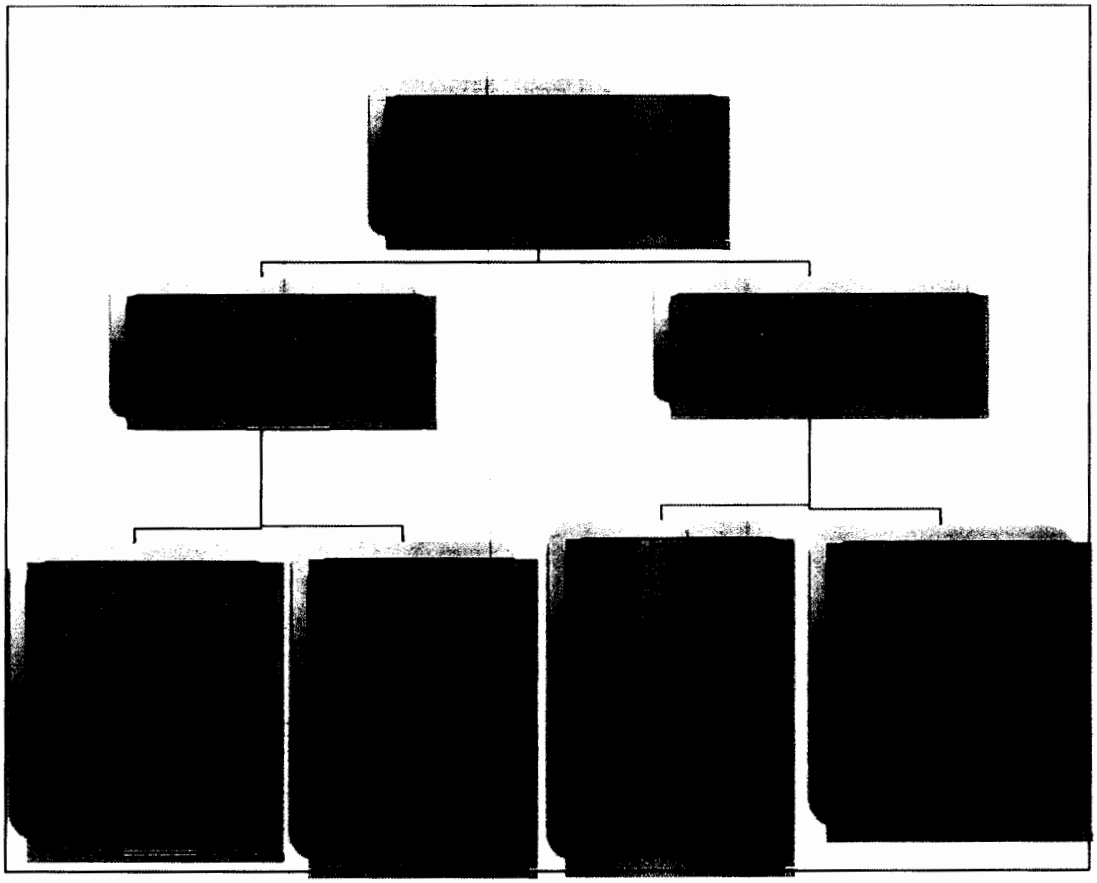
The ESMC is supported by well-equipped testing laboratory and other facilities to facilitate effective working.

The responsibilities of the various members of the environment management cell are presented in table below

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 AB Solar Park (Pvt.) Ltd's self-regulation integrated into a business model. CSR policy functions is 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.

- 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. Major focus is to initiate activities which are sustainable and will help to build lasting relationship with the local community. This would also help in creating inter-dependencies with 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 AB Solar Park (Pvt.) Ltd team and discussions with local people, following issues have been highlighted

Area	Community Need
Health	- Non-availability of adequate health related infrastructure; women and children are most affected - Low awareness on hygiene, sanitation and dietary issues
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
Employment / Livelihood	- Scope of employment for unskilled or semi-skilled laborers
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, AB Solar Park (Pvt.) Ltd'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 programmes to acquire and enhance skills.
  - Creating awareness about long term financial planning

6.3 ESMP DURING CONSTRUCTION AND OPERATION

The project activities will be executed in phased manner, Pre-construction Phase, Construction Phase and Operation phase. The major activities to be undertaken are described below.

6.3.1 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 environment 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 construction phase.

6.3.2 CONSTRUCTION/LABOUR CAMP MANAGEMENT

- The labor camp construction, upkeep and maintenance at the 20 MW Solar PV project site is under the scope of the contractor.

  150-200 laborers are likely to be working on the project area. Local community shall be preferred at all levels, reducing the influx substantially, 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, AB Solar Park (Pvt.) Ltd 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 construction period. AB Solar Park (Pvt.) Ltd will ensure that water will be supplied through water tanker from 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 injured or ill person to the nearest hospital.

- Adequate supply of fuel in the form of kerosene or LPG will be provided to

construction labours 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

6.4 Labor 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, non-discrimination 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 employee laws will be complied.

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.

Workers Organizations

The company will not discourage workers from collective bargaining in a positive manner for mutual benefit.

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.

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.

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 labour & encourages them to go to School by providing free education facilities & also providing education stipend for attending school.

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.

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 - AB Solar Park (Pvt.) Ltd Management - Environment Consultant
Transportation of construction material in covered trucks	Control of fugitive dust	Increase in dust emission	- AB Solar Park (Pvt.) Ltd 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 - AB Solar Park (Pvt.) Ltd Management
Provision of environmentally safe camping area for laborers	To provide a clean and healthy living condition for labours	Unhealthy living condition and spread of disease	- Contractor - AB Solar Park (Pvt.) Ltd Management

6.5 Operation Phase

During operation phase of the proposed project pollution impacts are minimum. 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: 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, AB Solar Park (Pvt.) Ltd 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: AB Solar Park (Pvt.) Ltd management shall have the responsibility to implement mitigation measures during operation

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.

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, earmuffs etc. should be provided to the persons working in high noise areas, to minimize their exposure to noise.

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 Manufactures, Storage and Import of Hazardous Chemicals Rules. 1989 under the Environment (Protection) Act, 1986

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 labour 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.

Labour Deployment and Labour Camp Management Plan

AB Solar Park (Pvt.) Ltd shall draw a Labour Deployment & Welfare Management Plan for the proposed Solar PV project. The EPC Contractor and the sub-contractor shall ensure the compliance of the labour welfare arrangement plan:

- Accommodation for Labour – Provision of Military Tents for accommodating outstation labours
- Accommodation for Women Labour- Separate provision of Military Tents for accommodating women labours
- 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 in septic tanks/ soak pits.
- Sanitation for Women Labour- Separate Toilets/ WC will be provided for women labour. Waste water will be disposed 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 site. Also the doctor will make occasional visits to site for Health check-up of labour
- Strict adherence to the Labour Laws applicable in the area of work will be ensured through robust Time Office department at Site.

6.6 Operation and Maintenance Phase

The problems envisaged during the operation and maintenance phase are accident, exposure to heat, noise, arc lights, chemicals etc. Suitable personnel protective equipment should be provided to all employees, likely to be exposed to these situations. The working personnel should be given the following personnel 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.
- Aluminised fibreglass 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.

6.7 Waste Management Plan

Scope & Purpose of the Plan

This Waste Management Plan "WMP" 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 life-cycle.
- Temporary accommodation during 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. AB Solar Park (Pvt.) Ltd 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.

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:

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 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 through waste handling agency.

- Hazardous waste viz. waste oil etc will be collected and stored in paved and bundled area and subsequently sold to authorized recyclers. Necessary manifest for the same will be maintained.

Operational Phase

There should be no solid wastes likely to be generated during operation phase

6.8 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/machineries and vehicles along the site access and approach roads particularly during construction phase. The plan will be regularly reviewed and as vehicle movement requirements are identified in detail.

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 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.
- 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 signage.

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.

6.9 ENVIRONMENTAL IMPACTS ASSOCIATED WITH CONSTRUCTION AND OPERATION STAGE

Environment Impacts due to Project Location and Design

Potential adverse environment 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.

Environmental Impacts Associated with Pre-Construction Stage

Acquisition of Cultivable and Non cultivable lands

There may be 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 is completed, and
- Compensation for temporary loss in agricultural production.

Impact on Climate

The Project and Transmission lines area consists of barren uncultivated lands. Also, there will be no removals of trees therefore there will be no impact on the climate conditions from the transmission lines during the construction and operation phases.

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 un-built roads, which are not maintained).

All these activities would give rise to 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 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.

Impact on Noise Levels

During the construction phase, the major sources of noise pollution are 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 day time. 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 inhabitated, there will be few residential areas exposed to noise generated during the construction phase and the noise produced during the construction period will have 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

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.

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.

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

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 adoption of mitigation measures like paving and surface treatment and water sprinkling.

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.

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.

Disposal of Debris

As a result of construction related activities, spoil 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.

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, lightening, 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 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.

Socio-Economics

Construction of transmission line will generate local employment, as number of unskilled labors will be required at the time of construction activities. Local employment during this period will increase socio-economic standards.

Resettlement and Rehabilitation

For the construction of transmission line, involuntary resettlement impacts is yet to be determined as some minor changes in transmission line route shall not be ruled out till AB Solar Park (Pvt.) Ltd obtains RoW permission for the transmission line. The land acquisition will not be done as far as possible. But, if AB Solar Park (Pvt.) Ltd has to do it under inevitable circumstances then AB Solar Park (Pvt.) Ltd will adopt and implement a Resettlement Framework consistent with the ADB Safeguard Policy Statement

Cultural sites

There are no archaeological, historical or cultural 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 find procedure to notify relevant authorities will be put in place by AB Solar Park (Pvt.) Ltd.

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.

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 labour 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/labour camps to avoid or minimize health hazards and environmental pollution.

- Contractor should handle and manage waste generated from the construction/labour camps without contamination to natural environment and it will reduce risk to general public who stay close to sites. Also contractor should be responsible to enhance the quality of environment.
- 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.

6.10 Safety and 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.

6.10.1 Safety Organization

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 of Safety Rules/Statutory provisions. Safety Department has prepared.

6.10.2 Safety Awareness Among Workers/Employees

Training programmes 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 programmes should be conducted periodically in a planned manner to refresh their knowledge.

6.10.3 First Aid Training

First aid training programmes should also be conducted for all employees with the help of qualified medical and para-medical staff. This programme may be

conducted in batches. The programme should include basic first-aid techniques and should be repeated periodically to refresh knowledge

6.11 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.

6.12 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.

6.13 FIRE FIGHTING ARRANGEMENT

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 has supporting staff at various levels. The fire control room is manned in 3 shifts round the clock.

6.14 CLEAN DEVELOPMENT MECHANISM

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.

6.15 ENVIRONMENTAL MONITORING PLAN

Regular monitoring of critical environmental parameters is of immense importance to assess the status of environment during plant operation. The monitored data can serve as an indicator for any change in environmental quality due to operation of the plant with respect to baseline environmental conditions, so that suitable mitigatory 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.

6.16 RESETTLEMENT BUDGET AND FINANCING PLAN

Proponent plans to procure 70 acres of private barren land for the project. The project would not result in physical and displacement as these lands are all barren and vacant. However AB Solar Park (Pvt.) Ltd will adopt a Resettlement Framework. Some provisions of the RF are described below:

- Procedure for damage tree compensation is in place with standard format. For damage of trees, horticulture department circular will be used for calculation and based on 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. AB Solar Park (Pvt.) Ltd 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 table.

Resettlement Budget

Item	Unit Rate (Rs)	Amount (Rs)
A. Compensation for loss of trees	Lump sum	Nil. Since there are no trees
B. Provision for unanticipated impact due to construction of transmission line towers	Lump sum	Nil. Since there are no trees which will be cut
Total (A+B)		N/A

6.17 COMMUNITY DEVELOPMENT PLAN

Any company, along with active support from government, has a role to play in 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.

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 centre 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.

Drinking Water: At present people are dependent on the tube wells for the drinking water. Scarcity of water during summer months due the drop is water table has observed in the region. Proponent can undertake repair work of old tube wells and sinking of new tube wells or supply of low voltage electric motors as per the needs of the villagers.

6.18 ENVIRONMENTAL MANAGEMENT PLAN

[redacted]			
[redacted]			
• Fuel combustion Emissions from Diesel generator; • Dust emissions during construction activities	Minor	• Use vehicles in good running condition with emissions within the permissible limits as per National Environmental Quality Standards (NEQs) • Maintenance of equipment and vehicles; • Speed limit restrictions will be implemented on site • Dust suppression methods will be adopted where applicable • Water will be sprinkled daily or when there is obvious dust problem, on all exposed surface. • Excavated materials will be covered, as feasible, to reduce potential for windblown matter	Not significant / negligible
[redacted]			
• Machinery and equipment • Earth works	Minor	• Equipment and machinery will be maintained in good working conditions,	Not significant / negligible

		• Proper design, maintenance and repair of construction machinery and equipment; • Use of proper silencers, mufflers and personal protective equipment's; • Nighttime traffic will be avoided near the communities • Use of further reduction measures (e.g. mufflers) may be assessed. • If necessary a grievance mechanism will be adopted for assessing complaints associated with construction noise, if any.	
• Clearing of small bushes and trees • Civil works • Septic tanks • Oil leaks and fuel spills	Moderate	• Land update to keep to a minimum • Proper domestic wastewater and waste management • Proper management of fuels used on to minimize release to soils • At decommissioning develop a re-instatement plan	Not significant
• Terrestrial biodiversity	Not significant	• Implement and update a solid waste management plan to include waste collection, storage, transport and disposal in an environmentally sustainable manner to avoid attraction of vermin • Hunting, trapping or harassment of wild	Not Significant

		life will be strictly prohibited and monitored • Personnel working during operational phase of the project will be strictly prohibited to hunting and trapping of wild life
• Work environment health and safety	Moderate	• A health and safety policy will be applied throughout the project and among all project contractors. • Abide by all national occupational health and safety regulations • Provision of suitable PPE, training and ongoing safety checks • Equipment periodic maintenance according to manufacturers' schedule • Plan temporary traffic arrangements during construction within the construction area. Review the plan periodically with respect to site conditions. • Give special consideration to local traffic management for the safety of pedestrians, especially near villages. • The project will create employment opportunities for the nearby areas. All the precautionary measures as required for the

		safety of workers are applicable • Take adequate precautions to prevent danger from electrical equipment • Provide a readily available first aid unit including an adequate supply of sterilized dressing material and appliances. • Ensure workers exposed to loud noise wear Ear plugs/ear muffs. • As there is no road facing the solar PV project, therefore reflection of PV panels will not be a problem for traffic • The project will not only provide electricity to the area but also create awareness of local people to the solar PV technology. • Workers accommodation complies with IFC standards • AB Solar Park (Pvt.) Ltd, its contractors and sub-contractors comply with the national labor law	
• Employment	Positive	• work opportunities for local communities mostly during construction phase	Positive
• Water resources used during construction activities	Minor	• Water from the nearby facility will be used after getting approval from the concerned authority • Water contamination during construction	• Minor • If using ready mix concrete the impact would be

		will be avoided through proper waste disposal arrangement • Proper drainage system and waste disposal system will be implemented for guard room for domestic use • Excess water wastage will be avoided and monitored in routine.	not significant
• Waste Management	Minor	• Septic tanks and soak pits will be used • Use of covered bins • Use separate Bins for recyclable material and other type of solid waste • Move waste from site on daily basis to avoid odour • Approved contractors will be hired for the recyclable waste material. • A separate waste area will be allocated for the project waste material as per the mentioned in the guidelines • Debris, Waste generated from construction material will be properly stored during the construction phase and will be removed from the site, once the construction is completed • Maintenance of vehicle and machinery will only be carried out at designated places to avoid any fuel spill	Minor

• Waste water	Minor	• Conduct daily inspections at the construction site to ensure removal of construction debris. • Provide an adequate treatment facility to treat the sewage generated from toilets before discharge. • Store construction material containing fine particles in an enclosure so that sediment laden water does not drain into nearby water drains.	Minor
• Traffic: Impacts resulting from increased traffic movements	Moderate	• Transportation for individual project is estimated to be 60 or more vehicles/day in total during peak construction. • International standard of EHS will be followed • Personal Protective equipment will be provided during construction and operation phase to the workers • First Aid kits will be provided on site • Road Sign board will be fixed at appropriate places to reduce safety hazards associated with project related vehicular traffic • Project drivers will be trained on defensive driving • Strict code of conduct will be followed	

		• Also make safety precautions and display on the notice board of entry gate in both national and local language	
Operations			
• Machinery and equipment	• Not significant	• Potential noise generating machines and equipment are designed to meet statutory regulations concerning noise. • Acoustic enclosures are installed for noise generating equipment, wherever possible such as inverters and transformers • Workers at noise generating machinery and equipment will be provided with the suitable personal protective equipment (PPEs) • If necessary a grievance mechanism will be adopted for assessing complaints associated with operation noise, if any.	• Not significant

• Septic tanks • Oil leaks	Minor	• Proper domestic wastewater and waste management Proper management of fuels used on to minimize release to soils • At decommissioning develop a re-instatement plan • Septic tank integrity checking • Good house-keeping measures; and, • Emergency response plan to include response to spill scenarios.	Not significant
3. Impact on Biological Environment			
• Terrestrial biodiversity	Minor	• Implement and update a solid waste management plan to include waste collection, storage, transport and disposal in an environmentally sustainable manner to avoid attraction of vermin	Not significant/negligible
4. Labor and workplace health and safety			
• Work environment health and safety	Minor	• A health and safety policy will be applied throughout the project and among all project contractors. • Abide by all national occupational health and safety regulations • Provision of suitable PPE, training and ongoing safety checks • Installing fire detection and fighting system	Not significant

		• Equipment periodic maintenance according to manufacturers' schedule	
5. Socio-economic			
• Employment	Positive	• Work opportunities for local communities mostly during construction phase	Positive
• Traffic: Impacts resulting from increased traffic movements	Minor	• Transportation for individual project is estimated to be 10 vehicles/day during normal operation. • Local workers in charge of O&M will be provided with decent sleeping amenities • AB Solar Park (Pvt.) Ltd, its contractors and sub-contractors comply with the national labor law	not significant

7 CONSULTATION, PARTICIPATION AND DISCLOSURE

7.1 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.

7.2 CATEGORIZATION OF PROJECTS AND ACTIVITIES

- All projects and activities are broadly categorized in to 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.
- All projects or activities included as Category 'A' 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)
- All projects or activities included as Category 'B' in the Schedule will require prior

7.3 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 project affected persons needs to be carried out.

7.4 PARTICIPANTS OF DISCUSSION

The venue for the consultation was a primary school located in the village closest to the Project site. 45 persons attended the consultation, Community participants included people from different walk of the society. Participants include Numberdar (Village head), 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.

7.5 PUBLIC CONSULTATIONS (FIELD CONSULTATION)

To make the discussion unbiased and fruitful, prominent people from 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 construction phase and utilization of local resources by company during construction phase. The local stakeholders were informed about the benefits of the project along with environment and social impact especially during construction phase.

During the interactive session, questions were raised by local community on various aspects such as impact of 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 satisfactory 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 construction phase.

8 CONCLUSION AND RECOMMENDATIONS

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 sub-projects 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 correction in work practices at the construction sites, or through the careful selection of sites and access routes.

The selected land is located within the government land. Thus 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 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 generation of direct and indirect employment opportunities.
- There is 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 proposed project.

No reliable baseline information of water, air and noise / vibration exists with respect to transmission line and substation locations.

Proper GRM will have to be implemented by proponent to overcome public inconvenience during the proposed project activities. It is highly recommended to establish a tree replanting programme which would be undertaken as per the directives/requirements of the Forest Department, and financed by company where ever trees will be planted for 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 owner of project to cover the environmental mitigation and monitoring requirements, and their associated costs.

8.1 CONCLUSION

An environment and social analysis has 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 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 construction phase and can be mitigated through a set of recommended measures and adequate provision for 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.

Grid connectivity study

Data consent is being requested from IESCO and NTDC. Once the data is officially obtained then we shall commence our Grid Interconnection Study.