Date: 30<sup>th</sup> March, 2017

Ref. No. ZSPPL/NEPRA/GL/101.

The Registrar,

National Electric Power Regulatory Authority

NEPRA Towers, Sector G-5/1, Islamabad.

Subject: Application for grant of Generation License of 100 MW Zorlu Solar Pakistan (Pvt.) Ltd

Dear Sir,

I, Syed Mumtaz Hassan being the duly authorized representative of Zorlu Solar Pakistan (Pvt.) Ltd by Board Resolution dated 06<sup>th</sup> January, 2017 hereby apply to National Electric Power Authority for the Grant of Generation License to Zorlu Solar Pakistan (Pvt.) Ltd pursuant to section 15 of the Regulation of Generation, Transmission and Distribution of Electric Power Act, 1997.

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

A BANK DRAFT in sum of Rupees **367,160** being the non-refundable 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.

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

Sincerely,

Syed Mumtaz Hassan,

Country Manager,

Zorlu Solar Pakistan (Pvt.) Ltd.





# **ZORLU SOLAR**

# ZORLU SOLAR PAKISTAN (PRIVATE) LIMITED

# **CORPORATE RESOLUTION**

It is certified that the following extract resolution has been approved by the Board of Directors of M/s. Zorlu Solar Pakistan (Private) Limited (the "Company") during the Board of Directors meeting on January 06, 2017 held at Levent 199 Büyükdere Caddesi No: 199 34394, Istanbul, Turkey.

RESOLVED that this company, Zorlu Solar Pakistan (Private) Limited ("Company") authorizes Mr. Syed Mumtaz Hassan, holding CNIC No: 42301-4366039-3, son of Syed Muhammad Mazhar-ul-Hassan and resident of 701-1, Oyster View Residency, Block-2, Clifton, Karachi Pakistan (the "Authorized Person"), to represent and bind the Company and to enter into negotiations with the Federal and/or any Provincial Government of Pakistan or any relevant governmental authority, to exchange information with governmental authorities, to send and receive formal documentation, to sign necessary documentation requested by governmental authorities stafed above, and; to do all such acts, deeds, matters, and things and to execute all such other documents as may be ancillary or incidental or as the Authorized Person shall think expedient for the scope aforesaid.

<u>Name</u>

Mr. Syed Mumtaz Hassan

Olgun Zorlu Director / Chief Executive

Mehmet Emre Zorlu Director Ömer Yüngül Director

Specimen Signature



ZORLU SOLAR PAKISTAN (PRIVATE) LIMITED Registered Office: C-117, Clifton Block 2, Karachi Tel: 021-35291682, 35875366, Fax: 021-95291681

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### **Prospectus:**

Zorlu Solar Pakistan (Pvt.) Ltd (herein after "ZSPPL") is Special Purpose Entity for 100 MW Solar Power Plant in QASP, Bahawalpur. ZSPPL is a subsidiary of Zorlu Enerji Group that was founded in 1993 with the foundation of Zorlu Energy Electricity Generation Inc. Zorlu Enerji is a global group of companies providing services in different areas of the energy sector. Zorlu Enerji Group offers an integrated service mix with the activities of different sectors of the energy sector, mainly electricity and steam production and sales carried out by Zorlu Energy, the only public company. Zorlu Enerji has a total installed power of 1046 MW, of which 700.3 MW is in Turkey.

Zorlu Enerji has a 100 percent share of Zorlu Energy Pakistan that is 56.4 MW Wind Power Plant located in the Jhimpir Sindh. The Wind power plant, in Jhimpir started commercial activity in 2013. The facility, which is Pakistan's first wind power plant, produces approximately 159 million kWh of electricity per year.

100MW Solar project in Pakistan will be one of the projects in oversea countries, A very close attention is being paid at this project and very advanced technology will be used for building up best performance of projects and make good reference project in Pakistan.

The projected total investment of this 100 MW Solar project is around USD 102 Million. Now, ZSPPL is applying for generation license of 100 MW solar project as IPP.

The proposed Solar Project use clean and renewable solar resource with zero emission, when put into operation, the project can provide power supply to the central Pakistan power grid, which currently is mainly relying on fossil fuel. Therefore, it can help to reduce the greenhouse gas emission from coal or oil-fired power generation. By estimating, after the completion of the station, it is expected to provide electricity grid each year about 179.598 million kWh, compared with the same capacity of thermal power, equivalent to annually save about 54947 t of standard oxide (SO<sub>2</sub>) of about 5151 t, nitrogen oxide (NO<sub>x</sub>) about 2576 t coal, reducing various atmospheric pollutant emissions, which reduce carbon dioxide (CO<sup>2</sup>) about 170000 t, sulfur dioxide (SO<sub>2</sub>) of about 5151 t, nitrogen oxide (NO<sub>x</sub>) about 2576 t.

Therefore, the proposed Solar project has no impact for surrounding society and environment.

# ANNEXURE-I

# **PROJECT INFORMATION**

### Project Background

Zorlu Solar Pakistan (Pvt.) Ltd (ZSPPL) is project company for 100 MW Solar Power Plant located in QASP, Bahawalpur. ZSPPL is a subsidiary of Zorlu Enerji Group that was founded in 1993 with the foundation of Zorlu Energy Electricity Generation Inc. Zorlu Enerji is a global group of companies providing services in different areas of the energy sector. Zorlu Enerji Group offers an integrated service mix with the activities of different sectors of the energy sector, mainly electricity and steam production and sales carried out by Zorlu Energy, the only public company. Zorlu Enerji has a total installed power of 1046 MW, of which 700.3 MW is in Turkey.

Since the issuance of the LOI in 2017, the Applicant conducted various studies to assess the feasibility of the Project. These studies included the SolarResource Assessment, Geo Technical investigation, Digital topographic map, Initial Environmental Examination and Grid interconnection Study. Based on the studies conducted by the Project technical consultant (Renewable Resources (Pvt) Ltd), the complete feasibility study was submitted by the Applicant to PPDB and PPDB has approved the feasibility study (subjected to approval of IEE and Grid Interconnection Studies) in first PoE meeting held on 10<sup>th</sup> March, 2017.

### Project Site

The 100 MW ZSPPL Solar Power Project is in Bahawalpur, Punjab province that is towards North-East of Karachi. The project site is located around 855 kilometers away from Karachi.

The total land area of the project site is about 500 acres allocated to Project Company by Energy Department, Punjab, for the implementation of 100 MW Solar PV project. The proposed site is located at latitude of 29°16'27.23"N and longitude of 71°47'41.85"E with elevation of around 117 to 128 meters. The overview of Site is shown in Figure below.



The project site coordinates are as listed in Table below:

	Latitude	Longi	tude
Boundary 1	29°16'50.10"N	71°47'1	9.98"E
Boundary 2	29°16'50.10"N	71 <b>*48'2</b>	<b>2.08</b> "E
Boundary 3	29°16'30.54"N	71°48'2	2.08"E
Boundary 4	29°16'30.54"N	71° <b>4</b> 8'9	).66"E
Boundary 5	29°16'20.76"N	71°48'9	).66"E
Boundary 6	29°16'20.76"N	71 <b>°47'5</b>	7.24"E
Boundary 7	29°16'1.20"N	71°47'5	7.24"E
Boundary 8	29°16'1.20"N	71°47'1	3.98"E

### Solar Farm Layout at Project Site:

The tentative layout at the project site is shown in Figure below. The terrain is flat and the elevation above sea level is approximately 117 to 128 m.

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### Topographical and Geological Conditions at Project Site:

Topographically, location of Bahawalpur division appeared as follows: In the north of its boundaries are limited to River Sutlej, Panjnad and Indus River, which separates Multan and Dera Ghazi Khan, (where the adjacent districts of Sahiwal, Vehari, Multan, Lodhran, Muzaffargarh and Dera Ghazi Khan are located); while Sukkur Division of Sind province lies in south west. The East Punjab province of India and ex-princely states of Bekaneer and Jessalmer were adjacent to the south of Bahawalpur. This area is extremely important regarding national defense and from a strategic point of view. Three districts of Division Bahawalpur are integral part of it: Bahawalnagar, Rahimyar Khan and Bahawalpur District. Bahawalpur division was an administrative unit of the Punjab Province of Pakistan, until the reforms of 2000 when the third tier of government was abolished. Bahawalpur got the charge of district, and it was bound on North by Lodhran District, on the East by Bahawalnagar District and India, on the South by India and on the West by Rahimyarkhan and Muzafar Garh Districts. Bahawalpur is one of the largest districts of the Punjab covering an area of 24,830 square miles. It has peculiar demographic, topographic and geographical characteristics. The district is situated almost in the center of the country at an elevation of 152 meters from the sea levels. It has Five Tehsils; Bahawalpur, Ahmad Pur East, Yazman (i/c Cholistan), Khair pur Tamewali, Hasilpur.

#### Site Accessibility:

Ariel distance of the port from the site is approximately 660 km. Total track length between Port Qasim and site is approximately 855 km. There are few bridges on the way from Bin Qasim port to the site. The load bearing capacity of the bridges in between the site and the port is fair for transportation. Considering the track has already been used for heavy transportation therefore road conditions are reasonable for transportation of equipment. Ariel view of the track is in Figure below. The track starts from Port Qasim and after covering 10 km distance through Pakistan Steel Mills Road, it joins National Highways (N5). After 08 km on N5 the track moves to N5-M9 Kathore link Road and covers around 20 km and joins Super Highway M9. After distance of almost 120 km on M9, the track joins N5 again after Hyderabad Bypass. After almost 670 km on N5, the track moves towards Site through Canal Road and after 23 km the track enters Quaid-e-Azam Solar Park road and reaches the Site after 15 km on QASP Main Road. Detailed access to the site from Port Qasim Karachi is shown in Figure below:



## Telecommunication at the Project Site:

PTCL telephone services are not available but few mobile operator services are available at Site.

# Availability of Semi-Skilled and Skilled Labor:

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

# Project Site Security:

The Applicant is quite cognizant of the fact that security situation in the country is unsatisfactory. It is planned to use the infrastructure of QASP with their coordination

in the most efficient manner to provide seamless security at offices, accommodations and the site.

# Grid Connectivity:

The Project would be connected to 220 kV NTDC Lal Sohanra Grid.

# Annual Energy production:

The predicted Annual Energy Production of the project is 179,598 MWh. The tables below show key details relating to power generation from the Project.

Annual Energy (Year 1)

Capacity Factor (Year 1)

179, 598 (MWh/yr)

20.5%

# **ANNEXURE: I-A**

# **Technology of Panels**

# Technology of Panels:

The Solar panel selected for the project is Cd-Te Thin Films, First Solar.

The details of panel are given in table below.

Parameters	Value		
Manufacturer	First Solar CdTe		
Nameplate Power (Panels)	115 Wp		
	117.5 Wp		
Power Tolerance (Module 115 Wp)	0-4.3%		
Power Tolerance (Module 117.5 Wp)	0-4.4%		
Efficiency at STC (Module 115 Wp)	15.98%		
Efficiency at STC (Module 118 Wp)	16.32%		
Maximum system voltage	1500		
Type of Cell (All 03)	CdTe		
Voltage at Max Power Point Vmpp (115 Wp)	69.30 V		
Voltage at Max Power Point Vmpp (117.5 Wp)	69.95 V		
Current at Maximum Power Point Impp (115 Wp)	1.66 A		
Current at Maximum Power Point Impp (117.5	1.679 A		
Wp)			
Open Circuit Voltage Voc (115 Wp)	87.6 V		
Open Circuit Voltage Voc (117.5 Wp)	88.1 V		
Short Circuit Current (Isc)	1.83		
Nominal Operating Cell Temperature (NOCT)	45 ℃		
Temperature Coefficient on Power (Pmpp)	-0.28%/°C		
Height × Width × Thickness (mm)	1200X600X6.8		
Weight (kg)	12.0		
No. of Modules (115 Wp)	434,784		
No. of Modules (117.5 Wp)	425,530		

# **ANNEXURE: I-B**

**Technology of Inverters** 

# Technology of Inverters:

Sungrow manufactures power supply equipment for solar PV and wind power projects. The company's products range from grid-connected PV inverters, wind power converters, and distributed power supply. It also provides development, construction, and operation management for renewable energy projects. Sungrow was ranked the 2nd largest PV inverter manufacturer in the world in 2013 by MW shipped. Sungrow has 8000 MW installed globally, and in 2013, Photon Magazine ranked its 30kW inverter asbest of all string inverters over 20kW, and among top 5 of all inverters tested.

Parameters	Sungrow SG 2500HV
DC Part - Input	
Vmax DC	1500 V
MPP range (at Perand Ver)	900-1300 V
Max. input current DC	3508 A
AC Part - Output	
Rated AC power at 25°C/ 50°C	2500 kW
Nominal AC voltage	550 V
Minimum efficiency	99.0 %
Frequency	50/60 Hz
Power Factor	0.8
Ambient Condition and Classification	
Ambient Temperature (operating)	-30 ~ +60 °C
Maximum relative humidity	0.95
Altitude (m)	4500 (max.)
IP protection	IP54

# **ANNEXURE: I-C**

# CONTROL, METERING INSTRUMENTATION & <u>PROTECTION</u>

# Control, Metering Instrumentation & Protection for 100 MW ZSPPL:

### **Operation Control:**

The main task of the operation control is to ensure an automatic and safe operation of the Solar Plant in all situations by monitoring and constantly keeping the parameters within the set range as stored in the control computer of the wind turbine.

To achieve this, a real-time control system will be used, that will query relevant data and processes it further. The parameters will be provided by Solar Module Manufacturer and are adapted to the respective site. The objective is a safe and automatic operation of the Solar Plant in all situations.

### Control of Solar Plant:

The propriety Solar Plant monitoring software will be used for Solar Power Plant. It offers comprehensive options to monitor and control a Solar Power Plant. The two essential tasks of a Solar Plant controller are:

- The optimum fulfillment of the grid operator feed-in regulations
- Ensuring output of the maximum possible power from the Solar Plant in case of error (internal or external)

The above tasks can, among other things, be realized by:

- Starting and stopping the Panels in a staggered sequence
- Active power limitation.
- Reactive power management.

# ANNEXURE: I-D PLANT CHARACTERISTICS

# Plant Characteristics ZSPPL:

The characteristics of Solar Plant are as follows:

Plant Characteristic	Value
Generation Voltage	132 kV
Power Factor	0.95
Frequency	50 Hz
Automatic Generation Control	SCADA controlled

# <u>ANNEXURE: I-E</u> <u>TECHNOLOGY DETAILS</u>

Technology details ZSPPL: The details for 100 MW Solar Plant are given in Table

Technology	Solar PV
Plant Size	100 MW
Number of Modules	860,314
Types of Panels	Cd-Te Thin Films

# ANNEXURE: I-F SAFETY & ENERGENCY PLANS

# Safety & Emergency Plans ZSPPL

### Fire Protection:

The fire prevention design of 132 kV boost sub-station in this project implements the principle of "Giving priority to prevention, combining prevention with elimination". Focusing on the actual situation of the project, advanced fire prevention technology is actively adopted to protect the safety, with convenient use, reasonable economy.

Because the boost substation is not very near the town, no fire agency is set, but one full-time firefighter needs to be equipped with. During the initial stage of fire, it is fought by the control center. If the event of a major disaster happens, the fire should be put out together with the support of the local fire brigade.

Fire hydrants, sand boxes, portable fire extinguishers and so on will be set in the boost substation, and will be configured in every place of the boost substation. The width of roads inside and outside of the station will be more than 4m, which can also be used as fire lanes. Every main building will have safe exits which will be opened to outside. Power supply for fire prevention adopts independent double loop, both of which will be respectively connected through the 33kV busbar. Water supply for fire prevention adopts water tank, which will be equipped with two pumps.

The fire prevention monitoring system would be set, and the fire prevention planning would be made during the construction period.

#### Labor Safety:

During the project construction and operation, adherence to the principle of "safety first, prevention crucial" to realize a full, whole-process, and all-around management and supervision and assurance of safe and economic operation of various types of equipment and the personal safety of the staff will be complied.

The hygiene and safety management institution may be set up in the Solar Plant, which would be responsible for the education, training and management on aspects of health and safety after the project is put into operation. A part time safety management personnel may be determined in production department, who will be responsible for labor safety and industrial hygiene daily.

Tour inspection regulations, operation monitoring regulations, and maintenance regulations should be established, and daily safety maintenance on the relevant apparatus, instrument and equipment for production should be done. As per features of the project, the hygiene and safety management institution should be configured monitoring equipment such as sound level meter, and the necessary safety propaganda apparatus.

The main contents of labor safety and industrial hygiene design are to analyze the hazard factors which may exist during the operation period ,such as fire and explosion protection, electrical injury, mechanical injury, and electromagnetic radiation, and risk factors which are possibly existing in highaltitude operations, excavation, lightning and electrical protection and other work during the construction period, to formulate the corresponding measures, establish the corresponding institution and emergency plan, and put forward a special investment and implementation plan.

### Accident Emergency Rescue Preplan:

The enterprise managing and operating the Solar farm shall conscientiously implement relevant national laws and regulations for production safety, perfect the rules and regulations, put into effect layer upon layer the production safety responsibility system, enhance the current management of production safety and on-site safety inspection, and organize production and operating activities strictly as per relevant regulations. The enterprise shall search out in time any hidden dangers, rectify and reform the hidden dangers conscientiously, work out safety countermeasures, assure labor resources material resources and registered capital required for the production safety, improve the safety education training of employees, and prevent new accident potential from occurring. The Solar farm shall establish accident emergency rescue system, work out accident treatment preplans (including salvage preplans and technological preparation preplans) in view of potentially affected areas, study out operable responding measures, and designedly organize actual training exercises so as to grasp the preplans, find out the errors and detects of the emergency preplans in process of training exercises, hereby work out analysis reports on training exercises, set forth corrective measures, and finish the improvement of emergency preplans.

The Solar farm shall establish an early-warning mechanism, emergency treatment capacity and accident emergency rescue action project against sudden major accidents. Corresponding emergency preplans shall be worked out for typical accidents related to Solar prevention and moisture protection etc., and more detailed, normative and complete accident emergency preplans shall be worked out for potential major accidents such as typhoon, fire, explosion, electric-power secondary system accidents, and construction-period major artificial accident prevention.

# ANNEXURE: I-G

# **TRAINING & DEVELOPMENT**

## Training & Development ZSPPL:

For the training and development, the main focus will be on trainings for accident emergency rescue system and working out accident treatment preplans (including salvage preplans and technological preparation preplans) in view of potentially affected areas, studying out operable responding measures, and designedly organizing actual training exercises so as to grasp the preplans and finding out the errors and detecting the emergency preplans in process of training exercises, hereby working out analysis reports on training exercises, setting forth corrective measures, and finishing the improvement of emergency preplans.

### Local Development:

To illustrate approach to sustainability, ZSPPL has defined the following themes to contribute to the local development and value creation. The general strategy is as follows:

- To employ local labour and enable knowledge transfer and job creation in local communities.
- To use local suppliers whenever feasible
- To plan for and contribute to local development initiatives
- Ensure to impact positively on local communities by addressing their needs and improving their live standards
- To train and educate people in how best to operate in a new, often foreign, culture to make every project friction free and a collaborative enterprise.
- To increase access to renewable electricity generation capacity in the local community.



SECURITIES AND EXCHANGE COMMISSION OF PAKISTAN

A025094

# COMPANY REGISTRATION OFFICE, KARACHI

# **CERTIFICATE OF INCORPORATION**

[Under section 16 (5) of the Companies Ordinance, 2016 (VI of 2016)]

Corporate Universal Identification No. 0103650

I hereby certify that <u>ZORLU SOLAR PAKISTAN (PVT.) LIMITED</u> is this day incorporated under the Companies Ordinance, 2016 (VI of 2016) and that the company is <u>limited by shares.</u>

Given under my hand at <u>Karachi</u> this <u>Eighteenth</u> day of <u>November</u>, <u>Two</u> <u>Thousand</u> and <u>Sixteen</u>.

\*\*\*\*\*

Incorporation fee Rs. 2.000/= only

(Zia ul-Rasheed Abbasi)

(Zia ul-Rasheed Abbasi) Joint Registrar of Companies Karachi



#### THE COMPANIES ORDINANCE, 1984

#### (PRIVATE COMPANY LIMITED BY SHARES)

#### Memorandum of Association

of

### Zorlu Solar Pakistan (Private) Limited

#### I. NAME:

The name of the Company is "ZORLU SOLAR PAKISTAN (PRIVATE) LIMITED" (hereinafter referred to as the "Company").

#### II. REGISTERED OFFICE:

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

III. OBJECTS:

The objects for which the Company is established are to undertake any or all of the following:

- 1. To carry on the business of establishing, operating and managing electric power projects and transmission systems for generating and supplying electric power, in any manner that may be deemed expedient by the Company, including but not restricted to setting up of thermal power plants, wind farms/power plants, hydro electric power plants, solar power plants, other renewable energy plants and to manufacture, assemble, acquire and supply all necessary power stations, transmission systems, control systems, cables, wires, lines, accumulators, lamps and works to generate, accumulate, distribute and supply electricity to customers, both public and private, including but not limited to villages, cities, towns, streets, docks, markets, theatres, buildings, industries, plants, utilities, and places, both public and private, and for all other purposes for which energy can be and would probably be provided.
- 2. To purchase and sell, import and export; rent, lease, mortgage, insure, pledge, hypothecate all kinds of movable and immovable property and to create rights and obligations in the property, to reduce, reproduce, modify, remove and transfer and release rights and obligation created on movable and immovable property, to assign and transfer, to annotate and to remove annotations and; to purchases, sell, rent, lease and iransfer all kinds of movable properties, equipment's, tools, machineries, spare parts, vehicles and to allocate rights over them.
- To enter into and execute all contracts including leasing contracts and; to reduce, reproduce, modify, remove and transfer and release real and personal rights which are established according to the contracts.
- To make bilateral agreements for the generation, distribution and transmission of electricity with respective governmental authorities.
- To establish infrastructure facilities for wholesate electricity data processing, control and command systems, to make agreements and supply of goods and services required for infrastructure facilities from domestic and overseas companies.

6. To make energy and capacity purchases, sales import and export deals.

- To purchase and sell engineering and consultancy services, provide training services for staff from domestic and foreign searces.
- 8. To participate in the privatization tenders, domestic and abroad, and to enter into concession contracts for sale and nurchase of energy.
- 9. To enter into any agreement or any arrangement for sharing profits, union of interest, co-operation, joint-ventures, reciprocal concessions, or otherwise with any individual, firm co-operative or other society, company, association, corporate body, research and education institutions, affiliates, Government or local authority or other legal entity.
- 10. To enter into all kinds debt agreements or debt instruments such as issuance of stocks, bonds, , shares without voting rights, public offerings, extracting all kinds of capital market instruments in order to receive funds and relative resources from both national and international capital markets: in relation thereto obtain the necessary permission and consents required under the applicable law.
- 11. To open, close and operate banking accounts of the Company with any bank or banks and to draw, make, accept, endorse, discount, execute and issue promissory notes, bills of exchange, bills of lading, warrants, debentures and other negotiable or transferable instruments.
- To make permanent or indefinite contracts, and agreements with public and private organizations, institutions and real entities,
- 13. To borrow money and to receive the proceeds of loans and to secure payment of money in such manner as the Company shall decide that it is necessary for realization of the purposes mentioned above, and in particular by:
  - the issue of perpetual or redeemable and convertible or non-convertible PTCs, TFCs, debentures or debenture stock (perpetual or otherwise), bonds, promissory notes, bills of exchange, and such other securities;
  - (ii) furnishing undertakings and guaranteeing the performance by the Company or any other person or company of any obligation undertaken by the Company or any other persons or company as the case may be, depositing securities, shares and documents of title;
  - (iii) hypothecating, charging and mortgaging all or any of the properties and assets (both present and future, movable and immovable) of the Company and creating pledge, liens etc. on such properties on the condition that such transactions shall not effect the performance of the Company; and
  - (iv) appointing attorneys, counsels and giving them powers and authority for executing documents, registering documents, selling and managing the properties, undertaking any business of the Company and furnishing and creating such other securities as may be considered expedient; and for the purposes aforesaid, or otherwise, execute, complete and deliver agreements and such other documents as may be required.
  - (v) drafting and concluding arbitration agreements, nomination of arbitrators.
  - 14. To guarantee the payment of money and the performance of contracts of engagement of the Company and to secure the payment of money and the

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performance of any contracts or engagements entered into by the Company and to discharge any debt or any obligations of or binding upon the Company by a mortgage or charge upon all or any part of the undertaking, property and rights of the Company (either present or future or both), or by the creation or issue of bonds, debentures stocks, pledges, liens or any other securities or by any other means.

- 15 To guarantee the payment of money unsecured or secured by or payable under or in respect of promissory notes, bonds, debentures, debenture stock (perpetual or otherwise), contracts, mortgages, charges, obligations, instruments and securities of the Company and generally to guarantee or become sureties for the performance of any contracts or obligations concerning the business of this Company.
- 16 To draw, make, accept, endorse, seal, execute, negotiate, purchase, hold and dispose of cheques, promissory notes, bills of exchange, drafts, charter parties, bills of lading, warrants and other negotiable documents and contracts, deeds and other instruments and to cancel and vary such instruments, relating to the business of the Company.
- 17 To apply for, purchase, or otherwise acquire, and protect and renew in any part of the world any patents, patent rights, brevets d'invention trade marks, designs, licences, concessions, and the like, conferring any exclusive or non-exclusive or limited right to their use, or any secret or other information as to any invention which may seem capable of being used for any of the purposes of the Company, or the acquisition of which may seem calculated directly or indirectly to benefit the Company, and to use, exercise, develop or grant licences in respect of, or otherwise turn to account the property, rights or information so acquired, and to expend money in experimenting upon, testing or improving and such patents, inventions or rights; and to sell any patent rights or privileges belonging to the Company, or which may be acquired by it, or any interest in the same, and to grant licences for the use and practice of the same or any of them and to let or allow to be used or to otherwise deal with any inventions, patents or privileges in which the Company may be interested, and to do all such acts and things as may be deemed expedient for turning to account any inventions, patents and privileges in which the Company may be interested.
- To employ and remunerate Directors, officials, agents, employees, trainees, and servants of the Company and any person. firm or body corporate rendering services to the Company either by cash payment or by allotment to him or her or them, as the case may be, of shares or securities of the Company, and to benefit employees and ex-employees of the Company, and to grant pension, gratuities and allowances and to provide houses, amenities, and conveniences of all kinds, and to determine the working hours and the scope of work concerned, and for the purpose of this paragraph the words "employees" and "ex-employees" shall include respectively, present and former Directors and other officials, agents, employees, trainees and servants.
- 19 To improve, develop, sell, exchange, take on lease, mortgage, pledge, hypothecate, assign, transfer, dispose of, turn to account or otherwise deal with all or any part of the present and future property and assets, immovable and movable, corporeal or incorporeal, tangible or intangible, and any right, title and interest therein of the Company, including rights, licence privileges, concessions and franchises as may seem expedient.
- 20 To payout of the funds of the Company all expenses of and incidental to the formation, registration, advertisement of the Company and the issue and subscription of the share or loan capital including brokerage and / or commission for obtaining applications for or placing or guaranteeing the placing of shares or any debentures,

debenture stock and other securities of the Company and also all expenses relating to the issue of any circular or notice and the printing, stamping and circulating of proxies and forms to be filled up by the members of the Company.

- 21. To pay for rights or property acquired by the Company and to remunerate any person or company whether by cash payment or by the allotment of shares, debentures or other securities of the Company as fully paid up
- 22. To adopt such means of making known the business, services and products of the Company as may seem expectient and in particular by undertaking serninars, training and demonstration programs and by advertising in the press, media and internet by circulars and by purchase and exhibition of works of art or interests, by publication of books and periodicals and by granting prizes, rewards and donations.
- 23. To establish and maintain or procure the establishment and maintenance of any contributory or non-contributory pension or superannuation funds for the benefit of, and give or procure the giving of donations, gratuities, pensions, allowances or emoluments to any persons who are or were at any time in the employment or service of the Company, or of any company which is a subsidiary of the company or is allied to or associated with the Company or with any such subsidiary company, or of any such other company as aforesaid, and also to establish and subsidize and subscribe to any institutions, associations, clubs or funds calculated to be for the benefit of or to advance the interests and well-being of the Company or of any such other company as aforesaid, either alone or in conjunction with any such other company as aforesaid, either alone or in conjunction with any such other company as aforesaid.
- 24. To open branches, liaison offices, register the Company and to undertake all or any of the business of the Company in any part of the world and to become a member of various associations and trade bodies whether in Pakistan or abroad.
- 25. To apply for and obtain necessary consents, permissions and licences from any Government, State, Local and other national or international authorities for enabling the Company to carry any of its objects into effect or for extending any of the powers of the Company or for effecting any modification of the constitution of the Company or for any other purpose which may seem expedient, and to oppose any proceedings or applications which may seem calculated, directly or indirectly to prejudice the interests of the Company, and to enter into arrangements with any Government or authorities, central, provincial, municipal, local or otherwise, public or quasi-public bodies or with any natural persons and legal entities, in any place where the Company or any of them or to obtain from any such Government, authorities or persons, any rights, privileges and concessions which the Company may think fit to obtain, and to carry out, exercise and comply therewith for the purposes of the Company.
- 26. To insure the property, assets and employees of the Company in any manner deemed fit by the Company, and to create any reserve fund, sinking fund, insurance fund, or any other special fund whether for depreciation or for repairing, insuring, improving, extending or maintaining any of the property of the Company or for any other purpose conducive to the interests of the Company.
- 27. To invest the surplus monies of the Company not immediately required in any manner but not to act as an investment company.

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# (except managing apened)

28 To open agencies, representative offices branch or liaison offices for conducting marketing activities (as permissible by law).

- 29 To establish, to build or to construct, all infrastructure facilities related to its activities.
- 30 To purchase, sell, rent, lease, import and export transportation vehicles, goods, machinery and equipment.
- 31 To advance money or give credit to such persons or companies and on such terms as may seem expedient, in particular to customers and others having dealings with the Company.
- 3.24 To import, export, buy, sell, own, install, and / or rent machinery and other equipment, goods, materials, raw materials and spare parts required for or in connection with the business of the Company
- 33 To enter into partnership or other joint venture or co-operation with any person or company or other legal entity, local or foreign, carrying on or engaged in any business or transaction which this Company is authorised to carry on or engage in, or otherwise assist any such person or company or legal entity.
- 34 To receive, declare and distribute profits and to capitalize such portion of the profits of the Company as are not distributed among shareholders of the Company, in the form of dividends, and as the Company may think fit, and to issue bonus shares, as fully paid up in favour of the shareholders of the Company.
- To file or register any documents required to be filed or registered under law, and to 35 pay any fees, charges, expenses, rents, taxes, duties and other dues payable in connection with the business or operation of the Company.
- 36 To make rules or regulations not inconsistent with this Memorandum, to provide for all matters for which provision is necessary or expedient for the purpose of giving effect to the provisions of this Memorandum and the efficient conduct of the affairs of the Company
- 37 To improve, manage, develop, grant rights or privileges in respect or, or otherwise deal with, all or any part of the property and rights of the Company and to establish laboratories, research and development centres to perform such research and development as the Company may deem advisable or feasible, and to expend money or experimenting upon and testing and improving or securing any processes, patent or protecting any invention or inventions which the Company may acquire or propose to acquire or deal with.
- 38 To accept, buy, sell, market, supply, transfer (including transfer of actionable claims) or deliver any and every kind of moveable property for such price and subject to such terms, conditions and warranties as the Company may think fit.
- 39 To sell, improve, manage, develop, exchange, lease, mortgage, enfranchise, dispose of, turn to account, or otherwise deal with, all or any part of the property, assets or undertaking of the Company for such consideration as the Company may think fit, and in particular for shares, debentures, or other securities of any other company whether or not having objects altogether or in part similar to those of this Company, and to distribute among the members in specie any property of the Company.
- ${\rm To}$  accept or give security, including but not limited to promissory notes, indemnity 4()bonds guarantees assignments, receipts, hailments, pledges, hypothecations, liens,

mortgages and charges, against the credit extended or moneys borrowed in connection with the business of the Company.

- 41. To settle disputes by negotiation, conciliation, mediation, arbitration, litigation or other means and to enter into compromise with creditors, members and any other persons in respect of any difference or dispute with them
- To develop and / or transfer technology and to acquire or pass on fechnical knowhow.
- 43. To train personnel and workers, both in Pakistan and abroad, to obtain technical proficiency in various speciallies connected with the business of the Company
- 44. To vest any real or personal property, rights or interests acquired by or belonging to the Company in any person or company on behalf of or for the benefit of the Company, and with or without any declared trust in favour of the Company, and to undertake and execute any trust the undertaking whereof may seem desirable, and either gratuitously or otherwise.
- 45. To pay underwriting commission and brokerage on any shares or securities issued by the Company.
- 46. To aid pecuniary or otherwise, any association, body or movement having for an object the solution, settlement, or surmounting of industrial or labour problems or troubles or the promotion of industry or trade.
- 47. To distribute among the shareholder of the Company, in specie, any property of the Company, or any proceeds of sale or disposal of any property of the Company, but so that no distribution amounting to a reduction of capital be made except with the sanction (if any) for the time being required by law.
- 48. The Company shall not engage in banking business or business of an investment company, insurance company or leasing company or in any unlawful business

It is hereby declared that

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

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

IV. LIABILITY:

The liability of the Members is limited

V. SHARE CAPITAL:

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The authorized capital of the Company is PKR 100.000 (Pak Rupees One Hundred Thousand only) divided into 10,000 (Ten Thousand) shares of PKR 10/- (Rupees Ten) each. The Company shall have power to increase, reduce or reorganize the capital of the Company, subdivide the share capital of the Company, into different classes in accordance with the provisions of the Companies Ordinance, 1984.

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 as set apposite to our respective names.

Name and Surreace	Father's / Husband's name in full	Nationality with any former Nationality	Occupation	Residential address (in full)	Number of shares taken by each subscriber	Signature
ZORLU ENERJI ELEKTRIK URETIM A.S. through its nominee				Organize Sanayi Bolgest Pembe Cati No 13 Bursa Turkey	997 (Nine Hundred and Ninery Any Shares Crity)	amerina
Olgun Zorlu	Zeki	Turkish	Executive	Levazim Mahallesi Koru Sk. Zorku Center Blok No.2. Beşiktaş İstanbul		Olh
Mehmet Emre Zorlu	Ahmet Nazif	Turkish	Executive	Levazim Mahallesi Koru Sk. Zorlu Center Blok No 2. Beşiktaş İstanbul	1 (One Share Only)	J.
Olgun Zorlu	Zeki	Turkish	Executive	Levazim Mahallesi Koru Sk. Zorlu Cente: Blok No.2. Muşiktaş İstanbul	1 (One Share Only)	D'M.A
Ömer Yüngül	Feyzi Kadri	Turkish	Executive	Alsancak Mahallesi 1476/1 Sokak 9/12 Konak Izmir	1 (One Share Obly)	UP
					Total Number of Shares Taken is 1,000 (One Thousand Oniy)	

Dated 22.09. 2016

Witness to the above signatures

Signature Mart ( Name

Signature Best Kecel: Name \_\_\_\_



Almet Lovent	Dran
Father's Name	Father's Name
<u>U 03200 176</u> Passport No.	U 1250 25 19 Passport No
Leven 193, Buyuhilere Cud.	- Level 199 Biyokbere Gd.
Sisti / Stubel	Sist ( istabul Turkay
Nationality	Turkish Nationality
Lawyer Occupation	Assistant Specialist

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4/1/17

#### THE COMPANIES ORDINANCE, 1984 (Company Limited by shares)

#### ARTICLES OF ASSOCIATION

#### OF

### ZORLU SOLAR PAKISTAN (PRIVATE) LIMITED

#### I. PRELIMINARY

#### 1. Table 'A' Not to Apply:

The regulations in Table 'A' in the First Schedule to the Companies Ordinance, 1984 shall not apply to the Company except as reproduced herein.

#### 2. Interpretation:

The head notes are inserted for convenience and shall not affect the construction of these Articles, and unless the context or the subject matter otherwise requires:

- (a) "Articles" means these Articles of Association, as originally framed or from time to time altered in accordance with law
- (b) "Board" means a meeting of the Directors duly called and constituted or as the case may be the Directors assembled at a Board.
- (c) "Company" means Zorlu Solar Pakislan (Private) Limited.
- (d) "Director" means the Directors of the Company appointed from time to time pursuant to these Articles.
- (e) "Month" means a calendar month according to the English calendar.
- (t) "Office" means the registered office for the time being of the Company.
- (g) "Ordinance" means the Companies Ordinance, 1984 or any modification or reenactment thereof for the time being in force.
- (h) "Register" means, unless the context otherwise requires, the register of members to be kept pursuant to Section 147 of the Ordinance.
- (i) "Seal" means the common or official seal adopted by the Company.
- (j) "Section" means section of the Ordinance
- "Special Resolution" means the special resolution of the Company as defined in Section 2(1)(36) of the Ordinance
- (I) Words importing masculine gender include the feminine gender.
- (m) Words importing singular number include the plural number and vice versa:
- (n) Expression referring to writing shall, unless the contrary intention appears, be construed as including references to printing, lithography, photography and other modes of representing or reproducing words in a visible form.
- (o) Words importing persons shall include bodies corporate
- (p) Unless the context otherwise requires words or expressions contained in these Articles shall bear the same meaning as in the Ordinance.

#### IL CAPITAL AND SHARES

#### A. SHARE RIGHTS

#### 3. Authorized Capital:

The authorized capital of the Company is PKR 100.000 (Pak Rupees One Hundred Thousand only) divided into 10.000 (Ten Thousand) shares of PKR. 10/- (Rupees Ten) each with power to the Company from time to time to increase or reduce or reorganize the said capital and divide the shares in the capital for the time being into several classes in accordance with the provisions of the Companies Ordinance. 1984 and the rules, regulations and notifications framed thereunder

#### 4. Issuance of <u>Shares Under Directors' Control</u>:

Subject to the provisions of the Ordinance and the rules, regulations and notifications framed thereunder and these Articles, the issuance of the shares shall be under the control of the Board who may elicit or otherwise dispose off the same or any of them to such persons, on such terms and conditions, and at such times as the Board thinks fit, and with full powers to give to any person the call of any shares at a premium or at part or at a discount, or on a redeemable basis, and for such time and for such consideration as the Board thinks fit.

#### 5. Amount Payable on Application

No shares shall be offered to the public for subscription except upon the term that the amount payable on application shall be the full amount of the nominal amount of the share.

#### 6. Allotment of Shares:

The Directors shall, as regards any allotrnent of shares, duly comply with such of the provisions of Sections 68 to 73, as may be applicable to the Company.

#### 7. Share Certificates:

Every person whose name is entered as a member in the Register shall, without payment, be entitled to receive within ninety days after allotment or within forty-five days of the application for registration of transfer, certificate under the Seal specifying the share or shares held by him and the amount paid up thereon.

Provided that, in respect of a share or shares held jointly by several persons, the Company shall not be bound to issue more than one certificate, and delivery of a certificate for a share to one of several joint shall be sufficient delivery to all

#### 8. Issuance of New Certificate:

It a share certificate is defaced, lost or destroyed, it may be renewed on payment of such fee, if any, not exceeding ten rupees, and on such terms, if any, as to evidence and indemnity and payment of expenses incurred by the Company in investigating title as the Directors think fit.

### 9. <u>Certificate Under Sea</u>l:

The certificate of title to shares shall be issued under the authority of the Directors or of a committee of Directors when authorized thereto by the Directors in such manner and form as the Directors may from time to time prescribe, and shall bear the autographic signature of two Directors or one Director and the secretary of the Company. The Seal shall affixed to every share certificate issued by the Company.

#### 10. Joint Holders:

The Company shall not be bound to register more than four persons as the joint holders of any share.

#### 11. Frusts Not Recognized:

Except as required by law, no person shall be recognized by the Company as holding any shares upon any trust.

#### B. TRANSFER OF SHARES

#### 13. <u>Transfer</u>:

The instrument of transfer of any share in the Company shall be executed both by the transferor and transferee, and the transferor shall be deemed to remain holder of the share until the name of the transferee is entered in the Register in respect thereof.

#### 14. Form of Transfer:

Shares in the Company shall be transferred in any usual or common form which the Directors shall approve.

#### 15. Non – Refusal of Transfer of Shares:

The Directors shall not refuse to transfer any fully paid shares unless (i) it is in contravention of Article 13 hereinabove or (ii) the transfer deed is defective or invalid. The Directors may decline to recognize any instrument of transfer unless:

- (a) a fee not exceeding twenty rupees as may be determined by the Directors is paid to the Company in respect thereof; and
- (b) the duly stamped instrument of transfer is accompanied by the certificate of the shares to which it relates, and such other evidence as the Directors may reasonably require to show the right of the transferor to make the transfer. If the Directors refuse to register a transfer of shares, they shall within one Month after the date on which transfer deed was lodged with the Company send to the transferee and the transferee, who shall, after removal of such defect or invalidity be entitled to re-lodge the transfer deed with the Company.

#### 16. Closure of Register:

On giving seven days previous notice in the manner provided in the Ordinance, the Register may be closed for such period or periods not exceeding forty-five (45) days in any one year as the Directors may from time to time determine, so that the Register shall not be closed for a longer period than thirty (30) days at a time.

#### C. TRANSMISSION OF SHARES

#### 17. Transmission:

The executors, administrators, heirs, or nominees, as the case may be, of a deceased sole holder of a share shall be the only persons recognized by the Company as having any title to the share, but nothing herein contained shall release the estate of a deceased holder (whether sole or joint), from any liability (whether sole or joint) in respect of any share solely or jointly held by him. In any case in which a grant of probate or letters of administration to the estate of a deceased sole or any surviving holder has not been obtained, the Board may, but shall not be bound, to recognize the title of any person claiming to be entitled to the deceased holder's shares on production by such claimant of a succession certificate or such ether evidence of title as the Board may deem sofficient, and upon the claimant furnishing such indemnity, if any, as the Board may require, in the case of a share registered in the nomes of two of more holders, the survivor or survivors shall be the only persons recognized by the Company as having any title to the share.

#### 18. Election to Register or Transfer

Any person becoming entitled to a share in consequence of the death or insolvency of a member shall, upon such evidence being produced as may from time to time be required by the Directors, have the right either to be registered as a member in respect of the share or, instead of being registered himself, to make such transfer of the share as the deceased or insolvent person could have made; but the Directors shall, in either case have the same right to decline or suspend registration as they, would have had in the case of a transfer of the share by the deceased or insolvent person before the death or insolvency.

#### 19. Rights of Person Entitled by Transmission.

A person becoming entitled to a share by reason of the death or insolvency of the holder shall be entitled to the same dividends and other advantages to which he would be entitled if he were the registered holder of the share, except that he shall not, before being registered as a member in respect of the share, be entitled in respect of it to exercise any right conferred by membership in relation to meetings of the Company.

#### 20. Liability for Transmission:

The Company shall incur no liability or responsibility whatsoever in consequence of its registering or giving effect to any transfer of shares made or purporting to be made by any apparent legal owner thereof(as shown or appearing in the register) to the prejudice of persons having or claiming any equitable right, title or interest to or in the same shares, notwithstanding that the Company may have had notice of such equitable right, title or interest or notice prohibiting registration of such transfer, and the Company shall not be bound or required to regard or attend or give effect to any notice which may be given to it of any equitable right, tille or interest, or be under any liability whatsoever for refusing or neglecting so to do, but the Company shall nevertheless be at liberty to regard and attend any such notice and give effect thereto, if the Board shall so think fit

#### D. ALTERATION OF CAPITAL

#### 21. Power to Increase Capital:

The Company may, from time to time, by ordinary resolution increase the share capital by such sum, to be divided into shares of such amount, as the resolution shall prescribe.

#### 22. Further Issue of Capital:

All further issue of shares capital shall first be subject to such of the provisions of Section 86 as are applicable to the Company. Thereafter, the Directors may dispose off the same in such manner as they think most beneficial to the Company.

#### 23. Provisions Applicable to New Shares:

Except and so far as otherwise provided by the conditions of issue or by these Articles, any new shares shall be subject to the same provisions with reference to transfer, transmission and otherwise as the shares in the original share capital.

#### 24. Consolidation and Sub-division:

The Company may, by ordinary resolution:

- (a) consolidate and divide its share capital into shares of larger amount than its existing shares;
- (b) sub-divide its existing shares or any of them into shares of smaller amount than is fixed by the Company's Memorandum of Association, subject, nevertheless, to the provisos to clause (d) of sub-section (1) of Section 92;
- (c) cancel any shares which, at the date of the passing of the resolution, have not been taken or agreed to be taken by any person.

### 25. Reduction of Share Capital:

The Company may, by Special Resolution, reduce its share capital in any manner and with, and subject to, any incident authorized and consent required by law.

#### III. MEETINGS AND PROCEEDINGS

#### A. GENERAL MEETINGS

#### 26. Statutory Meeting:

The statutory general meeting of the Company shall be held within the period required by Section 157.

#### 27. Annual General Meeting:

A general meeting to be called annual general meeting, shall be held, in accordance with the provisions of Section 158, within eighteen Months from the date of incorporation of the Company and thereafter once at least in every year within a period of four Months following the close of its financial year and not more than fifteen Months after the holding of its last preceding annual general meeting as may be determined by the Directors.

#### 28. Other Meetings:

All general meetings of the Company other than the statutory meeting or any annual general meeting shall be called extraordinary general meeting.

#### 29. Extraordinary Meetings:

The Directors may whenever they think fit, call an extraordinary general meeting, and extraordinary general meetings shall also be called on such requisition, or in default, may be called by such requisitionists, as is provided by Section 159. If at any time there are not within Pakistan sufficient Directors capable of acting to form a quorum, any Director of the Company may call an extraordinary general meeting in the same manner as nearly as possible as that in which meetings may be called by the Directors.

#### B. NOTICE AND PROCEEDINGS

#### 30. Notice of meetings:

Twenty-one (21) days notice at the least (exclusive of the day on which the notice is served or deemed to be served, but inclusive of the day for which notice is given) specifying the place, the day and the hour of meeting and, in case of special business, the general nature of that business, shall be given in the manner provided by the Ordinance for the general meeting, to such persons as are, under the Ordinance or the regulations of the Company, entitled to receive such notices from the Company, and in case of any foreign company having a registered office outside Pakistan, notice must be given by telex if such foreign company so desires; but the accidental omission to give notice to, or the non-receipt of notice by, any member shall not invalidate the proceedings at any general meeting.

#### 31. Special Business:

All business shall be deemed special that is transacted at an extraordinary general meeting, and also all that is transacted at an annual general meeting with the exception of declaring a dividend, the consideration of the accounts, balance sheet and the reports of the Directors and auditors, the election of directors, the appointment of, and the fixing of the remuneration of, the auditors.

#### 32. Notice for Special Resolution

Where it is proposed to pass a Special Resolution, at least twenty-one day's notice specifying the intention to propose the resolution as a Special Resolution, and specifying the date, place, and hour of meeting, whether annual or extraordinary, and the nature of the business, shall be given.

#### 33. Reduced Period for Notice:

With the consent of all members entitled to receive notice of a meeting, or to attend and vote at any such meeting, a meeting may be convened by shorter notice than specified above.

#### 34. Quorum:

No business shall be transacted at any general meeting unless a quorum of members is present at that time when the meeting proceeds to business. Two members present personally who represent not less than twenty-five per cent (25%) of the total voting power, either on their own account or as proxies, shall form a quorum for the meeting.

#### 35. Effect of Quorum Not Being Present:

If within half an hour from time appointed for the meeting a quorum is not present, the meeting, if called upon the requisition of members, shall be dissolved; in any other case, it shall stand adjourned to the same day in the next week at the same time and place, or to such other day, time and place as the Board may by notice to the members appoint. If at the adjourned meeting a quorum is not present, being not less than two, shall be a quorum.

#### 36. Chairman of Meeting:

The Chairman of the Board, and in his absence the Deputy Chairman of the Board, shall preside as chairman at every general meeting of the Company, but if there is no such chairman, or if at any meeting he is not present within fifteen minutes after the time appointed for the meeting, or is unwilling to act as chairman, any one of the Directors present may be elected to be chairman, and if none of the Directors is present, or willing to act as chairman, the members present shall choose one of their number to be chairman.

#### 37. Adjournment:

The chairman may, with the consent of any meeting at which a quorum is present (and shall if so directed by the meeting), adjourn the meeting from time to time and from place to place, but no business shall be transacted at any adjourned meeting other than the business left unfinished at the meeting from which the adjournment took place. When a meeting is adjourned for ten days or more, notice of the adjourned meeting shall be given as in the case of an original meeting. Save as aforesaid, it shall not be necessary to give any notice of any adjournment or of the business to be transacted at an adjourned meeting.

#### 38. <u>Voting</u>:

At any general meeting a resolution put to the vote of the meeting shall be decided on a show of hands unless a poll is (before or on the declaration of the result of the show of hands) demanded. Unless a poll is so demanded, a declaration by the chairman that a resolution has, on a show of hands, been carried, or carried unanimously, or by a particular majority, or lost, and an entry to that effect in the book of the proceedings of the Company shall be conclusive evidence of the fact, without proof of the number or proportion of the votes recorded in favor of, or against, that resolution.

#### 39. Demand for Poll:

A poll may be demanded only in accordance with the provisions of Section 167

#### 40. Manner of Taking Poll:

If a poll is duly demanded, it shall be taken in accordance with the manner laid down in Section 168 and the result of the poll shall be deemed to be the resolution of the meeting at which the poll was demanded. A poll demanded on the election of chairman or on a question of adjournment shall be taken at once. The demand for a poll shall not prevent the continuation of the meeting for the transaction of any business other than the question on which the poll was demanded.

#### 41. Casting Vote:

In the case of an equality of votes, whether on a show of hands or on a poll, the chairman of the meeting at which the show of bands takes place, or at which the poll is demanded, shall have and exercise a second or casting vote:

#### C. VOTES OF MEMBERS

#### 42. Right to Vote:

Subject to any rights or restrictions for the time being attached to any class or classes of shares, on a show of hand every member present in person or by proxy shall have one vote except for election of directions in which case the provisions of Section 178 shall apply. On a poll every member shall have voting rights as laid down in Section 160

#### 43. Voting by Joint Holders:

In case of joint-holders, the vote of the senior who tenders a vote, whether in person or by proxy, shall be accepted to the exclusion of the votes of the other joint-holders, and for this purpose seniority shall be determined by the order in which the names stand in the Register.

#### 44. Member of Unsound Mind:

A member of unsound mind, or in respect of whom an order has been made by any court having jurisdiction in lunacy, may vote, whether on show of hands or on a poli, by his committee or other legal guardian, and any such committee or guardian may, on a poli, vote by proxy.

#### 45. Voting: Corporation Representatives:

On a poll votes may be given either personally or by proxy. Provided that no body corporate shall vote by proxy as long as a resolution of its directions in accordance with the provisions of Section 162 is in force.

#### 46. Proxy to be in Writing:

The instrument appointing a proxy shall be in writing under the hand of the appointer or of his attorney duly authorized in writing. A proxy must be a member of the Company.

#### 47. Instrument Appointing Proxy to be Deposited:

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

#### 48. Form of Proxy:

An instrument appointing a proxy may be in the following form or a form as near thereto as may be

#### Zorlu Solar Pakistan (Private) Limited

Date:\_\_\_\_\_

Signature:\_\_\_\_\_

#### 49. <u>Revocation of Authority</u>:

A vote given in accordance with the terms of an instrument of proxy shall be valid notwithstanding the prior death or insanity of the principal or revocation of the proxy or of the authority under which the proxy was executed, or the transfer of the share in respect of which the proxy is given, provided that no intimation in writing of such death, insanity, revocation or transfer as aforesaid shall have been received by the Company at the Office before the commencement of the meeting or adjourned meeting at which the proxy is used.

#### 50. Irrevocable Proxy:

Any proxy declared expressly on its face to be irrevocable shall not be revoked or be deemed revoked by the member giving such proxy whether by attendance at any meeting held during the period of such proxy or by any other action on his part whatsoever or otherwise during the term of such proxy if such proxy is furnished to and filed with the records of the Company, and the Company shall be bound to recognize and give effect to such proxy in accordance with the terms thereof.

#### IV. MANAGEMENT AND ADMINISTRATION

#### A. BOARD OF DIRECTORS

#### 51. Number of Directors:

The number of Directors shall be fixed from time to time by the Directors and shall not in any case be less than three. The followings persons shall be the first directors of the Company:

- (i) Olgun Zorlu;
- (ii) Mehmet Emre Zorlu; and
- (iii) Ömer Yüngül

#### 52. Below Minimum:

The continuing Directors may act notwithstanding any vacancy in their body, but if the minimum falls bellows the number fixed by Article 51 hereof, the Directors shall not, except for the purpose of filling a vacancy in their number, act so long as the number remains below the minimum.

#### 53. Qualification of Directors & Share Qualification:

Save as provided in Section 187, no person shall be appointed as a Director unless he is a member of the Company. A Director shall not require any share qualification, so long as only subscribers' share is in (soue). After the first issue of shares the qualification of a Director shall be holding of a minimum one (1) share in the Company at least in his own name. In the case of (i) Directors representing the Government or an institution or authority which is a member, (ii) a whole-time director who is an employee of the Company; (iii) a chief executive, or (iv) a person representing a creditor, no qualification shall be required.

#### 54. Chairman of the Board:

The Directors may elect one of their number as the Chairman of the Board and vest in him such powers and functions as they may deem fit in relation to the management and administration of the affairs of the Company subject to their general supervision and control.

#### 55. Deputy Chairman of the Board:

The Directors may elect one of their number as the Deputy Chairman of the Board and vest in him such powers and functions as they may deem fit in relation to the management and administration of the affairs of the Company subject to their general supervision and control.

#### 56. Managing Director / Chief Executive:

The Directors may elect one of their number, or from outside their body, to be the Managing Director of the Company and vest in him such powers and functions as they deem fit in relation to the management and administration of the affairs of the Company subject to their general supervision and control. The Managing Director shall be the Chief Executive of the Company and, if not already a Director, he shall be deemed to be a

Director of the Company and be entitled to all the rights and privileges and subject to all the liabilities of that office.

#### 57. <u>Remuneration</u>:

Subject to any approval or limits required by law, terms and conditions and remuneration of

- (a) a Director for performing extra services, including the holding of the office of Chairman,
- (b) the Managing Director/Chief Executive, and
- any Director for attending the meetings of the Directors or a Committee of Directors,

shall he determined by the Board.

#### B. POWERS AND DUTIES OF DIRECTORS

#### 58. General Management Powers:

The control of the Company shall be vested in the Board and the business of the Company shall be managed by the Directors, who may pay all expenses incurred in promoting and registering the Company, and may exercise all such powers of the Company as are not by the Ordinance or by these Articles, required to be exercised by the Company in general meeting, subject nevertheless to the provisions of the Ordinance or to any of these regulations, and such regulations being not inconsistent with the aforesaid provisions, as may be prescribed by the Company in general meeting but no regulation made by the Company in general meeting shall invalidate any prior act of the Directors which would have been valid if that regulation had not been made.

#### 59. Borrowing Powers:

The Board may from time to time borrow any moneys for the purposes of the Company from the members or from any other persons, firms, Companies, corporations, institutions, or banks, or the Directors may themselves lend any money to the Company.

#### 60. Power to Secure:

The Board may secure payment of such sum or sums of money in such manner and upon such terms and conditions as they think fit, and in particular by the issue of bearer and registered bonds, perpetual or redeemable debentures, or by mortgage or charge or other security on the whole or any part of the property, assets and rights of the Company (both present and future). Any bonds, debentures or other securities issued or to be issued by the Company shall be under the control of the Board which may issue them upon such terms and conditions and in such manner and for such consideration as shall be considered by the Board to be for the benefit of the Company.

#### 61. Special Terms:

Any bonds, debentures or other securities may be issued at a discount, premium or otherwise and with any special privileges as to redemption, surrender, drawing, convertibility into shares, attending and voting at meetings of the Company, appointment of Directors and otherwise, provided that debentures with the right to vote or convertible into shares shall not be issued unless authorized by a Special Resolution.

#### 62. Duties of Direction:

The directors shall duly comply with the provisions of the Ordinance and in particular with the provisions in regard to the registration of the particulars of mortgages and charges affecting the property of the Company or created by it, to the keeping of a register of the Directors, and to the sending to the registrar of an annual list of members and a summary of particulars relating thereto, and notice of any consolidation or increase of share capital, or sub-division of shares, and copies of Special Resolutions and a copy of the register of Directors and notifications of any changes therein.

#### 63. Benefits:

The Board may pay and agree to pay pension or other retirement, superannuation, death or disability benefits or allowances to any person in respect of any Director or former Director who may hold or may have held any executive office or employment under the Company, or any subsidiary company of the Company, or its holding company (if any), and for the purpose of providing any such pensions or other benefits or allowances, may contribute to any scheme or fund and may make payments towards insurance or trusts in respect of such persons.

#### 64. Minute Books:

The Directors shall cause minutes to be made in books provided for the purpose of

- (a) all appointments of officiers made by the Directors:
- (b) the names of the Directors present at each meeting of the Directors and of any committee of the Directors.
- (c) all resolution and proceedings at all meetings of the Company and of the Directors and of committees of Directors and every Director present at any meeting of Directors or committee of Directors shall sign his name in a book to be kept for that purpose.

#### C. DISQUALIFICATION OF DIRECTORS

#### 65. Disgualification of Directors:

No person shall become a Director of the Company if he suffers from any of the disabilities or disqualifications mentioned in Section 187 and, if already a Director, shall cease to hold such office from the date he so becomes disqualified or disabled or

- (a) if removed by a resolution of members as hereinafter provided; or
- (b) if by notice in writing given to the Company he resigns his office.

Provided, however, that no Director shall vacate his office by reason only of his being a member of any company which has entered into contracts with, or done any work for, the Company but such Director shall not vote in respect of any such contract or work, and if he does so vote, his vote shall not be counted.

#### D. PROCEEDINGS OF DIRECTORS

#### 66. Meeting of Directors:

The Directors may meet together for the despatch of business, adjourn and otherwise regulate their meetings, as they think fit. As feast two Directors personally present shall constitute a quorum, however, where the Directors consider that one or more Directors may not be personally present at a the designated venue, meeting of the Directors may be duly convened through audio and/or video conference or other modern technologies acceptable to the Board, provided, further, that the secretary shall secure audio or video, as the case may be, recording of the proceedings of such meeting and keep in custody together with other relevant record. Questions arising at any meeting shall be decided by a majority of votes. A Director 'may, and the secretary on the requisition of a Director shall, at any time, summon a meeting of Directors. At least four clear days notice must be given to all Directors to summon a meeting of the Board, and such notice shall set forth the purpose or purposes of which such meeting, or to attend and vote at any such meeting, a meeting of the Board may be convened by shorter notice than specified in this Article.

#### 67. Chairman of Directors Meetings:

The Chairman of the Board shall preside at all meetings of the Board but, if at any meeting the chairman is not present within len minutes after the time appointed for holding the same or is unwilling to act as chairman, the Deputy Chairman shall preside, but, if at any meeting the Deputy Chairman is not present within ten minutes after the time appointed for holding the same or is unwilling to act as chairman, the Directors present may choose one of their number to be chairman of the meeting. In case of an equality of votes, the chairman shall have and exercise a second or casting vote.

#### 68. <u>Committees</u>:

The Directors may delegate any of their powers not required to be exercised in their meeting to committees consisting of such member or members of their body as they think fit. Any committee so formed shall, in the exercise of the powers so delegated, conform to any restrictions that may be imposed on it by the Directors.

#### 69. Chairman of Committee Meetings:

A committee may elect a chairman of its meetings, but if no such chairman is elected, or if at any meeting the chairman is not present within ten minutes after the time appointed for holding the same or is unwilling to act as chairman, the members present may choose one of their number to be chairman of the meeting.

#### 70. Proceedings of Committee Members:

A committee may meet and adjourn as it thinks proper. Questions arising at any meeting shall be determined by a majority of votes of the members present. In case of an equality of votes, the chairman shall have and exercise a second or casting vote.

#### 71. Validity of Directors Acts:

All acts done by any meeting of the Directors or of a committee of Directors, or by any person acting as a Director, shall, notwithstanding that it be afterwards discovered that there was some defect in the appointment of such Directors or persons acting as aforesaid, or that they or any of them were disqualified, be as valid as if every such person had been duly appointed and was qualified to be a Director.

#### 72. Resolution by Circulation:

A resolution in writing circulated to ad the Directors and signed by a majority of them or affirmed by them through facsimile, telex or telegram or other means of communication acceptable to the Board shall be as valid and effectual as if it had been passed at a meeting of the Directors duly convened and held.

#### E. ELECTION AND REMOVAL OF DIRCTORS

#### 73. First Election of Directors:

At the first annual general meeting of the Company, all the Directors shall stand retired from office, and Directors shall be elected in their place in accordance with Section 178 for a term of three years.

#### 74. Eligibility for Re-election:

A retiring Director shall be eligible for re-election.

#### 75. Election in Accordance with Ordinance:

The Director shall comply with the provisions of Section 174 to 178 and Section 180 and 184 relating to the election of Directors and matters ancillary thereto.

#### 76. Filling of Casual Vacancy:

Any casual vacancy occurring on the Board of Directors may be filled up by the Directors, but the person so chosen shall be subject to retirement at the same time as it be had become a Director on the day on which the Director in whose place he is chosen was last elected as Director.

#### 77. Removal of Director:

The Company may remove a Director but only in accordance with the provisions of the Ordinance.

#### 78. Alternate Directors:

Any Director not permanently resident in Pakistan and any Director so resident but intending to be absent therefrom for a period of not less than three months may appoint any person acceptable to the Board to be an Alternate Director of the Company to act for him. Every such appointment shall be by writing under the hand of the Director making the appointment. An alternate Director so appointed shall not be entitled to appoint another Alternate Director, but shall otherwise be subject to the provisions of the Ordinance and these Articles with regard to directors. An Alternate Director shall be entitled to receive notice of all meetings of the Board and to attend and vole as a Director at any such meeting at which the Director appointing him is not personally present, and generally to perform all the functions of his appointer as Director in the absence of such appointer. An Alternate Director shall ipso facto cease to be an Alternate Director if his appointer for any reason ceases to be a Director or if and when his appointer returns to the district where meetings of the Directors are ordinarily held, or removes the appointee from office by notice in writing under the hand of the appointer.

#### V THE SEAL

79. Common Seal:

The Directors shall provide a common seal of the Company which shall not be affixed to nay instrument except by the authority of a resolution of the Board or by a committee of Directors authorized in that behalf by the Directors, and two Directors or one Director and the secretary of the Company shall sign every instrument to which the common seal is affixed.

#### 80. Official Seal:

The Directors may provide for the use in any territory, district or palace not situated in Pakistan, of an official seal which shall be a facsimile of the common seal of the company, with the addition on its face of the name of every territory, district or place where it is to be used. The provisions of Section 213 shall apply to the use of the official seal.

#### VI. DIVIDENDS AND RESERVE

#### 81. Declaration of Dividends:

The Company in general meeting may declare dividends but no dividend shall exceed the amount recommended by the Directors.

#### 82. Interim Dividends:

The Directors may form time to time pay to the members such interim dividends as appear to the Directors to be justified from the profits of the Company.

#### 83. <u>Dividends Payable Out of Profits:</u>

No dividends shall be paid otherwise than out of profits of the year or any other undistributed profits from prior years. No unpaid dividend shall bear interest against the Company.

#### 84. Dividends Payable on Amount paid on Shares:

Subject to the rights of persons (if any) entitled to shares with special rights as to dividends, all dividends shall be declared and paid according to the amounts paid on the shares, but if and so long s nothing is paid upon any of the shares in the Company, dividends may be declared and paid according to the amounts of the shares.

#### 85. Reserve Fund:

The Directors may, before recommending any dividend, set aside out of the profits of the Company such sums as they think proper as a reserve or reserves which shall, at the discretion of the Directors, be applicable for meeting contingencies, or for equalizing dividends, or for any other purpose to which the profits of the Company may be properly applied, and pending such application may, at the like discretion, either be employed in The business of the Company or be invested in such investments (other than shares of the Company) as the Directors may, subject to the provisions of the Ordinance, from time to time think fit.

#### 86. Profit Carried Forward:

The Directors may carry forward any profits which they may think prudent not to distribute, without setting them aside as reserve

#### 87. Payment of Dividends in Specie:

With the Sanction of a general meeting any dividend may be paid wholly or in part by the distribution of specific assets and in particular of paid-up shares or debentures of any other company or in any one or more of such ways. Where any difficulty arises in regard to such distribution, the Directors may settle the same as they think expedient and in particular may fix the value for distribution of such specific assets or any part thereof and may determine that cash payments shall be made to any members upon the footing of the value so fixed, in order to adjust the rights of all members, and may vest any such specific assets in trustees upon trust for the members entitled to the dividend as may seem expedient to the Directors.

#### 88. Dividends to Joint Holders:

If several persons are registered as joint-holders of any share, any one of them may give effectual receipt for any dividend payable on the share

#### 89. Notice of Dividend:

Notice of any dividend that may have been declared shall be given to the persons entitled to a share therein. The Company may, if it deems fit, give such notice by advertisement in a newspaper circulating in the Province in which the Office is situated

#### 90. Period for Payment Dividend:

The dividend shall be paid within the period laid down in Section 251

#### 91. Non-Forfeiture of Dividends:

The non-forfeiture of dividends is hereby secured provided that, all dividends unclaimed for one year after having been declared may be invested or otherwise made use of by the Directors for the benefit of the Company until claimed, and the Company shall not be constituted a trustee in respect thereof. All dividends unclaimed for a period of six (6) years after having been declared may be forfeited and shall, in such cases revert to the Company.

#### VII, ACCOUNTS

#### 92. Books of Account:

The Directors shall cause to be kept proper books of account as required under Section 230.

#### 93. Place where Accounts Kept:

The books of account shall be kept at the Office or at such other place as the Directors shall think fit and shall be open to inspection by the Directors during business hours.

#### 94. Inspection by Members:

The Directors shall from time to time determine whether and to what extent and at what time and places and under what conditions or regulations the accounts and books or papers of the Company or any of them shall be open to the inspection of members not being Directors, and no member not being a Director) shall have any account and book

or papers of the Company except as conferred by law or authorized by the Directors or by the Company in general meeting

#### 95. <u>Annual Accounts:</u>

The Directors shall as required by Sections 233 and 236 cause to be prepared and to be laid before the Company in general meeting such profit and loss accounts and balance sheets duly audited and reports as are referred to in those sections.

#### 96. Balance Sheet and Profit and Loss Account:

A balance-sheet, profit and loss account, and other reports referred to in the preceding Article shall be made out in every year and laid before the Company in the annual general meeting made up to a date not more than six months before such meeting. The balance sheet and profit and loss account shall be accompanied by a report of the auditors of the Company and the report of Directors.

#### 97. Copy of Accounts to be Sent to Members:

A copy of the balance sheet and profit and loss account and reports of Directors and auditors shall, at least twenty-one days preceding the meeting, to be sent to the persons entitled to receive notices of general meetings in the manner in which notices are to be given as hereinafter provided

#### 98. <u>Compliance with Ordinance</u>:

The Directors shall in all respect comply with the provisions of Sections 230 to 236.

#### 99. Capitalization of Profits:

The Company in general meeting may upon the recommendation of the Directors resolve that it is desirable to capitalize any part of the amount for the time being standing to the credit of any of the Company's reserve amounts or to the credit of the profit and loss account or otherwise available for distribution, and accordingly that such sum be set free for distribution among the members who would have been entitled thereto if distributed by way of dividend and in the same proportions on condition that the same be not paid in cash but be applied in or towards paying up in full un-issued shares or debentures of the Company to be allotted and distributed, credit as fully paid up to and amongst such members in the proportion aforesaid, and the Directors shall give effect to such resolution.

#### 100. Audit:

Auditors shall be appointed and their duties regulated in accordance with Section 252 to 255.

#### 101. Notice to Members etc:

Notice shall be given by the Company to members and auditors of the Company and other persons entitled to receive notice in accordance with Section 50.

#### IX SECRECY

#### 102. Secrecy:

Every Directors, manager, adviser, auditor, trustee, member of a committee, officer, servant, agent, accountant or other person employed in the business of the Company shall, if so, required by the Directors before entering upon his duties, sign a declaration pledging himself to observe a strict secrecy respecting all transactions of the Company with its customers and the state of accounts with individuals and in matters relating thereto, and shall by such declaration pledge himself not to reveal any of the matters which may come to his knowledge in the discharge of his duties except when required to do so by the Directors or by any general meeting or by any a court of law and except so far as may be necessary in order to comply with any of the provisions in these presents.

#### 103. Members' Access to Company Premises:

No member or other person (not being a Director) shall be entitled to enter upon the property of the Company or examine the Company's premises or properties without the permission of a Director, subject to Article 86, to require discovery of or any information respecting any detail of the Company's trading or any matter which is or may be in the nature of a trade secret, mystery of trade, or secret process or of any matter whatsoever which may relate to the conduct of the business of the Company and which in the opinion of the Directors will be inexpedient, in the interest of the members of the Company, to communicate

#### X. RECONSTRUCTION

#### 104. <u>Reconstruction</u>:

On any sale of the undertakings of the Company the Directors or the liquidators on a winding up may, if authorized by a Special Resolution, accept fully paid shares, debentures or securities of any other company, either then existing or to be formed for the purchase in whole or in part of the property of the Company, and the Directors (if the profits of the Company permit) or the liquidators (in a winding up), may distribute such shares or securities, or any other properties of the Company amongst the members without realization, or vest the some in trustee for them, and any Special Resolution may provide for the distribution or appropriation of the cash, shares or other securities, benefits or property, otherwise than in accordance with the strict legal rights of the members or contributories of the Company, and for the valuation of any such securities or property at such price and in such manner as the meeting may approve, and all holders of shares shall be bound to accept and shall be bound by any valuation or distribution so authorized, and waive all rights in relation thereto save only such statutory rights (if any) as are, in case the Company is proposed to be or is in the course of being varied or excluded by these presents.

#### XI. WINDING UP

#### 105. Division and Distribution of Assets Upon Dissolution:

If the Company is wound up, the liquidator may, with the sanction of a Special Resolution of the Company and any other sanction required by law, divide amongst the members in specie or kind the whole or any part of the assets of the Company (whether they shall consist of property of same kind or not) and may, for such purpose, set such value as he deems fair upon any property to be divided as aforesaid and may determine how such division shall be carried out as between the members of different classes of members.

The liquidator may, with the like sanction, vest the whole or any part of such assets in trustee upon such trust for the benefit of the contributories, as the liquidator with the like sanction, shall think fit, but so that no member shall be compelled to accept any shares or other securities whereon there is any liability

#### XII. INDEMNITY

#### Indemnification: 106.

Every officer or agent for the time being of the Company may be indemnified out of the assets of the Company against any liability incurred by him in defending any proceedings, whether civil or criminal, arising out of his dealings in relation to the affairs of the Company, except those brought by the Company against him, in which judgment is given in his favor or in which he is acquitted, or in connection with any application under Section 488 in which relief is granted to him by the court.

#### XIII. ARBITRATION

#### Differences to be Referred to Arbitrator: 107.

Whenever any difference arises between the Company on the one hand and any of the members, their executors, administers or assigns on the other hand, touching the true intent or construction, or the incident or consequences of these Articles or of the statutes, or touching anything there or thereafter done, executed, omitted or suffered in pursuance of these Articles or of the statutes or touching any breach or alleged breach of these Articles, or any claim on account of any such breach or alleged breach, or otherwise relating to the premises, or to these Articles or to any statute affecting the Company or to any of the affairs of the Company, every such difference shall, as a condition precedent to any other action at law be referred, in conformity with the Arbitration Act, 1940, or any statutory modification thereof and any rules made thereunder, to the decision of an arbitrator to be appointed by the parties in difference or if they cannot agree upon a single arbitrator to the decision of two arbitrators of whom one shall be appointed by each of the parties in difference, or in the event of the two arbitrators not agreeing, then of an umpire to be appointed by the two arbitrators, in writing, before proceeding on the reference, and such decision shall be final and binding on the parties. The venue for arbitration shall be at Karachi.

(Notwithstanding the afore said ; An The event that a dispute, claim or controversy arises between the Company, its management of its An The event that a dispute, claim or controversy arises between the Company, its management of its shareholders, or between the shareholdes inter-se, or the directors inter-se, all steps may be taken to settle the dispute and resolve the issue through mediation by an accredited mediator before taking recourse to formal to formal dispute resolution such as arbitration or fitigation."

(amenderif)

108.

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

Name and Surname	Father's Husband's name in full	/ Nationality with any former Nationality	Occupation	Residential address (in full)	Number of shares taken by each subscriber	Signature
ZORLU ENERJI ELEKTRIK URETIM A.S. through its nominee	Zeki	Turkish	Executive	Organize Sanayi Bolgesi, Pembe Cad. No: 13 Bursa, Turkey Levazım	997 (Nine Hundred and Ninety Str. Shares Only)	Olh
				Mahallesi Koru Sk. Zorlu Center Blok No:2 Beşiktaş İstanbul		
Məhmet Emre Zorlu	Ahmet Nazif	Turkish	Executive	Levazım Mahallesi Koru Sk. Zorlu Centei Blok No:2 Beşiktas İstanbul	1 (One Share Only)	and and
Olgun Zorlu	Zeki	Turkish	Executive	Levazim Maltalitesi Koru Sk. Zorlu Center Blok No:2 Beşiktaş İstanbul	1 (One Share Only)	24
Örner Yüngül	Feyzi Kadri	Turkisi;	Exocutive	Alsancak Mahailesi 1476/1. Sokak 9/12 Konak - İzmir	1 (One Share Only)	M

Dated 22.09. 2016

C

Witness to the above signature

Signature Signature BELAT VELEC Name Mert Con Albayrak

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### FEASIBILITY STUDY REPORT

### <u>100 MW SOLAR PV POWER PROJECT FOR ZORLU SOLAR PAKISTAN</u> (PVT.) LIMITED (ZSPPL) AT BAHAWALPUR, PUNJAB.



**PROJECT COMPANY:** 

Zorlu Solar Pakistan (Pvt.) Ltd

**PROJECT CONSULTANTS:** 

**RENEWABLE RESOURCES (Pvt.) Ltd** 

**RE** RE

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APPROVED BY		Head of Projects Renewable Resc salman@renewa	s purces (Pvt.) Ltd ableresources.com.pk	
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## **LIST OF ABBREVIATIONS**

1						
	AC		Alternate Current			
	AEDB		Alternate Energy Development Board			
	CDM		Clean Development Mechanism			
	CFCs		hlorofluoro Carbons			
	Cm	1	Centimeter	entimeter		
	CO <sub>2</sub>		Carbon dioxide			
	СРРА		Central Power Purchasing Agency			
	DC	1	Direct Current			
	DISCOs	I	Distribution Companies			
	EE	E	nergy Efficiency			
	ЕМР	E	Environment Management Plan			
	EPA	E	Energy Purchase Agreement / Environmental Protection Agency			
	EPC	E	Engineering Procurement Construction			
	GDP	C	Gross Domestic Product			
	GHG	G	Green House Gas			
	GIS	Geographic Information System				
	GoP	Ģ	overnment of Pakistan			
	IEE	ir	nitial Environmental Examination			
	IPPs	Ir	ndependent Power Producers			
	الا	1	Joint Implementation			
	MEPCO	Multan Electric Power Company				
	km	к	lometer			
	kV	К	lovolt		-	
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kW	Kilowatt
LOI	Letter of Intent
LPG	Liquefied Petroleum Gas
LOS	Letter of Support
m²	Meter square
MW	Megawatt
NEPRA	National Electricity Power Regulatory Authority
NEQS	National Environmental Quality Standards
NOCs	No Objection Certificates
NREL	National Renewable Energy Laboratories
NTDC	National Transmission and Dispatch Company
0 & M	Operation & Management
PEPA	Pakistan Environment Protection Act
PMD	Pakistan Meteorological Department
PPDB	Punjab Power Development Board
RE	Renewable Energy
RE2	Renewable Resources (Pvt.) Ltd
WAPDA	Water and Power Development Authority
ZSPPL	Zorlu Solar Power (Pvt.) Ltd
QASP	Quaid-e-Azam Solar Park

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### **ACKNOWLEDGEMENTS**

The management of ZSPPL Ltd is thankful to Energy Department, Govt. of Punjab and the dedicated team of PPDB for generous support at all stages of project development and looks forward to continued support for future milestones.

The management of ZSPPL also looks forward to the cooperation of federal Government of Pakistan and other Government departments (NEPRA, NTDC, MEPCO, CPPA) which is being extended to the Project.

### **DISCLAIMERS**

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### **DOCUMENT INFORMATION**

### Purpose and Scope:

The purpose of this report is to provide information required for the relevant agencies to make informed decision regarding the implementation and execution of this project.

This document presents the technical, financial and commercial viability of this project within Pakistan's economic and regulatory framework.

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### **1 EXECUTIVE SUMMARY**

Located on the western stretch of the South Asian Continent, Islamic Republic of Pakistan is largely under the influence of tropical desert climate. The relative shortage of conventional energy resources in Pakistan, when coupled with the hiking energy prices worldwide, leads to a tension in the power supply of the country. It has become a top agenda of Pakistan government to find alternative energies, including solar power.

Government of Pakistan has formulated a policy to encourage the participation of private sector in the development and application of renewable energies. A Government organization called Punjab Power Development Board (PPDB) is established to facilitate the implementation of renewable energy projects.

Zorlu Solar Pakistan (Pvt.) Ltd is a subsidiary of Zorlu Enerji Group that was founded in 1993 with the foundation of Zorlu Energy Electricity Generation Inc. Zorlu Enerji is a global group of companies providing services in different areas of the energy sector. Zorlu Enerji Group offers an integrated service mix with the activities of different sectors of the energy sector, mainly electricity and steam production and sales carried out by Zorlu Energy, the only public company. Zorlu Enerji has a total installed power of 1046 MW, of which 700.3 MW is in Turkey.

Zorlu Enerji has a 100 percent share of Zorlu Energy Pakistan that is 56.4 MW Wind Power Plant located in the Jhimpir Sindh. The Wind power plant, in Jhimpir started commercial activity in 2013. The facility, which is Pakistan's first wind power plant, produces approximately 159 million kWh of electricity per year.

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### **1.1 PROJECT OVERVIEW**

Zorlu Solar Pakistan (Pvt.) Ltd (ZSPPL) is the Project Company for a 100 MW Solar Power Project located in Bahawalpur, Punjab province that is towards North-East of Karachi. The project site is located around 855 kilometers away from Karachi.

The total land area of the project site is about 500 acres allocated to Project Company by Energy Department, Punjab, for the implementation of 100 MW Solar PV project. The proposed site is located at latitude of 29°16'27.23"N and longitude of 71°47'41.85"E with elevation of around 117 to 128 meters.

The geographical location of the project is shown in Figure 1.



Figure 1: Geographical Location of Project

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Table 1: Project Site Coordinates				
	Latitude	Longitude		
Boundary 1	29°16'50.10"N	71°47'19.98"E		
Boundary 2	29°16'50.10"N	71°48'22.08"E		
Boundary 3	29°16'30.54"N	71°48'22.08"E		
Boundary 4	29°16'30.54"N	71°48'9.66"E		
Boundary 5	29°16'20.76"N	71°48'9.66"E		
Boundary 6	29°16'20.76"N	71°47'57.24"E		
Boundary 7	29°16'1.20"N	71°47'57.24"E		
Boundary 8	29°16'1.20"N	71°47'13.98"E		

The Project size will be 100 MW DC.

### 1.1.2 Project Status and Calendar

The complete feasibility study is being submitted. From here onwards, the Project shall pursue approval of feasibility and other project development tasks from the concerned stakeholders. In parallel, the Project shall also pursue Cost Plus Tariff Petition and signing of EPA / IA.

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### **Table 2: Project Planned Milestones**

	<b>2017</b>					
			gri Manuti			6 <sup>th</sup> Month
Preparation and Submission of Feasibility Study			in the second second second second second second second second second second second second second second second	289) 28 abade da ar		
Approval of Feasibility Study			e.			
Award of Generation License						
Tariff Determination						
Signing of EPA						
Signing of IA						
Financial Close						
Project Construction						
Project COD					La	

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#### 1.1.3 Geological Conditions

Bahawalpur was a princely state of the Punjab in what is now Pakistan, stretching along the southern bank of the Sutlej and Indus Rivers. It became part of Pakistan in 1947 and is divided into three districts: Bahawalpur, Rahimyar Khan and Bahawalnagar. Bahawalpur is located in Punjab and it's a 12th largest city in Pakistan. The city is capital of Bahawalpur District. The city was once the capital of the former princely state and later the province of Bahawalpur. The city was home to various Nawabs (rulers) and counted as part of the Rajputana states (now Rajasthan, India). The city is known for its famous palaces such as the Noor Mahal, Sadiq Ghar Palace, and Darbar Mahal, as well as the ancient fort of Derawar in the Cholistan Desert bordering India. The city is home to one of the few natural safari parks in Pakistan, Lal Suhanra National Park.

The princely state of Bahawalpur was founded in 1802 by Nawab Mohammad Bahawal Khan II after the break-up of the Durrani Empire. The city is over 4.51 kilometres long. Nawab Mohammad Bahawal Khan III signed a treaty with the British on 22 February 1833, guaranteeing the independence of the Nawab. The state acceded to Pakistan on 7 October 1947 when Nawab Sadiq Muhammad Khan Abbasi V Bahadur decided to join Pakistan at the time of independence. The predominantly Muslim population supported Muslim League and Pakistan Movement. After the independence of Pakistan in 1947, the minority Hindus and Sikhs migrated to India while Muslims refugees from India settled down in the Bahawalpur state. Bahawalpur became a province of Pakistan in 1952 and was merged into the province of West Pakistan on 14 October 1955. When West Pakistan was divided into four provinces Sindh, Balochistan, Khyber Pakhtunkhwa, and Punjab Bahawalpur was merged in Punjab.

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# 1.1.4 Summary of Power Production Estimates

The power production estimates have been calculated in detail based on the regional solar irradiance data, performance characteristics of solar panels and local weather conditions. The summary of power production estimates is given in **Table 3**.

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# Table 3: Summary of Power Production Estimate

raiameter	Value
Installed DC Power [kWp]	100,000
Irradiation on horizontal plane [kWh/m <sup>2</sup> ]	1930.6
Energy Yield [MWh]	179,5 <b>98</b>
Capacity Factor [%]	20.5 %

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### 1.1.5 EPC Contractor Selection

EPC Offers from multiple EPC contractors were considered. Currently, ZSPPL is leaned towards following Bidder. Details of the offer are as shown in Table 4.

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Table 4: Sp	ecifications of Solar Power E	uipment
Lead Bidder	Equipment	Manufacturer
Zorlu Industrial Pakistan (Pvt.) Ltd.	FS4115-3 (50 MW) FS4118-3 (50 MW)	Sungrow SG 2500HV

# 1.1.6 Design of Mechanical Works

Steel Support Structures will be designed and used to install solar panels. The steel structures with galvanized coating shall be directly imported from Turkey and some locals may also be used. The mechanical design shall bear the required level of corrosion and winds / gusts.

### 1.1.7 Design of Civil Works

The civil works will be required for the following purposes:

- Construction of Foundations for mounting of Solar Arrays.
- Construction of Power House.
- Construction of Office Building.

The design of civil works shall be according to the soil and seismic conditions; and to bear high winds / gusts.

# 1.1.8 Construction Management

The imported equipment shall come via Karachi Sea Port. The civil work materials shall be arranged from the nearest local markets / dealers. Certain items (steel accessories, local cables, electrical accessories shall come from appropriate cities including Islamabad, Karachi and Lahore.

No heavy machinery is required for construction and erection. There is semi-finished road access to the site, which easily serves for 10 ton trucks with little leveling. The site will be restored to the original landscape in the later phase of construction.

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### 1.1.9 0 & M Management

After the completion of construction, the Project shall be jointly managed with the principle of requiring "few on-duty staff".

The Project Site is separated into the production section and utility area. The production area includes the solar power equipment and accessories including power house. The offices are located in the production section. The location of support staff shall be arranged such that mutual communication and access is easy. The utility section is for daily living, including dormitories, dining rooms and the kitchen etc.

There will be on site support for routine maintenance and troubleshoot. For un-expected faults, maintenance resource and procedures shall be laid.

The project company shall be responsible for O & M service.

# 1.1.10 Environmental Management

A separate environment study has been carried out. There are no hazards. The minor adjustments required during construction phase have been addressed and mitigation plan is provided.

The Initial Environment Examination is attached as Annexure 3

#### 1.1.11 Health and Safety

During the construction and operation of the Project, the guideline of "safety first, (accident) prevention foremost" will be practiced. Comprehensive management and supervision will be applied to all staff members and the whole operation process, in order to ensure safe operation of the equipment and personal safety of workers.

A comprehensive safety system will be established during the preparation phase, and carefully implemented during the construction process. The systems of work sheet, operation sheet, shift relief, patrol inspection, operation guardianship, maintenance and over-haul will be strictly implemented.

A safety and health supervision department will be established, which is to be in charge of the education, training and management of safety and health related issues after the Project is put into operation.

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The systems of patrol inspection, operation guardianship, maintenance and over-haul will be established for the daily maintenance of production equipment, instruments and apparatus. The safety and health supervision department will be provided with appropriate inspection equipment, as well as necessary public education service for production safety.

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#### 1.1.12 CDM Aspect

The Project is a power generation project with renewable resource and virtually zero emission. When put into operation, the project can provide power supply to the national power grid, which currently is mainly relying on fossil fuel. Therefore, it can help to reduce the greenhouse gas emission from coal or oil-fired power generation. By estimation, using solar photovoltaic (PV) to generate 1 KWH electricity means saving 0.32 kg of standard coal, at the same time reducing the discharge of 0.272 kg of carbon dust pollution, 0.997 kg of carbon dioxide (CO<sub>2</sub>), sulfur dioxide (SO<sub>2</sub>) 0.03 kg, 0.015 kg nitrogen oxides (NOx).

After the completion of the station, it is expected to provide electricity grid each year about 179,598 MWh, compared with the same capacity of thermal power, equivalent to annually saving about 54947T of standard coal, reducing various atmospheric pollutant emissions, which reduce carbon dioxide (CO<sub>2</sub>) about 170000 T, sulfur dioxide (SO2) of about 5151T, nitrogen oxide (NOx) about 2576 T.

It is also consistent with the spirit of the Kyoto Protocol and qualifies for the application of CDM projects. NEPRA is allowing almost the same return on equity (RoE) to the thermal and the renewable energy projects. The Sponsors of the Project require CERs to bring the RoE at a level where they can invest in renewable energy projects in Pakistan in future as well. If the Project is approved and registered as a CDM project, CERs can provide extra financial resource for the Project. It will provide favorable conditions for the project financing, improve competitiveness of the project, and reduce investment risk during the project implementation process.

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# 1.1.13 Key Financial Figures

The key project figures are shown in Table 5.

	item	Description			Value	
1	<b>Project Capacity</b>				100 MW	
2	Annual Power Pro	oduction (GWh	/yr)		179.598	
3	Funding Plan		i.		75% DEBT. 25% EQUITY	4
4	Loan Period				13 YEARS	•
5	Grace Period				1 YEAR	
6	ROE				11%	
The de	etailed financial feas	sibility is attach	ed as Annex 4	I.		
nent Titl						
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# **1.2 RATIONAL FOR SOLAR POWER**

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

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

Alternatives to further fuel imports for electricity generation are the use of domestic coal, or generation from hydro-electric or other renewable sources, such as wind and solar power. These options will assist in reducing Pakistan's reliance on imported oil, and consequent vulnerability to changes in global oil prices which will in turn have a positive effect on the current trade deficit and inflating import bill. As with gas, securing future supplies of coal and hydro-electric power would rely on significant spending on infrastructure. Pakistan has domestic reserves of coal. However, coal currently makes up a very small proportion of total generation, largely the result of most of the reserves being located in one area, the Thar Desert. Exploiting the reserves would require huge and costly upfront investment in local infrastructure, and investment in transmission lines before power plant development could commence. Hydroelectric power already supplies almost 30% of electricity, and numerous sites for future investment in transmission to meet the expected power needs. Moreover, there are varying political stands on hydro-electric power options.

Looking at how the country's future electricity needs might be met in a way that supports the environmental objectives of the Government of Pakistan; solar power generation has the potential of being a strong contributor.

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The development of solar power generation projects could reduce dependence on fuels for thermal power generation, increase diversity in Pakistan's electricity generation mix, and reduce greenhouse gas (GHG) emissions avoiding thermal power generation.

Solar energy, on the other hand, 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 sq.m in a day. This amounts to about 2500-3000 sun shine hours and 1.9 - 2.3 MWh per sq.meter in a year. It has an average daily global isolation of 19 to 20 MJ/sq.meter 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.

Pakistan receives about 15.5x1014 kWh of solar irradiance each year with most regions receiving approximately 8 to 10 sunlight hours per day. The installed capacity of solar photovoltaic power is estimated to be 1600 GW per year, providing approximately 3.5 PWh of electricity (a figure approximately 41 times that of current power generation in the country).

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 photovoltaic and 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.

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# **1.3 COUNTRY OVERVIEW**

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

Pakistan has a tropical climate. It is hot and dry in most of its areas, with relatively high average annual temperature. The southern coastal areas have an average yearly temperature of 26°C. Most areas show temperatures higher than 40°C around noon in June and July.

Some parts of South Punjab, Sindh and Baluchistan even have temperatures higher extremes more than 50°C. The yearly precipitation in Pakistan is less than 250mm, with 1/4<sup>th</sup> of Pakistan having annual rainfall less than 120mm. Pakistan is under great influence of monsoon from Indian Ocean, which brings both precious rain and abundant wind energy resources.

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# **1.4 INDUSTRY OVERVIEW**

Every day the sun showers Earth with several thousand times as much energy as we use. Even the small amount that strikes our roof is many times as much as all the energy that comes in through electric wires. With the sun straight overhead, a single acre of land receives some four thousand horsepower, about equivalent to a large railroad locomotive. In less than three days the solar energy reaching Earth more than matches the estimated total of all the fossil fuels on Earth. It's all about converting maximum of it to useful energy. On average, solar power systems amortize themselves within 4 years, meaning after four years they have produced as much energy as it took to manufacture them. The expected lifetime of a system is 25-30 years.

The world solar insulation is given in Figure 4.





Top 10 solar power producers in the world are shown in Table 6.

Table 6: Specifications of Solar Power Equipment				
PV power station	Country	Total power(MW)		
Longyangxia Dam Solar Park	China	850		
Kamuthi Solar Power Project	India	648		
Solar Star (I&II)	USA	597		
Topaz Solar Farm	USA	550		
Desert Sunlight Solar Farm	USA	550		
Huanghe Hydropower Golmud Solar Park	China	500		
Copper Mountain Solar Facility	USA	450		
Quaid-e-Azam Solar Park	Pakistan	400		
Yanchi Sol <b>a</b> r Park	China	380		
Charanka Solar Park	India	345		

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### **1.5 PROJECT TEAM**

#### 1.5.1 The Project Company: Zorlu Solar Pakistan (Pvt.) Ltd.

Zorlu Solar Pakistan (Pvt.) Ltd is subsidiary of Zorlu Enerji Group, that was founded in 1993 with the foundation of Zorlu Energy Electricity Generation Inc. Zorlu Enerji is a global group of companies providing services in different areas of the energy sector. Zorlu Enerji Group offers an integrated service mix with the activities of different sectors of the energy sector, mainly electricity and steam production and sales carried out by Zorlu Energy, the only public company. Zorlu Enerji has a total installed power of 1046 MW, of which 700.3 MW is in Turkey.

Zorlu Enerji has a 100 percent share of Zorlu Energy Pakistan that is 56.4 MW Wind Power Plant located in the Jhimpir Sindh. The Wind power plant, in Jhimpir started commercial activity in 2013. The facility, which is Pakistan's first wind power plant, produces approximately 159 million kWh of electricity per year.

#### 1.5.2 Project Consultant: Renewable Resources (Pvt.) Ltd

Renewable Resources (RE2) is the overall Project Consultant and coordinated all the project development activities. The scope of work for RE2 in Project includes the feasibility study, coordination with all project development teams, tariff petition and energy purchase agreement.

RE2 provides consultancy services in the fields of Renewable Energy (RE), Energy Efficiency (EE) and Environment. RE2 offers services for "green" business innovation, customer education, project appraisal, project planning, design and management, development of feasibility studies and environmental studies, as well as client-specific research & surveys. The company has been incorporated as a private limited company in Pakistan under Companies Ordinance 1984.

RE2 provides high quality energy engineering and management consulting services to enable rapid deployment of efficient, cost-effective, reliable, and environment-friendly renewable energy systems. The customized technical solutions and services are dedicated to investment firms, energy groups, industries, financing institutions and public authorities involved in the development and / or acquisition of renewable and thermal power plants.

These services are backed with in-depth grip on technical, financial and administrative aspects at every stage that enables us to employ best practices in project development. This ultimately leads to implementation in accordance with the most efficient planning, which is a vital element in power projects in order to save unnecessary and huge overheads during execution.

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The RE2 team also has the expertise to deal with the legal aspects of power projects including Generation License, Tariff Application & justification, Energy Purchase Agreement and Implementation Agreement. The professional team of RE2 is well acquainted with the policies, regulations, methodologies and standards of the complete power projects cycle.

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# 2 COUNTRY & INDUSTRY PROFILE

The detailed stats and situation of energy in Pakistan, specific information and prospects of coal and international trends in coal based power sector is explained in Annex I.

At this juncture, Pakistan is encountering the worst electricity crises of the history resulting in extended load shedding to an extent which virtually suspends social life. The situation has further forced Government of Pakistan to again take decisions like early market shutdown, power cut off to industry, and two holidays per week thus affecting all business activities.

Pakistan's major electricity sources are thermal and hydro generation, meeting approximately 70% and 28% (respectively) of the country's annual electricity demand. The primary thermal generation fuels employed are furnace oil and gas. Oil import is a significant burden on the national exchequer. Import of gas could be seen as a viable option to overcome the depleting domestic reserves, but gas import has significant issues, mainly the need for substantial capital investment in infrastructure, security difficulties and physical terrain concerns. Moreover, it would still be an imported product.

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

Looking at how the country's future electricity needs might be met, coal has the potential of being a strong contributor in future because of being an indigenous resource and available in huge quantities in the country. The per kWh tariff for coal projects over the life cycle are now comparatively less than that of furnace oil tariff. Also, at international level, coal based power generation is a tested and proven technology, however, the technology possesses some environmental issues.

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# **3 REGULATORY REGIME**

The Pakistan Power Sector has a ministry overlooking the electricity business in the country and a regulatory authority, independent of the ministry, to control the business practices in the market. There are a number of stakeholders involved in the cycle:

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- Ministry of Water and Power (MoWP)
- National Electricity Power Regulatory Authority (NEPRA)
- National Transmission and Dispatch Company (NTDC)
- Punjab Power Development Board (PPDB)
- Central Power Purchase Agency Guarantee Limited (CPPA-GL)
- Energy Department, Government of Punjab.

#### 3.1 MINISTRY OF WATER AND POWER (MoWP)

The federal Ministry of Water and Power is the GoP's executive arm for all issues relating to electricity generation, transmission and distribution, pricing, regulation, and consumption. It exercises these functions through its various line agencies as well as relevant autonomous bodies. It also serves to coordinate and plan the nation's power sector, formulate policy and specific incentives, and liaise with provincial governments on all related issues.

### 3.2 NATIONAL ELECTRIC POWER REGULATORY AUTHORITY (NEPRA)

NEPRA has been created to introduce transparent and judicious economic regulation, based on sound commercial principles, in the electric power sector of Pakistan. NEPRA regulates the electric power sector to promote a competitive structure for the industry and to ensure the coordinated, reliable and adequate supply of electric power in the future. By law, NEPRA is mandated to ensure that the interests of the investor and the customer are protected through judicious decisions based on transparent commercial principles.

NEPRA remains to be the same platform for federal as well as provincial projects.

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### 3.3 NATIONAL TRANSMISSION AND DISPATCH COMPANY (NTDC)

National Transmission & Dispatch Company (NTDC) Limited was incorporated on 3<sup>rd</sup> August 1998 and commenced commercial operation on 1st March 1999. It was organized to take over all the properties, rights and assets obligations and liabilities of 220kV and 500kV Grid Stations and Transmission Lines/Network owned by Pakistan Water and Power Development Authority (WAPDA). The NTDC operates and maintains nine 500kV Grid Stations, 4,160km of 500kV transmission line and 4,000km of 220kV transmission line in Pakistan.

For low voltage such as 11 kV, the autonomous distribution companies (commonly called as DISCOS) are the power purchasers. Functionally, DISCOS fall at a step lower than NTDC and are looking after low voltage assets.

### 3.4 PUNJAB POWER DEVELOPMENT BOARD (PPDB)

Punjab Power Development Board (PPDB), working under Energy Department, provides a 'One-Window Facility' to private investors for implementation of IPPs in the Province under Punjab Power Generation Policy, 2009. Punjab Power Development Board Act, 2011 has been promulgated to provide legal cover to the activities of PPDB. The main objective of this Organization is to facilitate, promote and encourage development of Renewable Energy in Pakistan with a mission to introduce Alternative/Renewable Energy at an accelerated rate to achieve 10 percent share of RE in the energy mix of the country.

The current initiative is directed towards creating a market-based environment that is conducive to private sector investment and participation. The PPDB provides a one-window point of operations for investors in the alternate energy sector. This is done in order to reduce the timeframe required for the completion of these projects, which are deemed essential to meet Pakistan's short term and long-term energy requirements.

### 3.5 CENTRAL POWER PURCHASE AGENCY GUARANTEE LIMITED (CPPA-GL)

CPPA-GL is an agency to purchase power from wind power plants on behalf of NTDC. CPPA-GL acts as a one window for all affairs related to NTDC for the Project including signing of the Energy Purchase Agreement (EPA), establishment of Operating Committee (OC), development of Operating Procedures (OP), appointment of Independent Engineer (IE) and testing of the Project leading to declaration of commercial operations. CPPA-GL also handles payments to the Project against sale of electricity and all sort of Non-Project Missed Volume (NPMV) under the EPA.

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### 3.6 ENERGY DEPARTMENT, GOVERNMENT OF PUNJAB

The Energy Department was established on 5th July, 2011 on the initiative of Chief Minister Punjab, Muhammad Shahbaz Sharif, as a response to the energy crisis and to spearhead Punjab Government's efforts to exploit its energy sources and initiate power projects in the public and private sector. The purview of the department is constantly expanding, with more responsibilities and powers being devolved to the provinces in the wake of the 18th Amendment to the Constitution of Pakistan.

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The Energy Department has a vision of fully tapping Punjab's indigenous energy potential, which is Hydropower, Solar, Biomass and coal. The Department and its attached bodies are fully engaged with the Federal and international entities, and also encouraging the private sector to invest in the power sector.

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The Kyoto Protocol to the United Nations Framework Convention on Climate Change will strengthen the international response to climate change. Adopted by consensus at the third session of the Conference of the Parties (COP) in December 1997, it contains legally binding emissions targets for Annex I (industrialized) countries. By arresting and reversing the upward trend in greenhouse gas emissions that started in these countries 150 years ago, the Protocol promises to move the international community one step closer to achieving the Convention's ultimate objective of preventing dangerous anthropogenic [man-made] interference with the climate system.

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The Protocol's first commitment period started in 2008 and ended in 2012. A second commitment period was agreed on in 2012, known as the Doha Amendment to the protocol, in which 37 countries have binding targets: Australia, the European Union (and its 28 member states), Belarus, Iceland, Kazakhstan, Liechtenstein, Norway, Switzerland, and Ukraine. Belarus, Kazakhstan and Ukraine have stated that they may withdraw from the Protocol or not put into legal force the Amendment with second round targets. Japan, New Zealand and Russia have participated in Kyoto's first-round but have not taken on new targets in the second commitment period. Other developed countries without second-round targets are Canada (which withdrew from the Kyoto Protocol in 2012) and the United States (which has not ratified the Protocol). As of July 2015, 36 states have accepted the Doha Amendment, while entry into force requires the acceptances of 144 states.

Negotiations were held in Lima in 2014 to agree on a post-Kyoto legal framework that would obligate all major polluters to pay for CO<sub>2</sub> emissions. China, India, and the United States have all signaled that they will not ratify any treaty that will commit them legally to reduce CO<sub>2</sub> emissions.

The ultimate objective of the UNFCCC is the "stabilization of greenhouse gas concentrations in the atmosphere at a level that would stop dangerous anthropogenic interference with the climate system. Even if Annex I Parties succeed in meeting their first-round commitments, much greater emission reductions will be required in future to stabilize atmospheric GHG concentrations.

For each of the different anthropogenic GHGs, different levels of emissions reductions would be required to meet the objective of stabilizing atmospheric concentrations. Carbon dioxide (CO2) is the most important anthropogenic GHG. Stabilizing the concentration of CO2 in the atmosphere would ultimately require the effective elimination of anthropogenic CO2 emissions.

Some of the principal concepts of the Kyoto Protocol are:

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 Binding commitments for the Annex I Parties. The main feature of the Protocol is that it established legally binding commitments to reduce emissions of greenhouse gases for Annex I Parties. The commitments were based on the Berlin Mandate, which was a part of UNFCCC negotiations leading up to the Protocol.

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- Implementation. In order to meet the objectives of the Protocol, Annex I Parties are required to
  prepare policies and measures for the reduction of greenhouse gases in their respective countries.
  In addition, they are required to increase the absorption of these gases and utilize all mechanisms
  available, such as joint implementation, the clean development mechanism and emissions trading,
  in order to be rewarded with credits that would allow more greenhouse gas emissions at home.
- Minimizing Impacts on Developing Countries by establishing an adaptation fund for climate change.
- Accounting, Reporting and Review in order to ensure the integrity of the Protocol.
- Compliance. Establishing a Compliance Committee to enforce compliance with the commitments under the Protocol.

### 4.1 EMISSION REDUCTION MECHANISMS

There are three methods in Kyoto Protocol which permits the acquisition of emissions credits by means of project-based investment abroad:

#### $(1,\ldots,n_{1},\ldots,n_{N}) \in \mathbb{R}^{N} \times \{1,\ldots,n_{N}\}$

An emission trading, also called Carbon trading, involves trading carbon emission credits within nations. Allowances are created, thereby making emissions a commodity that can be traded between industries etc. The Kyoto Protocol says that it is acceptable to trade in emissions, but that it should not be the major means to achieve one's commitments. Some European countries and corporations have started implementing such programs to get a head start and to see how well it will work.

#### A DEVELO MENT MECHANISM (CDM)

Clean Development Mechanism (CDM) allows richer countries to offset their CO<sub>2</sub> emission against the emissions prevented when technology that cuts down on greenhouse gas emissions is deployed in poor countries.

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Joint Implementation (also known as Activities Implemented Jointly) is where developed countries invest in emission-reducing activities in other industrialized countries, and gaining reduction units as a result.

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# 4.2 ROLE OF CDM IN ZORLU PAKISTAN (ZSPPL) PROJECT



The Project is a power generation project with renewable resource and virtually zero emission. When put into operation, the project can provide power supply to the central Pakistan power grid, which currently is mainly relying on fossil fuel. Therefore, it can help to reduce the greenhouse gas emission from coal or oil-fired power generation. By estimating, using solar photovoltaic (PV) to generate 1 KWH electricity means saving 0.32 kg of standard coal, at the same time reduce the emission of 0.272 kg of carbon dust pollution, 0.997 kg of carbon dioxide (CO<sub>2</sub>), sulfur dioxide (SO<sub>2</sub>) 0.03 kg, 0.015 kg nitrogen oxides (NOx).

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After the completion of the station, it is expected to provide electricity grid each year about 168.505 million kWh, compared with the same capacity of thermal power, equivalent to annually save about 54947 t of standard coal, reducing various atmospheric pollutant emissions, which reduce carbon dioxide (co2) about 170000 t, sulfur dioxide (SO2) of about 5151 t, nitrogen oxide (NOx) about 2576 t.

It is also consistent with the spirit of the Kyoto Protocol and qualified for the application of CDM projects. If the project is approved and registered as a CDM project, CERs can provide extra financial resource for the project. It will provide favourable conditions for the project financing, improve competitiveness of the project, and reduce investment risk during the project implementation process. The CDM benefits in the Project (if incurred) shall be availed according to the provision in the Policy.

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# 5 SOLAR PV INDUSTRY & OPPORTUNITIES 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/m<sup>2</sup>/day. This amounts to about 2500-3000 sun shine hours and 1.9 - 2.3 MWh/m<sup>2</sup>/ year. It has an average daily global insolation of 19 to 20 MJ/m<sup>2</sup>/day with annual mean sunshine duration of 8 to 8.5 hours (6-7 hrs 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/m<sup>2</sup>, 24 (80%) consecutive days are available in this area for solar energy. Such conditions are ideal for solar thermal applications.

Pakistan receives about 15.5x10<sup>14</sup> kWh of solar irradiance each year with most regions receiving approximately 8 to 10 sunlight hours per day. The installed capacity of solar photovoltaic power is estimated to be 1600 GW per year, providing approximately 3.5 PWh of electricity (a figure approximately 41 times that of current power generation in the country).

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.

Solar PV was considered as an expensive option in the early times. During last 05-10 years, the continuously increasing oil prices and the continuously decreasing PV prices have really created worth of it. Particularly for non-oil producing country like Pakistan, there is immense potential.

An overview 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.

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Figure 5: NREL Solar Map of Pakistan

The off grid solar applications are seen since 1980's in Pakistan. In the current decade, there have been some installations for captive needs for commercial and industrial uses.

The learning curve in wind power sector has helped in devising effective implementation strategy for solar power projects in Pakistan. Government of Pakistan is offering excellent incentives to investors for solar power development in the country. Investors have been offered lucrative fiscal and financial incentives that are of key interest for them to come to this market. Provincial governments, particularly Punjab Government, are also facilitating development of solar power in Pakistan. Though we started late to develop solar PV power projects, i.e. in 2009, however, now we are at stages where serious projects are coming up.

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### 5.1 Projects initiated under federal LOIs

Till date, around 30 projects with cumulative capacity of more than 700 MW capacity hold valid LOIs from AEDB and are at various stages of development. No project has achieved COD as yet under AEDB's LOI. Currently there is no Upfront tariff available for Solar IPPs however, projects can opt for Cost Plus Tariff. NEPRA has also started working on Reverse Bidding options for Solar IPPs.

#### 5.2 Projects initiated under Provincial LOIs by PPDB.

PPDB is offering Federal Govt. Guarantee to projects initiated under provincial LOIs, provided they obtain a tripartite LoS (PPDB, Prov. Govt. and IPP). Required amendment in the RE Policy 2006 has been approved by ECC. Standard Templates of TLOS, PG, Facilitation Agreement and Coordination Agreement have also been approved by the ECC and are available.

The developments in the solar sector, the demand for new generation and GoP's plans to harness clean sources of energy have resulted in creating interest from several local and foreign investors for developing solar power projects in Pakistan. There is a huge interest developed for investment in the solar sector.

Government of Punjab owns the Quaid e Azam solar park which is a complete 1000 MW project out of which first phase of 100 MW has been completed by QASP itself and 300 MW by Private investors. Hence, total 400 MW is operational and is being injected to Grid.

#### 5.3 PPDB's SUPPORTING MEASURES

Several measures have been undertaken by PPDB to create an enabling environment for development of Solar power in Pakistan. A snapshot of the same is given below:

- Facilitate the private investors on behalf of the Government in matters relating to the setting up of power projects in accordance with the policy of the Government;
- Implement the policy of the Government relating to power generation and coordinate with various departments and agencies of the Government in the field of power generation;
- Negotiate and finalize, with the prospective private investors in the power sector, the implementation plans, feasibility studies and operational plans;
- Receive fees and charges from private investors in processing of their applications for power projects and shall deposit and disburse the fees or charges;
- Issue no objection certificate, permission or license for use of canal or river water or land of the Government for power generation;
- Explore potential sites for hydel and coal power generation and develop nonconventional sources of energy including solar, wind, biomass, biogas and solid waste;

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- Examine energy policies of the Federal Government and advise the Government on effect of the policies of the Federal Government;
- Co-ordinate with the Federal Government or any authority or agency of the Federal Government for installation of power houses, grid stations and transmission lines according to needs of the Province;
- Encourage and ensure exploitation of indigenous resources for development of thermal or Hydel power projects in the Province;
- Encourage the local and foreign entities to form joint ventures for participation in the development of the power projects;
- Advise the Government on bulk power supply from the national grid for transmission and distribution within the Province, levy of tax on consumption of electricity, laying of transmission lines and determination of power tariff for distribution of electricity within the Province;
- Acquire, where necessary, land for power projects; and
- Perform such other functions as may be prescribed to promote power generation in the Province.

### 5.4 Projects initiated under Provincial LOIs by GOS

Government of Sindh (GOS) is also taking steps like PPDB to enable solar power development in the province of Sindh. GOS has issued some LOIs for Solar power projects and those projects are at different stages of development.

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# **6 PROJECT IN TERMS OF POLICY FRAMEWORK**

The project is being developed under the "Punjab Power Generation Policy 2006 (Revised in 2009)" for Development of Renewable Energy.

The project has now reached the stage of submitting the feasibility study.

All pre-requisites of submitting the feasibility study are complete.

The project shall follow the negotiated (Cost plus) tariff regime with NEPRA. Currently the project is. The tariff petition/application is planned to be filed upon approval of feasibility study.

During determination/application review of the tariff, the Project Company shall begin discussions of EPA / IA and debt arrangement. In fact, the preliminary round of discussions with lenders has already been completed while making the feasibility study.

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

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# **7 PROJECT SITE**

### 7.1 SITE DETAILS

The site is located near Bahawalpur, Punjab, towards Northeast of Karachi. Figure below shows general overview of the Site. The Site having area of 500 Acres allocated to Zorlu Solar is located in a Solar Park where 04 plants of 100 MW each are already operational and total Capacity of this Solar Park is more than 1000 MW, and in near future, more Solar projects are planned.



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Table 7:	Geographical	l Coordinates	of Project	Site

	Latitude	Longitude	
Boundary 1	29°16'50.10"N	71°47'19.98'	Έ
Boundary 2	29°16'50.10"N	71°48'22.08'	Έ
Boundary 3	29°16'30.54"N	71°48'22.08'	'E
Boundary 4	29°16'30.54"N	71°48'9.66"	E
Boundary 5	29°16'20.76"N	71°48'9.66"	2
Boundary 6	29°16'20.76"N	<b>71°47'57</b> .24"	E
Boundary 7	29°16'1.20"N	71°47'57.24''	E
Boundary 8	29°16'1.20"N	<b>71°47'</b> 13.98''	E
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### Figure 8: Project Site Views

### 7.2 LOCATION OF GRID

Pakistan has a vast transmission and distribution system ranging from Northern areas to the farthest corner of Balochistan and Sindh. National Transmission and Dispatch Company (NTDC) is the main authority which manages all the transmission facilities and the National Grid with the help of 08 distribution companies, the MEPCO.

The project site is located around 1 km from the 220 kV NTDC Lal Suhanra Grid Station. A separate electrical and grid interconnection study will be conducted for the project including Power Quality, Load Flow, Short Circuit and Power Evacuation.

# 7.3 TRANSPORTATION AND ACCESS ROADS

The major track from Karachi to site is multi-lane road. The terrain is flat. In general, the track has no issue and a good route for accessing the site area. The Bin Qasim Port is first port of Pakistan and the point of delivery of equipment for the proposed Solar power project is located towards southwest of the site as shown in Figure below:



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#### Figure 9: Site orientation from Karachi

Ariel distance of the port from the site is approximately 660 km. Total track length between Port Qasim and site is approximately 855 km. There are few bridges on the way from Bin Qasim port to the site. The load bearing capacity of the bridges in between the site and the port is fair for transportation. Considering the track has already been used for heavy transportation therefore road conditions are reasonable for transportation of equipment. Ariel view of the track is in Figure below. The track starts from Port Qasim and after covering 10 km distance through Pakistan Steel Mills Road, it joins National Highways (N5). After 08 km on N5 the track moves to N5-M9 Kathore link Road and covers around 20 km and joins Super Highway M9. After distance of almost 120 km on M9, the track joins N5 again after Hyderabad Bypass. After almost 670 km on N5, the track moves towards Site through Canal Road and after 23 km the track enters Quaid-e-Azam Solar Park road and reaches the Site after 15 km on QASP Main Road. Detailed access to the site from Port Qasim Karachi is shown in Figure below:

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### 7.4 CLIMATIC CONDITIONS

Bahawalpur has extremes of climate; the summer season begins from April and continues till October. June and July are the hottest months in Bahawalpur with its average high temperatures at 34.8°C, maximum temperature goes above 50°C. The coldest month is January with average temperature around 11.1°C. The average high temperatures rise to 34.8°C here in Jun and fall to 25.2 °C with an average 21 mm of rainfall. Bahawalpur has more than 8 hours of sunshine daily on average.

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The mean maximum and minimum temperatures for the coldest month are 12 and 5 degree Celsius respectively. Rainfall Towards the end of June monsoon conditions appear and during the following two months the rainy season alternates with humid weather. The winter rain falls during December, January and February ranging from 18 to 21 millimeters. Maximum and Minimum Temperature Regime Map of Pakistan is shown in **Figure 9, Figure 10** & rainfall map in **Figure 11.** 



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### 7.5 TELECOMMUNICATION

PTCL telephone services are not available but mobile services of Zong and Telenor are available at Project Site.

# **8 SELECTION OF EPC CONTRACTOR**

After the approval of feasibility study, the Project Company will take open tending procure to choose right EPC company with rich international engineering experience.

For Pakistan 100MW solar project, the sponsor is planning to choose one big and strong EPC company with international experience, also in Pakistan, design job will be done by their company, key components like modules, inverter, cables and transformer will be chosen by the sponsor. They will provide technical support and supervise this construction work.

# **9 TOPOGRAPHY**

Topographically, location of Bahawalpur division appeared as follows: In the north of its boundaries are limited to River Sutlej, Panjnad and Indus River, which separates Multan and Dera Ghazi Khan, (where the adjacent districts of Sahiwal, Vehari, Multan, Lodhran, Muzaffargarh and Dera Ghazi Khan are located); while Sukkur Division of Sind province lies in south west. The East Punjab province of India and ex-princely states of Bekaneer and Jessalmer were adjacent to the south of Bahawalpur. This area is extremely important regarding national defense and from a strategic point of view. Three districts of Division Bahawalpur are integral part of it: Bahawalnagar, Rahimyar Khan and Bahawalpur District. Bahawalpur division was an administrative unit of the Punjab Province of Pakistan, until the reforms of 2000 when the third tier of government was abolished. Bahawalnagar District and India, on the South by India and on the West by Rahimyarkhan and Muzafar Garh Districts. Bahawalpur is one of the largest districts of the Punjab covering an area of 24,830 square miles. It has peculiar demographic, topographic and geographical characteristics. The district is situated almost in the center of the country at an elevation of 152 meters from the sea levels. It has Five Tehsils; Bahawalpur, Ahmad Pur East, Yazman (i/c Cholistan), Khair pur Tamewali, Hasilpur.

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Its topography comprises of sand dunes that are sparingly dotted with wild bushes. Owing to scanty rainfall the vast expanse of land remains largely uncultivated, but the banks of the river are lined with cultivation and vegetation. Some areas have been made cultivatable by means of canals and tube wells. The Lal Sohanra is almost barren and consists of small bushes and sand dunes. But the proposed location for the installation of plant is totally barren land and there is no plantation in the vicinity of the project area. The site is already allocated for the Quaid-e-Azam Solar Park and there are already four projects are developed in the project area.

The water level in this area is higher than in the upland. The soil is sandy. The upland is flat plains. The general height of the area is from 118 to 127 meters above the sea level. Topographic map of Bahawalpur derived from satellite mapping is shown in Figure below:



Figure 14: Topographic map of Bahawalpur district

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# **10 CIVIL WORKS**

The civil works include the following structures:

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

Regarding the foundation of solar array, it is planned to use screw pile, this kind of pile uses hot dip galvanized steel C which is stable and strong enough in our sand region. It can stand the wind of 100km/h with 25 years' life time by using this kind of pile, it can shorten the installation time on site to get COD at earlier period.

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Below are the pictures of screw pile.



The design of construction mainly includes center control building complex, water pump house, inverter room, etc. Both the complex and the inverter room will be single-floor brick-concrete structure.

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# **11 ELECTRICAL WORKS**

The detailed report on Electrical and Grid Interconnection Studies performed by Power Planners International (PPI) is attached as Annexure 2.

The detailed design activity of the electrical works shall be carried out by the Sponsor prior to start of construction. This sequence is in accordance with industrial practices.

A brief overview of the plant interconnection is given here.

## **11.1 PV PLANT ELECTRICAL OVERVIEW**

The key electrical components of the plant shall include the PV panels, connection box, cabling, inverter, step up transformer and switchgear.

The conversion of solar radiation into electrical energy (DC power) shall be performed using the PV panels. The PV panels shall be split in multiple groups since that will allow for the use of lower current carrying capacity cables, and shall offer more redundancy in contingency conditions.

The DC electricity from the panels shall be converted into 50 Hz AC via the inverters. There may be some support apparatus such as junction boxes between the inverter and the panels.

The output voltage of the inverter can be classified as low voltage (LV), and therefore, shall require stepping up to medium voltage level (MV) i.e. 33 kV. This shall be achieved using step up transformers.

Once stepped up to 33 kV through transformer, the power shall be transferred to the 132kVA booster transformer, then the output voltage will become 132kV (High Voltge, HV) and NTDC will evacuate from Project Substation's Gantry point.

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### **11.2 SINGLE LINE DIAGRAM**

A single line diagram as described in the previous section is presented here. The detailed design may include other balance of plant (BOP) equipment such as capacitor banks, earthing transformers etc.



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# **11.3 INTERCONNECTION OF PV MODULES AND FORMATION OF ARRAYS**

With 100MW project size, through technical and economic comparison, it is being considered to use First Solar CdTe Thin Film modules with total quantities of 860,314 pcs.

With comprehensive considering of radiation distribution, project location and other factors such as wind speed, temperature, etc. Considering this 100MW project, it is decided to use the fixed mounting system with tilt angel of 21 degrees and 5 m pitch.

# **12 MECHANICAL WORKS**

The mechanical engineering design mainly includes following structures:

Steel Structures to support the Solar Arrays

It is considered to use the fixed mounting system with material of hot dip galvanized steel C, this kind of the mounting system has the advantage of free maintenance and strong windproof. It can be used in complicated district and installation is easy.

Below is the photographical representation of the fixed mounting system.



The mechanical works (installation) are included in the scope of EPC contract. The detailed design activity of the mechanical works shall be carried out by the project company prior to start of construction. This sequence is in accordance with international and Pakistani power sector practices.

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# **13 CONSTRUCTION MANAGEMENT**

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

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

The Project Company personnel will supervise construction activities right from the beginning. The team will monitor construction schedule, owner's engineers and the EPC contractor to complete the project within given time frame and in-line with HSE guidelines.

The Project Company shall prepare a Construction Management Master Plan, which shall be the basis that shall take into account all relevant aspects. The master plan shall be regularly reviewed, updated and shared with all project stakeholders.

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

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# **14 O&M MANAGEMENT**

After the project put into operation, the Project company will be responsible for O & M service. During the construction period, the project company will start to hire local engineers and provide them training how to do electrical installation and teach them how to do routine's O & M jobs.

Once the project put into operation, project company shall set up O & M team including 2 or 3 Turkish engineers and dozens of local engineers to monitor whole system and coordinate with local electrical power company. The job of cleaning the modules shall hire other local works or appoint local company to do, cleaning frequency every month shall be decided based on the dirty status of the modules. O & M agreement will be signed separately.

The liaison with power purchaser (CPPA) related to monthly dispatch logs and the financial management shall remain with the Project Company.

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

The above O&M strategy shall be finalized with the signing of O&M agreements.

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# **15 INITIAL ENVIRONMENT EXAMINATION**

The Initial Environmental Examination (IEE) of 100MW solar PV is conducted by Renewable Resources (Pvt.) Ltd and is attached at Annexure 3.

The report is prepared as requirement of Government of Pakistan for the development of all power projects and as per guidelines published by Pakistan Environmental Protection Agency (Pak-EPA), guidelines followed by Asian Development Bank, World Bank guidelines as well as the best practices followed at international level.

The summary of report is presented in this section; however detailed report is submitted to concerned authorities for approval.

A solar PV plant will occupy a significant area, about 500 Acres, and unless it is well-shielded, it is likely to be a prominent visual feature.

While the solar technology itself is considered to be relatively benign, it is likely to require consideration of similar environmental issues as a small gas-fired power station and the issues raised by the large land area required. Some specific issues to be considered are area required for the solar field and the consequent impacts on visual amenity and local flora and fauna; reflections from the solar field.

However, further consideration will be given to the impacts on any residences, facilities and transport within line of sight of the reflector field.

The highlights of the study are given below:

### **15.1 OVERVIEW**

A detailed Initial Environmental Examination (IEE) of the project is conducted for approval from the concerned Environmental Protection Agency of Pakistan. This chapter is a summary IEE of 100MW solar power project.

This chapter presents the results and conclusion of environmental assessment of Bahawalpur, Multan and Muzaffargarh which are in near vicinity to the project site for the installing of 100 MW solar power project. The study was conducted by Renewable Resources Pvt. Ltd.

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### **15.2 REQUIREMENT OF ENVIRONMENTAL ASSESSMENT**

Under GoP regulation, the Pakistan Environmental protection agency review of initial environmental examination and environmental impact assessment regulation (2000) categorize development projects in two schedules according to their potential environmental impacts. The proponents of the project that have to reasonably foreseeable impacts are required to submit an IEE for their respective project (schedule I). This 100 MW solar power project has no adverse environmental impacts (Schedule I) and required to submit IEE.

### **15.3 SCOPE OF THE IEE STUDY**

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

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

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

The IEE report stands on following strings:

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

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## **15.4 DESCRIPTION OF THE PROJECT**

Type and category of project

• 100 Mega Watt Solar power project, Renewable energy, Schedule B.

## **15.5 OBJECTIVE OF THE PROJECT**

The objectives of the project are;

- i. To promote solar PV technology in Pakistan
- ii. By using indigenous renewable resources of power generation, avoid depletion of natural resources for future generation and environmental stability.
- iii. Contribute to improved electricity supply service delivery to a limited extent specifically having a wide rural outreach.
- iv. Improve microeconomic efficiency of the power sector by reducing fossil fuel usage.
- v. Reduce greenhouse gas emissions from power generation and contribute to negligible emission, effluent, and solid waste intensity of power generation in the system.
- vi. Conserve natural resources including land, forests, minerals, water, and ecosystems.
- vii. Develop the local economy and create employment, particularly in rural areas and in a district that is designated a backward area, a priority concern of the Government of Pakistan.

## **15.6 ALTERNATIVES CONSIDERED**

Project alternative fuels and "with and without" Project consequences are also discussed.

### **15.7 DESCRIPTION OF ENVIRONMENT**

The Project Site is acquired in Quaid-e-Azam Solar Park, Bahawalpur-Punjab. The project site is located around 855 Kilometers away from Karachi city.

The total land area for the implementation of 100 MW Solar PV project is about 500 acres and the land is allocated by the Government of Punjab to the project owners. Bahawalpur is one of the oldest cities of Pakistan and is located at 20 km away from project site. Bahawalpur is a part of Cholistan Desert and it is situated on the left bank of Indus River.

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Bahawalpur has extremes of climate; the summer season begins from April and continues till October. June and July is the hottest month in Bahawalpur with its average high temperatures at 34.8°C. The coldest month is January with average highs at 11.1°C. The average high temperatures rise to 34.8°C here in Jun and fall to 25.2 °C with an average 21 mm of rainfall. Bahawalpur has more than 8 hours of sunshine daily on average. The mean maximum and minimum temperatures for the coldest month are 12 and 5 degrees Celsius respectively. Rainfall Towards the end of June monsoon conditions appear and during the following two months the rainy season alternates with humid weather. The winter rain falls during December, January and February ranging from 18 to 21 millimeters.

Flora of the district has been greatly modified by human agency of the old open forests of small trees and shrubs; there remains only a few Rakhs or portions of forest which are kept as gazing ground for cattle etc. Amongst trees the most important are Kikar (Acacia Nilotica), Shisham or Tahli (Dalbergia sissoo), Sharin (Albizzia lebbek, Dharek (Malia azerdaracb), Phulahi (Acacia modesta), and Bair (Zizyphus Mauritiana), Frash (Tamasix Aphylla), Pillu (Salvadora Oleoides) are planted for shade.

## **15.8 PHYSICAL RESOURCES**

### 15.8.1 Topography and Geology

Topographically, Bahawalpur is situated in Southern Punjab, Pakistan, on the eastern bank of River Sindh (River Indus), which runs from north to south. Its topography comprises sand dunes that are sparingly dotted with wild bushes. Owing to scanty rainfall the vast expanse of land remains largely uncultivated, but the banks of the river are lined with forest and vegetation. Some areas have been made cultivatable by means of canals and tube wells.

The water level in this area is higher than in the upland. The soil is sandy. The upland is flat plains sloping from north-west to south-west. The general height of the area is from 117 to 128 meters above the sea level.

#### 15.8.2 Soil

In general, subsurface stratigraphy at the site consists of three basic litho logical units as given below:

- a) Lean Clay/Silty Clay
- b) Sandy Silt/Silt
- c) Silty fine Sand/fine Sand

The soil is alluvial with sandy textured sand dunes covering 50 to 60 percent of the area. These soils are the alluvial deposits of the recent geologic times. The subsurface stratigraphy is as discussed below:

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a) The first soil unit of brown silty clay/lean clay forms the topsoil cover at the site at all the locations and generally continues to a depth of 1 .0 m-3.5m below top of ground. This stratum contains trace fine sand and trace to little concretions at places. It is present in a soft to a stiff state of consistency and has low to medium plasticity.

b) The second soil unit of brownish grey sandy silt/silt underlies the upper silty clay/ lean clay stratum. This layer has a thickness of 1.0 to 3.0m and is present in a firm state.

c) The third soil unit of brownish grey non-plastic fine silty sand underlies the silt/silty sand stratum. It is present in a loose to medium-dense state.

#### 15.8.3 Climate

Bahawalpur has extremes of climate; the summer season begins from April and continues till October. June and July is the hottest month in Bahawalpur with its average high temperatures at 34.8°C. The coldest month is January with average highs at 11.1°C. The average high temperatures rise to 34.8°C here in Jun and fall to 25.2 °C with an average 21 mm of rainfall. Bahawalpur has more than 8 hours of sunshine daily on average. The mean maximum and minimum temperatures for the coldest month are 12 and 5 degrees Celsius respectively. Rainfall Towards the end of June monsoon conditions appear and during the following two months the rainy season alternates with humid weather. The winter rain falls during December, January and February ranging from 18 to 21 millimeters.

#### 15.8.4 Water

The present main source of water supply system in the villages near the site is through the wells which are 25 to 30 meters deep.

#### 15.8.5 Forest

Flora of the district has been greatly modified by human agency of the old open forests of small trees and shrubs; there remains only a few Rakhs or portions of forest which are kept as gazing ground for cattle etc. Amongst trees the most important are Kikar (Acacia Nilotica), Shisham or Tahli (Dalbergia sissoo), Sharin (Albizzia lebbek, Dharek (Malia azerdaracb), Phulahi (Acacia modesta), and Bair (Zizyphus Mauritiana), Frash (Tamasix Aphylla), Pillu (Salvadora Oleoides) are planted for shade.

Bahawalpur is famous for Kitchen use vegetables. While wheat, corn, MungBean, Channa, Bajra (Pennisetum Lyphoideum), Gawara (Cyamopsis Psoralides) and Jawar (Sorghum Vulgare) are famous field products. Cotton is also produced in very low quantity now. Major fruits are Citrus, Mango and Dates.

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#### **15.8.6 Socio Economic Conditions**

Main occupation of the residents of Bahawalpur district is agriculture. The agricultural area of District is 155,648 acres. As per the consensus of 1998, the total employed persons, 44.7% had elementary occupations followed by 34.8% skilled agricultural and fishery workers, service workers, shop and market sales workers, representing 3.5% and 19.2% respectively. In rural areas people having elementary occupations were again in majority, followed by skilled agriculture and fishery workers and service workers, shop and market sales workers, shop and market sales workers, shop and market sales workers, shop and market sales workers, shop and market sales workers, shop and market sales workers, shop and market sales workers representing 56.3%, 31.7% and 5.3% respectively. The highest percentage in urban area is of elementary occupation; followed by service workers, shop and market sales workers having 43.1% and 19.4% respectively.

Bahawalpur district is essentially agrarian. Agriculture is the backbone of its economy and main source of earning for almost entire 78% rural population directly or indirectly. It is well known cotton and wheat growing area and produces 14% of cotton and 4% of wheat of the total Punjab's production. Rice, Sugarcane, Gram, Pulses and Sunflower/Soybean/Canola (oil seed) are the other major crops. The total cropped area in Bahawalpur equals 696,000 hectares. Out of this irrigated area is 686,000 hectares and 10,000 hectares is unirrigated land.

### **15.9 CONCLUSIONS OF IEE**

Prime benefit of the Project will be the replacement of conventional power generation with renewable energy. Solar energy will replace fossil fuel powered generation, and therefore reduce suspended particulate matter and greenhouse gas emissions into the atmosphere.

Impacts are manageable and can be managed cost effectively - Environmental impacts are likely to result from the proposed Power project. Careful mitigation and monitoring, specific selection criteria and review/assessment procedures 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. Since proposed land is covered with shrubs, thus there is no need for removal for the construction of the Solar PV project.

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

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- Significantly improvement in the economic activities in the surrounding areas due to generation of direct and indirect employment opportunities.
- The Project Area does not fall under any sensitive, protected area.
- No threatened / Near-Threatened species of wildlife was recorded in the Project Area.
- There is negligible removal of trees for the project, which is the main positive impact to the proposed project area.
- 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 with mitigations being properly taken care.

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Report No. PPI-256.1-Draft/17



# INTERCONNECTION STUDY

For

100 MW Solar Power Project by Zorlu Energy Pakistan Limited



Draft Report (March 2017)

# POWER PLANNERS INTERNATIONAL LTD.

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# **Executive Summary**

- The data received from the client is validated and the study objective, approach and methodology have been described. The net AC output power of the plant would be 80 MW.
- The system data provided to PPI as per NTDC Letter No. GMPP/CEMP/TRP-380/827-29 dated 14-02-2017 has been used. The Solar Power Plant data as provided by the client has been used. This has been attached in Appendix-A
- The expected COD of Zorlu Energy Pakistan Limited (referred to as Zorlu Solar-l in the remainder of the report) Power Plant is in the third quarter of 2017. The nearest substation is the recently constructed Lal-Sohanra 220/132 kV Substation.
- ❖ Given the location of Zorlu Solar-I power plant, the most feasible interconnection scheme would be a direct 132kV double circuit from Zorlu Solar-I PP to Lal Sohanra 220/132kV substation. The distance of the site of solar plant from the grid station ,as verified from site visit is approximately 2 km. The conductor used would be Rail with a thermal capacity of 202 MVA. The final scheme of circuits is shown in Appendix – A.
- The above proposed interconnection scheme has been tested for steady state, short circuit and transient stability conditions through detailed technical studies.
- Detailed load flow studies have been carried out for the peak and off-peak load conditions of Summer 2017 and Summer 2018. Similarly, a future scenario of Summer 2021 is also studied for the proposed scheme under normal and N-1 contingency conditions to meet the reliability criteria.
- Steady state analysis by load flow for all the scenarios described above reveals that the proposed scheme is adequate to evacuate the maximum net AC power of 80 MW of the plant under normal and contingency conditions.
- The short circuit analysis has been carried out to calculate maximum fault levels at the Zorlu Solar-I Power Plant 132 kV, and the substations of 132 kV in its vicinity. We find that the fault currents for the proposed scheme are much less than the rated short circuit capacities of switchgear installed at these substations. There are no violations of exceeding the rating of the equipment due to contribution of fault current from Zorlu Solar-I Power Plant.

- The maximum short circuit level of 132 kV bus bar of Zorlu Solar-I Power Plant is 11.14 kA and 11.93 kA for 3-phase and 1-phase faults respectively for the year 2021. Therefore industry standard switchgear of the short circuit rating of 40 kA would be fine to be installed at 132 kV switchyard of Zorlu-Solar-PP as per NTDC requirement taking care of any future generation additions and system
- The dynamic stability analysis of proposed scheme of interconnection has been carried out. The stability check for the worst case of three phase fault right on the 132 kV bus bar of the Zorlu Solar-I power plant substation followed by the final trip of 132 kV circuits emanating from this substation, has been performed for fault clearing of 5 cycles (100 ms). The system is found strong enough to stay stable and recovered with fast damping. The proposed scheme successfully passed the dynamic stability checks for near and far faults.
- The proposed scheme of interconnection has no technical constraints or problems, it fulfills all the criteria of reliability and stability under steady state load flow, contingency load flows, short circuit currents, dynamic/transient conditions and power quality; and is therefore recommended to be adopted.



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## 1. Introduction

### 1.1 Background

Zorlu Energy Pakistan Limited (Zorlu-Solar) is developing a 100 MW Photovoltaic (PV) based Solar Power Project. The site of proposed project is located in Punjab in the concession area of Multan Electric Power Company (MEPCO). The net AC output power of the plant would be 80 MW. The project will start commercial operation by the third quarter of 2017. The electricity generated from this project would be supplied to the MEPCO network through the network developed for evacuation of power.

### 1.2 **Objectives**

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

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

### 1.3 Planning Criteria

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

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

#### **Dynamic/Transient:**

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

# 2. <u>Assumptions of Data</u>

### 2.1 Solar Power Plant data

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



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

#### **Steady State data:**

The data of the 132/33 kV Transformers is as follows:

MVA Rating of the Transformer = 100 MVA

Percentage Reactance of the Transformer = 11%

One -5/+20 MVAR SVC will be used to provide reactive compensation for Zorlu Solar-I-PP

Net AC Output of Solar PP = 80 MW

#### **Dynamic Data:**

Converter time constant for IQcmd seconds = 0.02 s

Converter time constant for IQcmd seconds = 0.02 s

Voltage sensor for LVACR time constants = 0.02 s

Voltage sensor time constant = 1.1 s

### 2.2 Network data

The 132 kV networks available for interconnection to Zorlu Energy Pakistan Limited Power Plant are as shown in Sketches attached in Appendix-A. The lengths of the circuits are also mentioned in the sketches.

The input data of NTDC has been used in this study as per NTDC Letter No. GMPP/CEMP/TRP-380/827-29 dated 14-02-2017. The latest load forecast and the generation expansion plan of NTDC provided vide this letter has been used as shown in Appendix A.

# 3. <u>Study Approach and Methodology</u>

### 3.1 <u>Understanding of the Problem</u>

The 100 MW Solar Power Plant by Zorlu Energy Pakistan Limited is going to be a photovoltaic (PV) based solar project in Punjab embedded in the 132 kV distribution network of MEPCO. It would run almost all the months of the year though with some variation in its output due to variation in the strength of light in winter and in rainy season.

The existing nearest grid station is Lal Sohanra 220/132 kV Substation. This is a recently constructed grid station with 1x250 MVA transformation capacity. The addition of this source of power generation shall provide relief to the 220kV Transmission lines from M.Garh-1 to BWP-New. The 132 kV network of MEPCO in the electrical vicinity of Zorlu Solar-I has significant load demand; therefore a considerable portion of the power from Zorlu Solar-I Power Plant will be utilized in meeting this load demand.

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

### 3.2 Approach to the problem

The consultant has applied the following approaches to the problem:

- A base case network model has been prepared for the peak load case of Summer 2017, after the COD of 100 MW Solar PV Plant by Zorlu Energy Pakistan Limited, comprising all 500 kV, 220 kV and 132 kV system, envisaging the load forecast, the generation additions and transmission expansions for that year particularly in MEPCO.
- The expected COD of the project is by the third quarter of 2017. In view of planned COD of Zorlu Solar-1 Power Plant, the above proposed interconnection scheme has been tested for steady state conditions through detailed load flow studies for the peak and off-peak load conditions of Summer 2017 and Summer 2018 to assess the maximum impact on the Grid.

In addition, an extended term scenario of Summer 2021 has also been studied for load flow analysis.

- Performed technical system studies for peak load conditions to confirm technical feasibility of the interconnections. The scheme has been subjected to standard analysis like load flow, short circuit, transient stability study and power quality to check the strength of the plant and the proposed interconnection scheme under disturbed conditions.
- Determine the relevant equipment for the proposed technically feasible scheme.
- Recommend the technically most feasible scheme of interconnection.

# 4. <u>Development of Scheme of Interconnection</u>

# 4.1 The Proposed Network for Zorlu Solar-I Power Plant

The nearest existing MEPCO/NTDC interconnection facilities at the time of commissioning of Zorlu Solar-I Power Project is Lal-Sohanra 220/132 kV Substation.

There is strong 220 kV network in the vicinity connecting Bahawalpur-New 220/132 kV grid station Muzaffargarh 220 kV substation. A strong system helps in stable operation of a power plant.

# 4.2 The Scheme of Interconnection of Zorlu Solar-I Power Plant

Given the location of Zorlu Solar-I power plant, the most feasible interconnection scheme would be a direct 132kV double circuit from Zorlu Solar-I PP to Lal Sohanra 220/132kV substation. The distance of the site of solar plant from the grid station ,as verified from site visit is approximately 2 km. The conductor used would be Rail with a thermal capacity of 202 MVA. The final scheme of circuits is shown in Appendix – A.

### 4.3 Solar Plant Substation 132/33 kV

A substation would be built at the Solar Power Plant to collect all the power from the collector groups, spread out in the solar park, at medium voltage (MV) level of 33 kV and step-up this power to high voltage (HV) level of 132 kV so that the Farm's output may be evacuated to the main grid of MEPCO/NTDC.

Keeping in view of the current practices in NTDC and DISCOs, the substations for power plants of this order, the 132 kV bus bars are double bus with a coupler i.e. double bus-single-breaker scheme. However for 132/11 kV substations, the MV bus i.e. 11 kV a single bus with or without sectionalizers. Keeping in view the NTDC/DISCOs practice, we propose to provide good reliability to a power plant as follows:

- Double-bus single-breaker scheme with a Bus Coupler at 132 kV
- Single bus scheme with a sectionalizer to enable to have two bus sections at 33kV

#### 4.3.2 Conceptual Design of 132 kV

132 kV bus bars of the Farm substation would comprise as follows:

- Double bus bars with a Bus Coupler
- Two breaker bays to connect two transformers 132/33 kV
- Two breaker bays to connect two circuits of 132 kV i.e. double circuit on single tower overhead line to connect to the grid system.

Rating of all the breakers and bus bar equipment would be

Short circuit rupturing capacity= 40 kANormal continuous current= 2000 A for line and TF breakers= 2500 A for Bus Coupler

The other equipment of the substation consists of:

- Two 132/33 kV, 80/100 MVA ONAN/ONAF OLTC transformers, 132±8×1.25%/33kV, to fulfill N-1 criteria of Grid Code
- Energy meters would be installed on HV side (132 kV) of the 132/33kV transformers.

#### 4.3.2 Conceptual Design of 33 kV

The conceptual design of 33kV (MV) bus bar of the Farm substation would comprise of:

- Two single bus-sections of 33 kV with a bus sectionalizer
- Two breaker bays to connect two transformers of 132/33 kV
- One station auxiliary transformer 33/0.55 kV
- One SVC of the size of -5/+20 MVAR
- One breaker bay to connect -5/+20 MVAR SVC

Rating of all the breakers and bus bar equipment would be

Short circuit rupturing capacity = 31.5 kA

Normal continuous current = 1250 A for line breakers

= 2500A for Bus Sectionalizer and Power TF

## 5. <u>Detailed Load Flow Studies</u>

### 5.1 Modeling of Solar Power Plant in the Load Flow

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

The Farm Substation is represented by two bus bars as Zorlu 33 kV and Zorlu 132 kV, with two inter-bus transformers of 80/100 MVA each. These transformers have an overload capacity of 100 MVA for a limited time to cover N-1 contingency criteria of Grid Code i.e. in case of outage of one transformer, the other can take up the full output of Farm.

### 5.2 <u>Reactive Power Requirements</u>

Zorlu Solar-I is considering inverters with a nominal output of 2500 kW each. Part of the reactive power produced by these inverters would be consumed by the 0.55kV/33 kV step-up transformers and the rest may be consumed in the MV collector cables of the solar plant. However some reactive power might reach the MV bus bar of solar plant substation. That means each inverter is self sufficient to meet VAR absorption requirement of its step-up transformer with some contribution of VARs to the Solar Plant MV network.

The Grid Code Addendum No.2 requires to meet the criteria of  $\pm$  0.95 power factor at the point of interconnection with the NTDC/MEPCO grid at 132 kV (point of common coupling). Therefore Zorlu with its maximum net AC output of 80 MW generating capacity is required to pump 26.29 MVAR to the grid at maximum AC power output of 80 MW. The VAR generating capability of the inverters will not be able to fully meet this VAR demand of the system because of VAR loss in step-up transformers of 0.55/33 kV, collector cables and the HV/MV i.e. 132/33 kV transformers at the Solar Plant substation. In order to meet the Grid Code criteria, we have proposed the installation of one SVC of -5/+20 MVAR at 33 kV bus of the Solar Plant substation capable of generating 20 MVAR and delivering at 132 kV bus about 26.29 MVAR after VAR loss across 132/33 kV transformers.

### 5.3 Base Case Peak Summer 2017, Without Solar Power Plant

A base case has been developed for the peak load of Summer 2017, using the network data of MEPCO and NTDC.

The results of load flow for this base case are plotted in Exhibit 0.0 of Appendix-B. The system plotted in this Exhibit shows 132 kV network in the vicinity of Zorlu Solar-I including the substations of Lal-Sohanra, Bahwalpur-New, Lodhran and Solar power plants including Quaid-e-Azam Solar Power Plant, Appolo, Best Green and Crest energy Solar PPs.

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

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

Exhibit 0.1 Bahawalpur Cantt to BWP-N 132 kV Single Circuit Out

- Exhibit 0.2 Crest Energy to Bahawalpur Cantt 132 kV Single Circuit Out
- Exhibit 0.3 Yazman to BWP-N 132 kV Single Circuit Out
- Exhibit 0.4 BWP-N to Lodhran 132 kV Single Circuit Out
- Exhibit 0.5 BWP-N to BU. Jadid 132 kV Single Circuit Out
- Exhibit 0.6 BWPN-2 to Samasata 132 kV Single Circuit Out
- Exhibit 0.7 M.Garh-1 to BWP-N 220 kV Single Circuit Out
- Exhibit 0.8 M.Garh-1 to Multan 220 kV Single Circuit Out

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

### 5.4 Load Flow with Zorlu Solar Power Plant-Case Summer 2017

We have considered the scenario of Peak Summer 2017 so that we can judge the impact of the project on the system after its COD when the loading on the lines would be at its Summer Peak.

The results of load flow with Zorlu Solar-I Power Plant interconnected as per proposed scheme mentioned in chapter 4 are shown for each case. Zorlu Solar is connected in a loop with Lal.Sohanra 220/132kV substation. The power flows on the circuits under normal conditions are seen well within the rated capacities and the voltages on the bus bars are also within the permissible operating range of  $\pm$  5 % off the nominal.

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

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

- Exhibit 1.1 Zorlu SLR-I 132/33 kV Single Transformer Out
- Exhibit 1.2 Zorlu SLR-I to Lal Suhanra 132 kV Single Circuit Out

Exhibit 1.3 Bahawalpur Cantt to BWP-N 132 kV Single Circuit Out

Exhibit 1.4 Crest Energy to Bahawalpur Cantt 132 kV Single Circuit Out

- Exhibit 1.5 Yazman to BWP-N 132 kV Single Circuit Out
- Exhibit 1.6 BWP-N to Lodhran 132 kV Single Circuit Out
- Exhibit 1.7 BWP-N to BU. Jadid 132 kV Single Circuit Out
- Exhibit 1.8 BWPN-2 to Samasata 132 kV Single Circuit Out
- Exhibit 1.9 M.Garh-1 to BWP-N 220 kV Single Circuit Out
- Exhibit 1.10 M.Garh-1 to Multan 220 kV Single Circuit Out

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

Similarly, Off-Peak load case for Summer 2017 was also studied to judge the impact in light load conditions. Load flow results reveal that there is no capacity constraints on the 132 kV circuits under normal conditions i.e. without any outages of circuits. N-1 contingency analysis has been carried out for this off-peak load scenario and the plotted results are attached in Appendix – B as follows:

- Exhibit 2.1 Zorlu SLR-I 132/33 kV Single Transformer Out
- Exhibit 2.2 Zorlu SLR-I to Lal Suhanra 132 kV Single Circuit Out
- Exhibit 2.3 Bahawalpur Cantt to BWP-N 132 kV Single Circuit Out
- Exhibit 2.4 Crest Energy to Bahawalpur Cantt 132 kV Single Circuit Out
- Exhibit 2.5 Yazman to BWP-N 132 kV Single Circuit Out
- Exhibit 2.6 BWP-N to Lodhran 132 kV Single Circuit Out
- Exhibit 2.7 BWP-N to BU. Jadid 132 kV Single Circuit Out
- Exhibit 2.8 BWPN-2 to Samasata 132 kV Single Circuit Out
- Exhibit 2.9 M.Garh-1 to BWP-N 220 kV Single Circuit Out
- Exhibit 2.10 M.Garh-1 to Multan 220 kV Single Circuit Out

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

# 5.5 Load Flow with Zorlu Solar Power Plant-Case Summer 2018

We have also considered the scenario of Peak Summer 2018 so that we can judge the impact of the project after addition of other solar PPs in the vicinity of Zorlu Solar. In this scenario of 2018, there are three loops connected to lal.Sohanra 220/132 kV substation each having two 100 MW Solar PPs. Hence, a total of 600MW is connected to Lal.Sohanra grid station and transformation capacity at this grid station is also increased to 3x250MVA as per the latest transmission expansion plan of NTDC.

The results of load flow for this scenario are shown in Appendix-B. The power flows on the circuits under normal conditions are seen well within the rated capacities and the voltages on the bus bars are also within the permissible operating range of  $\pm 5$  % off the nominal.

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

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

Exhibit 3.1 Zorlu SLR-I 132/33 kV Single Transformer Out

Exhibit 3.2 Zorlu SLR-I to Lal Suhanra 132 kV Single Circuit Out

- Exhibit 3.3 Lal Suhanra 220/132 kV Single Transformer Out
- Exhibit 3.4 Bahawalpur Cantt to BWP-N 132 kV Single Circuit Out
- Exhibit 3.5 Crest Energy to Bahawalpur Cantt 132 kV Single Circuit Out
- Exhibit 3.6 Yazman to BWP-N 132 kV Single Circuit Out
- Exhibit 3.7 BWP-N to Lodhran 132 kV Single Circuit Out

Exhibit 3.8 BWP-N to BU. Jadid 132 kV Single Circuit Out

Exhibit 3.9 BWPN-2 to Samasata 132 kV Single Circuit Out

- Exhibit 3.10 M.Garh-1 to BWP-N 220 kV Single Circuit Out
- Exhibit 3.11 M.Garh-1 to Multan 220 kV Single Circuit Out

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

Similarly, Off-Peak load case for Summer 2018 was also studied to judge the impact in light load conditions. Load flow results reveal that there is no capacity constraints on the 132 kV circuits under normal conditions i.e. without any outages of circuits.

N-1 contingency analysis has been carried out for this off-peak load scenario and the plotted results are attached in Appendix – B as follows:

Exhibit 4.1 Zorlu SLR-I 132/33 kV Single Transformer Out

Exhibit 4.2 Zorlu SLR-I to Lal Suhanra 132 kV Single Circuit Out

Exhibit 4.3 Lal Suhanra 220/132 kV Single Transformer Out

Exhibit 4.4 Bahawalpur Cantt to BWP-N 132 kV Single Circuit Out

Exhibit 4.5 Crest Energy to Bahawalpur Cantt 132 kV Single Circuit Out

- Exhibit 4.6 Yazman to BWP-N 132 kV Single Circuit Out
- Exhibit 4.7 BWP-N to Lodhran 132 kV Single Circuit Out
- Exhibit 4.8 BWP-N to BU. Jadid 132 kV Single Circuit Out
- Exhibit 4.9 BWPN-2 to Samasata 132 kV Single Circuit Out

Exhibit 4.10M.Garh-1 to BWP-N 220 kV Single Circuit OutExhibit 4.11M.Garh-1 to Multan 220 kV Single Circuit Out

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

# 5.6 Load Flow with Zorlu Solar Power Plant-Peak Load Case Summer 2021

Detailed load flow studies have also been carried out for an extended term spot year of 2021. The objective is to have a comprehensive total view of Solar power potential expected to be commissioned by 2021 and the adequacy of respective transmission plans to evacuate overall power from the Solar Power Plants sources going to be added in the area by that time. Similarly all other generation that are expected to be commissioned till 2021 have also been modeled in the case as per the generation plan obtained from NTDC.

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

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

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

- Exhibit 5.1 Zorlu SLR-I 132/33 kV Single Transformer Out
- Exhibit 5.2 Zorlu SLR-I to Lal Suhanra 132 kV Single Circuit Out
- Exhibit 5.3 Lal Suhanra 220/132 kV Single Transformer Out
- Exhibit 5.4 Bahawalpur Cantt to BWP-N 132 kV Single Circuit Out

Exhibit 5.5	Crest Energy to Bahawalpur Cantt 132 kV Single Circuit Out
Exhibit 5.6	Yazman to BWP-N 132 kV Single Circuit Out
Exhibit 5.7	BWP-N to Lodhran 132 kV Single Circuit Out
Exhibit 5.8	BWP-N to BU. Jadid 132 kV Single Circuit Out
Exhibit 5.9	BWPN-2 to BWP-Energy 132 kV Single Circuit Out
Exhibit 5.10	M.Garh-1 to BWP-N 220 kV Single Circuit Out
Exhibit 5.11	M.Garh-1 to Multan 220 kV Single Circuit Out

The results indicate that under all contingent conditions, the power flowing on the intact circuits are within the rated limits and the bus voltages are also within the allowable limits.

# 5.7 Conclusion of Load Flow Analysis

From the analysis discussed above, we conclude that the proposed interconnection scheme of Zorlu Solar-I PP ensures its reliability and availability under all events of contingencies i.e. planned or forced outages studied in this report for the scenarios of 2017,2018 and for the extended term scenario of 2021.

# 6. Short Circuit Analysis

### 6.1 <u>Methodology and Assumptions</u>

The methodology of IEC 909 has been applied in all short circuit analysis in this report for which provision is available in the PSS/E software used for these studies. . The maximum fault currents have been calculated with the following assumptions under IEC 909:

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

For evaluation of maximum short circuit levels we have assumed contribution in the fault currents from all the installed generation capacity of hydel, thermal and nuclear plants in the system in the year 2017 i.e. all the generating units have been assumed on-bar in fault calculation's simulations.

### 6.2 Fault Current Calculations without Zorlu Solar-I Power Plant

### 6.2.1 Maximum Short circuit Levels - Case 2017

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

The results are attached in Appendix - C.

The short circuit levels have been represented graphically on the bus bars of 33 kV and 132 kV which are shown in the Exhibit 6.0 attached in Appendix-C.
Both 3-phase and 1-phase fault currents are indicated in the Exhibit which are given in polar coordinates i.e. the magnitude and the angle of the current. The total fault currents are shown below the bus bar.

The tabular output of the short circuit calculations is also attached in Appendix-C for the 33 kV and 132 kV bus bars of our interest i.e. 132 kV circuits lying close to Zorlu Solar-I. The tabular output is the detailed output showing the contribution to the fault current from the adjoining sources i.e. the lines and transformers connected to that bus. The phase currents, the sequence currents and the sequence impedances are shown in detail for each faulted bus bar.

The total maximum fault currents for 3-phase and 1-phase short circuit at these substations are summarized in Table 6.1. We see that the maximum fault currents do not exceed the short circuit ratings of the equipment at these 132 kV substations which normally are 31.5 kA, 40 kA.

Substation	3-Phase Fault Current (kA)	1-Phase Fault Current (kA)
BWP-N 132 kV	10.00	8.48
Bahawalpur Cantt 132 kV	7.24	5.30
Crest Energy 132 kV	6.04	4.14
Qad-Solar-I 132 kV	5.96	4.08
Best Green 132 kV	4.56	2.98
Appolo Solar 132 kV	4.52	2.95
Yazman 132 kV	4.67	3.13
Bahawalpur 132 kV	8.00	6.27
Lodhran 132 kV	6.60	4.92
BU. Jadid 132 kV	6.06	4.39
BWPN-2 132 kV	7.57	6.88
Mubarakpur 132 kV	4.17	2.92
BWP-N 220 kV	10.51	8.10
M.Garh-I 220 kV	36.37	36.62

 Table - 6.1

 Maximum Short Circuit Levels without Zorlu Solar-I PP

Multan 220 kV	47.31	37.36
M-Garh-2 220 kV	33.92	32.88

## 6.3 <u>Fault Current Calculations with Zorlu Solar-I Power Plant</u> interconnected

### 6.3.1 Maximum Short circuit Levels - Case 2017

Fault currents have been calculated for the electrical interconnection of Solar PP as per proposed scheme. Three phase and single-phase fault currents have been evaluated at the 33 kV and 132 kV bus bars of Zorlu Solar-I Power and other bus bars of the 132 kV substations in the electrical vicinity of Zorlu Solar-I. The graphic results are indicated in Exhibit 7.0

The tabulated results of short circuit analysis showing all the fault current contributions with short circuit impedances on 132 kV bars of the network in the electrical vicinity of Zorlu Solar-I Power Plant are placed in Appendix-C. Brief summary of fault currents at significant bus bars of 33 kV and 132 kV are tabulated in Table 6.2.

We find that even after the interconnection of Zorlu Solar-I Power Plant these fault levels are much below the rated short circuit values of the equipment installed on these substations. The maximum short circuit level of 132 kV bus bar of Zorlu Solar-I Power Plant is 5.04 kA and 6.16 kA for 3-phase and 1-phase faults respectively. Therefore industry standard switchgear of the short circuit rating of 40 kA would be fine to be installed at 132 kV switchyard of Z

orlu-Solar-PP as per NTDC requirement taking care of any future generation additions and system reinforcements in its electrical vicinity. Similarly the maximum short circuit level of 33 kV bus bar of Zorlu Solar-I Power Plant is 12.58 kA and 17.06 kA for 3-phase and 1-phase faults respectively.

Substation	3-Phase Fault Current (kA)	1-Phase Fault Current (kA)
Zorlu-MV 33 kV	12.58	17.06
Zorlu SLR-I 132 kV	5.04	6.16

Table-6.2Maximum Short Circuit Levels with Zorlu Solar-I PP – Case 2017

Lal Suhanra 132 kV	5.14	6.20
Lal Suhanra 220 kV	7.64	6.75
BWP-N 132 kV	10.11	9.18
Bahawalpur Cantt 132 kV	7.31	5.55
Crest Energy 132 kV	6.10	4.28
Qad-Solar-I 132 kV	6.02	4.21
Best Green 132 kV	4.60	3.04
Appolo Solar 132 kV	4.56	3.02
Yazman 132 kV	4.72	3.22
Bahawalpur 132 kV	8.08	6.67
Lodhran 132 kV	6.67	5.17
BU. Jadid 132 kV	6.12	4.59
BWPN-2 132 kV	7.64	7.25
Mubarakpur 132 kV	4.20	2.98
BWP-N 220 kV	10.62	9.25
M.Garh-I 220 kV	36.45	37.00
Multan 220 kV	47.36	37.43
M-Garh-2 220 kV	33.94	32.92

## 6.3.2 Maximum Short circuit Levels - Case 2021

Fault currents have been calculated for the electrical interconnection of proposed scheme for the year 2021. Three phase and single-phase fault currents have been evaluated at the 33 kV and 132 kV bus bars of Zorlu Solar-I Power and other bus bars of the 132 kV substations in the electrical vicinity of Zorlu Solar-I. The graphic results are indicated in Exhibit 8.0

The tabulated results of short circuit analysis showing all the fault current contributions with short circuit impedances on 132 kV bars of the network in the electrical vicinity of Zorlu Solar-I Power Plant are placed in Appendix-C. Brief summary of fault currents at significant bus bars of 33 kV and 132 kV are tabulated in Table 6.3.

We find that for this futue scenario, these fault levels are much below the rated short circuit values of the equipment installed on these substations. The maximum short circuit level of 132 kV bus bar of Zorlu Solar-I Power Plant is 11.14 kA and 11.93 kA for 3-phase and 1-phase faults respectively for the year 2021. Therefore industry standard switchgear of the short circuit rating of 40 kA would be fine to be installed at 132 kV switchyard of Zorlu-Solar-PP as per NTDC requirement taking care of any future generation additions and system reinforcements in its electrical vicinity. Similarly the maximum short circuit level of 33 kV bus bar of Zorlu Solar-I Power Plant is 18.66 kA and 24.10 kA for 3-phase and 1-phase faults respectively for the year 2021.

Substation	<b>3-Phase Fault Current</b>	1-Phase Fault Current
	(kA)	(kA)
Zorlu-MV 33 kV	18.66	24.10
Zorlu SLR-I 132 kV	11.14	11.93
Lal Suhanra 132 kV	11.68	12.25
Lal Suhanra 220 kV	9.61	8.49
BWP-N 132 kV	13.84	11.77
Bahawalpur Cantt 132 kV	11.01	8.54
Crest Energy 132 kV	8.49	6.40
Qad-Solar-I 132 kV	8.32	6.25
Best Green 132 kV	5.92	4.45
Appolo Solar 132 kV	5.86	4.40
Yazman 132 kV	5.42	3.66
Bahawalpur 132 kV	10.43	8.01
Lodhran 132 kV	8.66	6.39
BU. Jadid 132 kV	8.41	6.17
BWPN-2 132 kV	8.72	8.25
Mubarakpur 132 kV	4.84	3.26
BWP-N 220 kV	12.99	10.22

 Table-6.3

 Maximum Short Circuit Levels with Zorlu Solar-I PP – Case 2021

M.Garh-I 220 kV	39.53	39.90
Multan 220 kV	53.90	43.40
M-Garh-2 220 kV	36.60	36.34

#### 6.4 <u>Conclusion of Short Circuit Analysis</u>

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

The maximum short circuit level of 132 kV bus bar of Zorlu Solar-I Power Plant is 11.14 kA and 11.93 kA for 3-phase and 1-phase faults respectively for the year 2021. Therefore industry standard switchgear of the short circuit rating of 40 kA would be fine to be installed at 132 kV switchyard of Zorlu-Solar-PP as per NTDC requirement taking care of any future generation additions and system reinforcements in its electrical vicinity.

Similarly the maximum short circuit level of 33 kV bus bar of Zorlu Solar-I Power Plant is 18.66 kA and 24.10 kA for 3-phase and 1-phase faults respectively for the year 2021. Therefore industry standard switchgear of the short circuit rating of 31.5 kA would be fine to be installed at 33 kV switchyard of Zorlu-Solar-PP as per NTDC requirement taking care of any future generation additions and system reinforcements in its electrical vicinity

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## 7. <u>Transient Stability Analysis</u>

### 7.1 Assumptions & Methodology

#### 7.1.1 Stability Models

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

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

Generator	PVGU1
Electrical Model	PVEU1
Solar Panel Model	PANELUI

#### 7.1.2 System Conditions

We have used the system conditions of Peak Summer 2017 because this will allow the maximum impact of Zorlu Solar-I Power Plant to be judged.

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

#### 7.1.3 Presentation of Results

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

#### 7.1.4 Worst Fault Cases

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

### 7.2 <u>Transient Stability Simulations' Results</u>

### 7.2.1 Fault at 132 kV Zorlu Solar-I

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

Fig. 1.1 Bus Voltages

The bus voltage of 33 kV bus bar of Zorlu Solar-I and 132 kV bus bars of Zorlu-Solar, Lal Suhanra, Bahawalpur-2 and 220kV bus bars of BWP-New, Lal Sohanra are plotted. The results show quick recovery of the voltages after clearing of fault.

Fig. 1.2 Frequency

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

Fig. 1.3 MW/MVAR Output of Solar Power Plant

The pre-fault output of Zorlu Solar-I Power Plant was 80 MW and it gets back to the same output quickly after fast damping of the oscillations in its output. Similarly MVAR output acquires equilibrium at a same value.

Fig. 1.4 MW /MVAR flow from Zorlu to Lal Sohanra 132 kV

Followed by clearing of fault, the trip of 132 kV circuit between the Zorlu Solar-I and Lal Sohanra causes the entire output of Zorlu Solar-I to flow through the intact second circuit. We plotted the flows of MW and MVAR on this intact circuit and see that the power flows on this circuit attains to steady state level with power swings damping down fast.

Fig. 1.5 Rotor Angles

The rotor angles of the generators of Hamza 11kV, RYK 11kV, Guddu 220 kV, KAPCO 132 kV are plotted relative to machines at Guddu-New 500 kV. The results show that the rotor angles gets back after the first swing and damps down quickly. The system is strongly stable and very strong in damping the post fault oscillations.

Fig. 1.6 MW/MVAR Output at Adjacent Plant (Appolo Solar)

The output of Appolo Solar gets back to the same output quickly after fast damping of the oscillations in its output. Similarly MVAR output acquires equilibrium at a same value.

#### Fig. 1.7 Voltage Sensor for LVACR

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

### 7.2.2 Fault at 132 kV Zorlu Solar-I (Stuck Breaker Case)

We applied three-phase fault on the Zorlu-Solar 132 kV bus bar, cleared fault in 9 cycles (180 ms) followed by trip of 132 kV circuit between the Zorlu Solar-I to Lal Sohanra 132 kV. We monitored different quantities for one second pre-fault and nine seconds after clearance of fault (post-fault) conditions and plotted the results attached in Appendix – D and discussed as follows;

Fig. 2.1 Bus Voltages

The bus voltage of 33 kV bus bar of Zorlu Solar-I and 132 kV bus bars of Zorlu-Solar, Lal Suhanra, Bahawalpur-2 and 220kV bus bars of BWP-New, Lal Sohanra are plotted. The results show quick recovery of the voltages after clearing of fault.

Fig. 2.2 Frequency

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

Fig. 2.3 MW/MVAR Output of Solar Power Plant

The pre-fault output of Zorlu Solar-I Power Plant was 80 MW and it gets back to the same output quickly after fast damping of the oscillations in its output. Similarly MVAR output acquires equilibrium at a same value.

Fig. 2.4 MW/MVAR flow from Zorlu to Lal Sohanra 132 kV

Followed by clearing of fault, the trip of 132 kV circuit between the Zorlu Solar-I and Lal Sohanra causes the entire output of Zorlu Solar-I to flow through the intact second circuit. We plotted the flows of MW and MVAR on this intact circuit and see that the power flows on this circuit attains to steady state level with power swings damping down fast.

Fig. 2.5 Rotor Angles

The rotor angles of the generators of Hamza 11kV, RYK 11kV, Guddu 220 kV, KAPCO 132 kV are plotted relative to machines at Guddu-New 500 kV. The results show that the rotor angles gets back after the first swing and damps down quickly. The system is strongly stable and very strong in damping the post fault oscillations.

Fig. 2.6 MW/MVAR Output at Adjacent Plant (Appolo Solar)

The output of Appolo Solar gets back to the same output quickly after fast damping of the oscillations in its output. Similarly MVAR output acquires equilibrium at a same value.

Fig. 2.7 Voltage Sensor for LVACR

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

## 7.2.3 Fault at 33 kV Zorlu Solar-I (Trip Single Transformer)

We applied three-phase fault on the Zorlu Solar-I 33 kV bus bar, cleared fault in 9 cycles (180 ms) followed by trip of a single 132/33 kV Transformer at Zorlu Solar-I. We monitored different quantities for one second pre-fault and nine seconds after clearance of fault (post-fault) conditions and plotted the results attached in Appendix – D and discussed as follows

Fig. 3.1 Bus Voltages

The bus voltage of 33 kV bus bar of Zorlu Solar-I and 132 kV bus bars of Zorlu-Solar, Lal Suhanra, Bahawalpur-2 and 220kV bus bars of BWP-New, Lal Sohanra are plotted. The results show quick recovery of the voltages after clearing of fault.

Fig. 3.2 Frequency

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

Fig. 3.3 MW/MVAR Output of Solar Power Plant

The pre-fault output of Zorlu Solar-I Power Plant was 80 MW and it gets back to the same output quickly after fast damping of the oscillations in its output. Similarly MVAR output acquires equilibrium at a same value.

Fig. 3.4 MW /MVAR flow from Zorlu 132/33 kV Transformer

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

Fig. 3.5 Rotor Angles

The rotor angles of the generators of Hamza 11kV, RYK 11kV, Guddu 220 kV, KAPCO 132 kV are plotted relative to machines at Guddu-New 500 kV. The results show that the rotor angles gets back after the first swing and damps down quickly. The system is strongly stable and very strong in damping the post fault oscillations.

Fig. 3.6 MW/MVAR Output at Adjacent Plant (Appolo Solar)

The output of Appolo Solar gets back to the same output quickly after fast damping of the oscillations in its output. Similarly MVAR output acquires equilibrium

### Fig. 3.7 Voltage Sensor for LVACR

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

## 7.3 Conclusion of Dynamic Stability Analysis

The results of dynamic stability show that the system is very strong and stable for the proposed scheme for the severest possible faults of 132 kV systems near to and far of the Solar Power Plant of Zorlu Solar-I. Therefore there is no problem of dynamic stability for interconnection of this Solar Power Plant; it fulfils all the criteria of transient stability. The reactive support from the inverter also helps the system stability.

### 8. <u>Conclusions</u>

- Interconnection study for 100MW Zorlu Solar PP has been carried out. The nearest substation is the recently constructed Lal-Sohanra 220/132 kV Substation. Given the location of Zorlu Solar-I power plant, the most feasible interconnection scheme would be a direct 132kV double circuit from Zorlu Solar-I PP to Lal Sohanra 220/132kV substation. The distance of the site of solar plant from the grid station ,as verified from site visit is approximately 2 km. The conductor used would be Rail with a thermal capacity of 202 MVA. The final scheme of circuits is shown in Appendix A.
- Detailed load flow studies have been carried out for the peak and off-peak load conditions of Summer 2017 and Summer 2018. Similarly, a future scenario of Summer 2021 is also studied for the proposed scheme under normal and N-1 contingency conditions to meet the reliability criteria.
- Steady state analysis by load flow for all the scenarios described above reveals that the proposed scheme is adequate to evacuate the maximum net AC power of 80 MW of the plant under normal and contingency conditions.
- The short circuit analysis has been carried out to calculate maximum fault levels at the Zorlu Solar-I Power Plant 132 kV, and the substations of 132 kV in its vicinity. We find that the fault currents for the proposed scheme are much less than the rated short circuit capacities of switchgear installed at these substations. There are no violations of exceeding the rating of the equipment due to contribution of fault current from Zorlu Solar-I Power Plant.
- The maximum short circuit level of 132 kV bus bar of Zorlu Solar-I Power Plant is 11.14 kA and 11.93 kA for 3-phase and 1-phase faults respectively for the year 2021. Therefore industry standard switchgear of the short circuit rating of 40 kA would be fine to be installed at 132 kV switchyard of Zorlu-Solar-PP as per NTDC requirement taking care of any future generation additions and system
- The dynamic stability analysis of proposed scheme of interconnection has been carried out. The stability check for the worst case of three phase fault right on the 132 kV bus bar of the Zorlu Solar-I power plant substation followed by the final trip of 132 kV circuits emanating from this substation, has been performed for fault clearing of 5 cycles (100 ms). The system is found strong enough to stay

stable and recovered with fast damping. The proposed scheme successfully passed the dynamic stability checks for near and far faults.

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

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## PROJECT SPONSORS: CORLU ZORLU SOLAR PAKISTAN (PRIVATE) LIMITED

### **PROJECT CONSULTANTS**:

**RENEWABLE RESOURCES (PVT.) LTD PAKISTAN** 

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ADB	Asian Development Bank
AEDB	Alternative Energy Development Board
CBD	Convention on Biological Diversity
CITES	Convention on Trade of Endangered Species
CLs	Core Labor Standards
FESCO	Distribution Companies
Db	decibel
DMC	Developing Member Countries
EIA	Environmental Impact Assessment
EHS	Environment Health and Safety
EMP	Environment Management Plan
ESMC	Environmental and Social Management Cell
EPA	Energy Purchase agreement
ЕММР	Environment Monitoring and Management Plan
GAD	Gender and Development
GHG	Greenhouse Gas Emissions
GRM	Grievance Redressal Mechanism
IA	Implementation Agreement
IEE	Initial Environmental Examination
IFC	International Finance Corporation
JICA	Japan International Cooperation Agency
Km	Kilometers
LAA	Land Acquisition Act
LOI	Letter of Intent

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LOS	Law of Seas	
MEA	Multilateral Environmental Agreements	
MW	Mega Watt	
MWh	Mega Watt Hour	
MJ/sq.m	Mega Joule per square meter	
NCS	National Conservation Strategy	
NEP	National Environmental Policy	
NEQS	National Environmental Quality Standards	
NGO	Non-Governmental Organization	
NOx	Nitrate Oxides	
NREL	National Renewable Energy Laboratories	
NTDC	National Transmission and Dispatch Company	
0 & M	Operation and Maintenance	
PEPA	Pakistan Environment Protection Act	
POPs	Persistent Organic Pollutants	
Pak-EPA	Pakistan Environment Protection Agency	
PM	Particulate Matter	
РРВ	Parts Per Billion	
PV	Photo Voltaic	400 0 0 0 <b>0 0 0 0</b> 0 0 0 0 0 0 0 0 0 0 0
RE2	Renewable Resources (Pvt.) Ltd	
SCR	Social Complaint Register	<u></u>
SHEE	Safety Health Environment and Energy	<b>RE 1</b>
Sox	Sulphate Oxides	

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UNFCC	United Nation Framework on Climate Change	
WAPDA	Water And Power Development Authority	<u> </u>
WHO	World Health Organization	
WID	Women in Development	

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# **EXECUTIVE SUMMARY**

#### Introduction:

#### **Sponsor's Introduction (Proponent):**

Zorlu Enerji Group, founded in 1993 with the foundation of Zorlu Energy Electricity Generation Inc. Zorlu Enerji is a global group of companies providing services in different areas of the energy sector. Zorlu Enerji Group offers an integrated service mix with the activities of different sectors of the energy sector, mainly electricity and steam production and sales carried out by Zorlu Energy, the only public company. Zorlu Enerji has a total installed power of 991 MW, of which 525 MW is in Turkey.

Zorlu Enerji has a 100 percent share of Zorlu Energy Pakistan that is 56.6 MW Wind Power Plant located in the Jhimpir Sindh. The Wind power plant, in Jhimpir started commercial activity in 2013. The facility, which is Pakistan's first wind power plant, produces approximately 159 million kWh of electricity per year.

100MW solar project in Pakistan is our first Solar Project in Pakistan and one of the biggest projects at overseas countries, The advanced technology for best performance of project is being focused and used it is targeted to make it one of its kind reference project in Pakistan. Along with this project, it is planned to add 200MW solar project in Quaid-e-Azam Solar Park, Pakistan to make our contribution for Pakistan nations in relieving energy —shortage such social problem. The project is located in District Bahawalpur (Extension of Quaid-e-Azam Solar Park). The proposed site located at latitude of 29°16'28.08"N and longitude of 71°47'45.96"E with elevation of around 127m meters.

The report is *Initial Environmental Examination (IEE)* for submission to Environment Protection Agency (EPA)-Punjab as per Pakistan Environment Protection Act, 1997.

# **COMPANY CONTACT INFORMATION**

Project Company	Zorlu Solar Pakistan (Pvt.) Ltd
Sponsor / Holding Company	Zorlu Energy Group

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Email	mumtaz.hassan@zorlu.com
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	35291681
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	C -117, Block-2, Clifton, Karachi, Pakistan. Tel:

# **CONSULTANT CONTACT INFORMATION**

Renewable Resources is the Project consultant engaged for Project development including the Initial Environmental Examination (IEE) & Environmental Impact Assessment (EIA) of the Project.

The contact details of consultant are given below;

Renewable Resources (Pvt) Ltd		
Islamabad Office	1002, 10 <sup>th</sup> Floor, G <b>reen Tower</b> , Jinnah Av <b>enue</b> , Blue Area, Islamabad – Pakistan Tel: 0092 51 8734901 Fax: 0092 51 8358592	
Karachi Office	86/1 Khayaban-e-Bahria, Phase V, DHA, Karachi – Pakistan Tel: 0092 21 35347122	
Website	www.renewableresources.com.pk	
Contact Person	Dr. Irfan Afzal Mirza, CEO	
Email	irfanmirza@renewableresources.com.pk	

**Renewable Resources (Pvt.) Ltd** is the professional technical advisor for the Project. Renewable Resources is a consulting company specialized in Renewable Energy (RE), Energy Efficiency (EE) and Environment (Env) Projects. The company is owned by group of professionals who have been intimately involved in the renewable energy program of Pakistan, and have a fundamental understanding of issues relating to power project development, which include but are not limited to feasibility studies, regulatory approvals, concession and security documents, and applicable policies.

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RE2 is capable of conducting full feasibility package featuring power production estimates, grid interconnection and tariff model. RE2 also has the expertise to deal with all technical aspects regarding the legal documents of power projects. The professional team of RE2 is well acquainted with the policies, regulations, methodologies and standards of RE power Projects and its work output meets international standards. RE2 is presently a consultant for various power Projects in Pakistan sponsored by local and international investors, with international banks.

RE2 has gained significant experience in conducting Environmental and Social Impact Assessments (ESIA) and Initial Environmental Examinations (IEE) of renewable energy projects in accordance with national and international laws and standards. These studies cover all baseline environmental conditions and anticipated environmental impacts of projects and provide comprehensive Environmental Management Plans.

To date, RE2 has conducted thirty (30) environmental studies of renewable energy projects, which have all been approved by the relevant Environmental Protection Agencies.

#### **Brief Description and its Methodology:**

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

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

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

The IEE study was conducted in four phases.

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- Phase-I involved the definition and categorization of the Project components, collection of baseline data and information of the defined Project area through physical survey and consultation with the local inhabitants near the Project area.
- Phase-II involved the laboratory analysis of the different environmental parameters which includes (Ambient Air Monitoring, Ambient Noise, and Water quality analysis of the project area conducted by the third party and the reports are attached in the **annexures III.**
- Phase-III involved assessment of potential impact assessment of the pre-construction, construction, operation and Decommission phase of the Project.
- Phase-IV involved the mitigation measures, formulation and monitoring of an Environmental Management Plan (EMP) to minimize the environmental impacts of the Project during construction and operation phase.

The approach of IEE study includes the following steps:

- Describing the Project and details of Project Proponents
- Review of applicable Statutory Requirements and compliances
- Establishing environmental baseline conditions through survey and consultation with the local stakeholders
- Scoping the issues and establishing the boundaries of the assessment
- Review of Project Alternatives
- Assessing the potential environmental effects of the Project, including residual and cumulative effects
- Identifying potential mitigation measures to eliminate or minimize the potential adverse environmental impacts
- Environmental Management & Monitoring Plan and follow-up programs

#### **Statutory Requirements:**

This report is prepared in compliance of the following regulatory requirement:

- Guidelines published by Pakistan Environmental Protection Agency (Pak-EPA),
- Punjab Environmental Protection Agency
- Punjab Environmental Protection Agency Regulations, 2016
- Asian Development Bank Polices and Guidelines (For Lenders)
- IFC Guidelines (For Lenders)
- Performance Standards of IFC and World Bank group
- The best practices followed at international level.

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#### **Project Overview:**

The Project Site is acquired at Quaid-e-Azam Solar Park, District Bahawalpur-Punjab. The project site is located around 37 kilometers away from Bahawalpur City.

The total land area of the project site is about 500 acres allotted to the project owners for the implementation of 100 MW Solar PV project by Punjab Government. The proposed site located at latitude of 29°16'28.08"N and longitude of 71°47'45.96"E with elevation of around 127m meters.

#### **Description of Environment**

A data collection survey that included investigations of geology, meteorology, hydrology, ambient air quality, water quality, soil characteristics, noise levels, flora and fauna, land use pattern, and socioeconomic conditions was undertaken in the vicinity of the site. Primary data was collected to establish baseline conditions for the soil, water (surface and ground) quality, flora and fauna, and noise. Secondary data was collected for land, ecology, climate, and socioeconomic factors.

The physical survey of the site was conducted by Mr. Irfan Parvez of Renewable Resources Pvt. Limited. The environmental and social baseline conditions observed in the Project area are presented in **Section 4** of this report.

#### **Stakeholder Consultation:**

Stakeholder consultation was carried out as part of IEE study like; consultation with WWF, Wildlife department, District Officer Environment, Forest Department etc. The main objectives of the consultations were to apprise the stakeholders about the proposed project activities; obtain their views, concerns and recommendations; and address / incorporate them in the project design - thus enhancing the environmental and social performance of the project.

#### Impact Assessment and Mitigation

During the IEE, the project potential social and environmental impacts were identified through site visit conducted by RE2 and observe the gaps. Each identified impact was then characterized with respect to its nature, reversibility, geographical extent, consequence-severity and likelihood. Based upon this characterization, the impacts were then assessed to be of high, medium or low significance. The key potential environmental and social issues identified during

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the study included contamination of soil and water, safety hazards, damage to infrastructure, air quality deterioration, noise emissions, threat to wildlife and habitat modification. Similar impacts during the plant operation were identified; these included soil and water contamination, safety hazards, species mortality, habitat modification, noise and vibration. The IEE has recommended appropriate mitigation measures in Section 07 of the report to address the above concerns, and to keep the residual impacts within acceptable limits.

### **Finding and Recommendation for Mitigation Measures**

The project area is already developed for anther solar project and it's a huge chunk of land available to install another solar project which will not cause any significant impact in the project area and also nearby surroundings. The Project will not cause any significant lasting environmental and social impacts. The environmental disturbance normally associated with construction activities will be minimized through an EMP, implementation of which will continue during EPC and which includes monitoring arrangements. As solar PV technology is a clean energy source with no significant impacts on the environment and no GHG gas emissions - once it is operational. However the consistent monitoring through ESMP shall be conducted to mitigate or reduce the risk of impact if accountable.

The project has been discussed with local people, government officials and NGO like; WWF, Bahawalpur Wildlife department and Bahawalpur and Lal Suhanra Forest department. The consultations elicited general support for the project. There were no serious environmental issues raised or matters that the Consultant had overlooked. The main concerns expressed by the locals were to ensure that local people get employment by the project. Meanwhile, measures should be in place to avoid excessive noise and dust.

The following Annexures are attached with the report in order to support the results and findings of the report.

Annexure-I: Environmental Management and Monitoring Plan

Annexure-II: EMP Implementation Cost Estimates

- Annexure-III: Laboratory Analysis Report for (Ambient Air, Water and Noise)
- Annexure-IV: Social Survey Forms

Annexure-V: Snapshots of Community Consultation

Annexure-VI: Snapshots of Stakeholders Consultation

Annexure-VII: Copy of Land allotment Letter

Annexure –VIII: Copy of LOI

Annexure –IX: Letter of District Government, EPA

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Annexure –X: Letter of Wildlife Department, Bahawalpur Annexure –XI: Letter of Meteorological Department

## **Environmental Management Plan and proposed Monitoring**

An Environmental Management Plan (EMP) had been developed to provide an implementation mechanism for the mitigation measures mentioned above - according to local legislative and foreign lender (IFC) requirements. The EMP provides the organization structure for the environmental and social management system during the project, and defines the roles and responsibilities of project players. The EMP includes a mitigation plan, a monitoring plan, the communication and documentation requirements, and training needs, in the context of the environmental and social management of the project.

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# **SECTION 1**

# **INTRODUCTION AND PURPOSE OF STUDY**

# **1 INTRODUCTION AND PURPOSE OF STUDY**

### 1.1 PROJECT PROPONENT

Zorlu Enerji Group, founded in 1993 with the foundation of Zorlu Energy Electricity Generation Inc. Zorlu Enerji is a global group of companies providing services in different areas of the energy sector. Zorlu Enerji Group offers an integrated service mix with the activities of different sectors of the energy sector, mainly electricity and steam production and sales carried out by Zorlu Energy, the only public company. Zorlu Enerji has a total installed power of 991 MW, of which 525 MW is in Turkey.

Zorlu Enerji has a 100 percent share of Zorlu Energy Pakistan that is 56.6 MW Wind Power Plant located in the Jhimpir Sindh. The Wind power plant, in Jhimpir started commercial activity in 2013. The facility, which is Pakistan's first wind power plant, produces approximately 159 million kWh of electricity per year.

### **1.2 DETAILS OF CONSULTANT**

Renewable Resources is the Project consultant engaged for Project development including the Initial Environmental Examination (IEE) & Environmental Impact Assessment (EIA) of the Project.

**Renewable Resources (Pvt.) Ltd** is the professional technical advisor for the Project. Renewable Resources is a consulting company specialized in Renewable Energy (RE), Energy Efficiency (EE) and Environment (Env) Projects. The company is owned by group of professionals who have been intimately involved in the renewable energy program of Pakistan, and have a fundamental understanding of issues relating to power project development, which include but are not limited to feasibility studies, regulatory approvals, concession and security documents, and applicable policies.

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RE2 is capable of conducting full feasibility package featuring power production estimates, grid interconnection and tariff model. RE2 also has the expertise to deal with all technical aspects regarding the legal documents of power projects. The professional team of RE2 is well acquainted with the policies, regulations, methodologies and standards of RE power Projects and its work output meets international standards. RE2 is presently a consultant for various power Projects in Pakistan sponsored by local and international investors, with international banks.

To date, RE2 has conducted thirty (30) environmental studies of renewable energy projects, which have all been approved by the relevant Environmental Protection Agencies. The following experts were involved in preparation of IEE Report as mentioned in below table. All of the team members are very experienced persons who have been involved to conduct and review the IEE/EIA studies for several multi-sectoral projects.

Name	Designation	· · · · · · · · · · · · · · · · · · ·
Irfan Parvez	Environment Expert	·····
Farooq Ali Khan	Environmentalist/ Sociologist	
Salman Nazir	Head of Projects	
Muhammad Ali Afzal	Project Manager	
Umair Ali Khilji	Surveyor	
	Name Irfan Parvez Farooq Ali Khan Salman Nazir Muhammad Ali Afzal Umair Ali Khilji	NameDesignationIrfan ParvezEnvironment ExpertFarooq Ali KhanEnvironmentalist/ SociologistSalman NazirHead of ProjectsMuhammad Ali AfzalProject ManagerUmair Ali KhiljiSurveyor

## **1.3 PROJECT BACKGROUND AND JUSTIFICATION**

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

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Figure 1-1: Electricity Mix of Pakistan by Source<sup>1</sup>

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

<sup>1</sup> Energy Year Book of Pakistan 201	4		
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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. Hydroelectric 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. Moreover, there are various political issues relating to the development of hydro-electric and coal generation power plants, which remain to be resolved.

In light of the prevailing circumstances at how the country's future electricity needs might be in a way that supports the environmental objectives of the Government of Pakistan; solar power generation appears to be a viable and 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. Also the per kWh tariff for solar power projects are now comparatively lower than that of furnace oil projects; particularly the Rental Power Projects, which were previously inducted to meet the urgent needs of electricity shortfalls.

## **2 PROSPECTS OF SOLAR ENERGY IN PAKISTAN**

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

Pakistan 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 sq.m in a day. This amounts to about 2500-3000 sun shine hours and 1.9 - 2.3 MWh per sq.met in a year. It has an average daily global insolation of 19 to 20 MJ/sq.met 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.

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To summarize, the sun shines for 250-300 days per years in Pakistan with an average sun shine hours of 8-10 per day. This gives 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 2.1**.



Figure 2.1: NREL Solar Map of Pakistan

## 2.1 NATURE AND LOCATION OF PROJECT

The Project Site is acquired in Quaid-e-Azam Solar Park (Extension) Lal Sohanra, District Bahawalpul-Punjab. The project site is located around 37 kilometers away from Bahawalpur

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City. The land area of about 500 acres is leased by the Government of Punjab to the project owners, for the implementation of 100 MW solar PV project. The total boundary of land and the portion selected for project site is shown in the **Figure 2.1**.



Figure 2.2: Location of Site on Pakistan Map

Bahawalpur was a princely state of the Punjab in what is now Pakistan, stretching along the southern bank of the Sutlej and Indus Rivers. It became part of Pakistan in 1947 and is divided into three districts: Bahawalpur, Rahimyar Khan and Bahawalnagar. Bahawalpur is located in Punjab and its a 12th largest city in Pakistan. The city is capital of Bahawalpur District. The city was once the capital of the former princely state and later the province of Bahawalpur. The city was home to various Nawabs (rulers) and counted as part of the Rajputana states (now Rajasthan, India). The city is known for its famous palaces such as the Noor Mahal, Sadiq Ghar Palace, and Darbar Mahal, as well as the ancient fort of Derawar in the Cholistan Desert bordering India. The city is home to one of the few natural safari parks in Pakistan, Lal Suhanra National Park.

## 2.2 TYPE AND CATEGORY OF THE PROJECT

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The project is located in Bahawalpur and it's a clean source of energy which have minor or no impact on the surrounding environment. The project fall under the schedule-I as per the regulation of Punjab EPA (2016). The detailed has been mentioned below;

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

The IEE/EIA Regulations 2000 issued under PEPA 1997 provides separate lists for the projects requiring IEE or EIA. Since the total power generation capacity of 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. These are also mentioned in the Punjab Environmental Protection Agency Regulations, 2016 and according to these regulation the e project falls in Schedule-I and required IEE study.

The document has also been made to comply with the requirements of <u>ADB's safeguard policy</u> <u>statement, 2009</u> as well as local and national standards. To comply with other lender's requirement, the IEE report also addresses <u>IFC's and World Bank group performance standards</u> which will be met by the project.

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

The purpose of Initial Environmental Examination (IEE) is to identify the reasonably foreseeable environmental 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

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- 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
- Efficient production, delivery and use of energy; and
- Pollution prevention and waste minimization, pollution controls (liquid effluent and air emissions) and solid and chemical waste management.
- GHG reduction potential.

## 2.3 APPROACH AND METHODOLOGY

The IEE study is focused at developing the environmental profile of the project area so as to evaluate the (baseline data) existing conditions on physical and biological environment, and social environment together with the anticipated environmental impacts and proposed mitigation measures. Detailed assessment of the social and biological environment of the area was conducted through field survey for the distance up to 10 Km radius of the project site, however the influence zone of the environmental impacts is considered as 5 Km. The main purpose of IEE study is to ensure that:

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

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The present IEE report has identified the significant environmental aspects and screened the potential aspects to ensure that the likely impacts due to proposed activities during construction, installation of SPV's and operation of the proposed project, and the residual impact on adoption of mitigation measures have been critically assessed with respect to compliance with the Pakistan Environmental Protection Act 1997, Punjab Environment Protection Act 1997 (Amended 2012) and World Bank, IFC.

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

#### ALL SOMER

The key activities of this phase included:

<u>**Project Data Compilation**</u>: A generic description of the proposed activities relevant to environmental assessment was compiled with the help of the - Primary and Secondary data collection through literature, EHS guidelines, national and international standards and onground Surveys & environmental testing. A list of potential environmental & as well as social issues was developed. A stakeholder analysis was carried out for the consultation carried out subsequently as mentioned in Section 08.

<u>Published Literature Review</u>: Secondary data on weather, soil, water resources, wildlife, and vegetation were collected from internet, published literature and books. The data was then reviewed and compiled.

Legislative Review: Information on relevant legislation, regulations, guidelines, and standards was reviewed and compiled.

<u>Identification of Potential Impacts</u>: The information collected in the previous steps was reviewed and potential environmental and social issues identified.

#### **Baseline Data Collection:**

**Primary Data** To collect primary data, a field visit was conducted to verify and collect primary data on the site alternatives. A questionnaire was developed and views of local inhabitants were taken about the solar power Project. It also include the social including social and biological surveys, and laboratorial testing conducted by the SGS for the purpose of analyzing environmental parameters in order to quantify either they are meeting with NEQS standards.

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Secondary Data A reasonable data of baseline information on the Project area was available from some alternative resources including existing literature, internet help, existing available information, field surveys and associated departments.

### 2.3.2. Import Assessment

The environmental, socioeconomic, and project information collected was used to assess the potential impacts of the proposed activities. The issues studied included potential project impacts on:

- Geomorphology
- Groundwater and surface water quality
- Ambient air quality and ambient noise levels
- Ecology of area, including flora and fauna
- Local communities
- Noise impact
- Visual Impact
- Shadow Impact

Wherever possible and applicable, the discussion covers the following aspects:

- The present baseline conditions
- The potential change in environmental parameters likely to be effected by project related activities
- The identification of potential impacts
- The evaluation of the likelihood and significance of potential impacts
- The definition of mitigation measures to reduce impacts to as low as practicable
- The prediction of any residual impacts, including all long-term and short-term; direct and indirect; beneficial and adverse impacts
- The monitoring of residual impacts
- An Environment Management Plan (EMP) for the mitigation measures identified during the project

#### 233 Documentation

This report documenting the IEE process and results is prepared accordance with the relevant guidelines set by the Pakistan Environment Protection Agency (Pak-EPA).

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# 2.4 METHOD FOR EVALUATING IMPACT

The description of baseline conditions represents the basis for evaluating the impacts of the project. The description and evaluation of the environmental impacts and proposals for measures to be taken to mitigate and compensate for any determined environmental impacts during construction and operation phase are presented in Environment Management Plan (EMP) (Annexure-I). In the interest of transparent presentation and evaluation, tabulated evaluation procedures have been applied. On the basis of a point system, the severity of a particular environmental impact together with its general trends i.e. negative or positive is described. The evaluation scale applied is as follows

$\longleftrightarrow$	=High
$\Leftrightarrow$	=Medium
$\diamond$	=Low
$\mathbf{O}$	=No Impact
	=Locally Favorable
to the	=Regionally Favorable

For this judgment, international and national standard like those of the World Bank, WHO, etc are used. According to these standards, impacts are evaluated as follows;

High	International and national standards are exceeded.
Medium	Between international and national standards
Low	International and national standards are met

# 2.5 PROJECT OVERVIEW AND OBJECTIVES

The Solar Power Project is located in Lal Soharnra for the development of Quaid-e-Azam Solar Park (Extension), District Bahawalpur, which is approximately 37 km from Bahawalpur City, Pakistan. The Project site consists of 500 acres of land, which has been leased by the

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Government of Punjab. Zorlu Solar Pakistan (Pvt.) Limited got LOI from PPDB in year 2017, 17<sup>th</sup> January to develop 100 MW solar PV power project in the area of Lal Soharnra, Bahawalpur, Punjab Pakistan.

The total land area acquired for the installation of 100 MW Solar PV Project is 500 acres leased by the Government of Punjab.

The proposed project brings in multifold advantages. Not only does it produce clean, pollution free energy, it also has the capacity to provide employment to the people living around the area. It has the capacity of turning the area into clean energy producing hub which will be emulated in other areas of the country.

The brief overview of project is summarized in Table 1.1 below;

### Table 2.1: Project at a Glance

S. No	Particulars	Description
1	Project Site	Lal Soharnra, Bahawalnur, Province Puniah Pakistan
2	Land Available for project	202.343 Hectares
3	Project Capacity	100MW
4	Total number of Solar PV modules to be installed	869,701
6	Estimated Project Cost	101.4 million USD

The overall objectives of the project are;

- i. Contribute to meeting the electricity supply deficit in project area in particular; and country in general.
- ii. Provide electricity to stimulate and support the expansion of local industry and service businesses.
- iii. By using indigenous renewable resources of power generation, avoid depletion of natural resources for future generation and environmental stability.
- iv. Create employment opportunities during construction and operations and also provide opportunities for developing ecotourism.

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- v. Contribute to improved electricity supply service delivery to a limited extent specifically having a wide rural outreach.
- vi. Improve microeconomic efficiency of the power sector by reducing fossil fuel usage.
- vii. Reduce greenhouse gas emissions from power generation and contribute to negligible emission, effluent, and solid waste intensity of power generation in the system.
- viii. Conserve natural resources including land, forests, minerals, water, and ecosystems.
- ix. Improve the local physical infrastructure such as roads and transmission network in the project area.
- x. Develop the local economy and create employment, particularly in rural areas and in a district that is designated a backward area, a priority concern of the Government of Pakistan.

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# **SECTION 3**

# LAGISLATIVE REQUIREMENTS OF IEE

# **3 LAGISLATIVE REQUIREMENTS OF IEE**

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.

A number of 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. Most of the existing laws on environmental and social issues have been enforced over an extended period of time, and are context-specific.

### 3.1 NATIONAL ENVIRONMENTAL LAWS

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

# 3.2 POLICY GUIDELINES (www.epa.gov.pk)

### 3.2.1 National Conservation strategy

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

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

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

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

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

The key to protection of the biological heritage of Pakistan lies in the involvement of local people and in the support provided by competent institutions for conservation and sustainable use. The Government of Pakistan has recognized the importance of these measures in the

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preparation of National Conservation Strategy and in becoming a signatory to, and ratifying, the Convention on Biological Diversity (CBD) in 1994. Developing the Biodiversity Action Plan for Pakistan, 2000 has been the most significant direct steps towards addressing the biodiversity loss. This law is applicable for all the project and cover the core 14 points of NCS to sustain the environment for the betterment of future generation.

### 3. F. The Bodiversity Action Plan

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

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

# 3.3 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 (Environment Protection Department in Punjab for this project) are responsible for environmental planning and development, approval of Initial Environmental Examination (IEE) and Environmental Impact Assessments (EIA) of new projects at provincial level.

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# 3.4 LAWS, REGULATIONS AND GUIDELINES

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

# 3.5 PAKISTAN ENVIRONMENTAL PROTECTION ACT, 1997

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

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

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

The Pakistan Environment Protection Agency Review of IEE and EIA Regulations provide the necessary details 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.

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**	An EIA or IEE is conducted as pe	the requirement and following the Pak-FPA guidelines
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- 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.

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

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

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

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

# 3.8 POLICY FOR DEVELOPMENT OF POWER GENERATION PROJECTS, 2006

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

# 3.9 PROJECT DEVELOPMENT IN TERMS OF POLICY FRAMEWORK

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	Issuance of Letter of Allocation of Project Land	0 months
<del></del>	Completion and approval of feasibility studies (FS)	2 months
	Application of Generation License and Tariff Determination to NEPRA.	3 months
	Agreed Terms Sheet for Debt	4 months
	Achievement of Financial Close	5 months
	Achievement of Commercial Operation Date (COD)	6 months

The following paragraphs describe the progress of the Project and timelines mentioned in the table below in terms of the Power Policy:

#### a ser serve Mintent (13)1

The first step for the development of a project pursuant to the Policy is to register with the PPDB and obtain a Letter of Intent. The sponsors of the Project successfully filed their application and obtained their LOI from the PPDB on 17<sup>th</sup> Jan, 2017 after depositing their bank guarantee. The LOI is the official mandate for the Project Company to commence working on the Project, with the support of the PPDB and other government departments. The LOI heralds the commencement of activities leading to the preparation of a feasibility study and acquisition of land for the Project. LOI is attached in **Annexure VIII.** 

#### 397 Academion Lune

The land is being allocated by the Government of Punjab in the Quaid-e-Azam Solar Park (Extension) Lal Sohanra area. Land measures 500 acres of area. The leasing document of land is attached in the **Annexure VII**.

### ener Saba , sion of Feakbably Study

The Project Company is required to submit a detailed feasibility study, including Technical Feasibility, Electrical Grid Studies, and Environmental Studies, to the PPDB for their approval. The feasibility study of the Project is in progress. The proponent has been submitted the complete set of feasibility studies to PPDB. The complete feasibility study will submitted to PPDB on 28<sup>th</sup>, February, 2017.

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#### NULL Industriation Englise

In order to produce and sell electricity in Pakistan, a project is required to obtain a "Generation License" from the regulator, NEPRA. The Project Company is therefore required to make an application to NEPRA for its Generation License. An application for the generation license along with necessary documents will be submitted to NEPRA after submission of Feasibility Study to PPDB.

#### The Three Determination

A Tariff petition will be submitted by the Project Company to NEPRA for approval of Cost Plus tariff. This application will be submitted simultaneously with the application of Generation License.

### 3.5 \*\* Letter of Support (LOS)

Once the tariff gets approved, the Project Company can engage its lenders to finalize its financing terms and conditions. After award of Tariff, AEDB & PPDB will issue a Letter of Support to the Project Company as soon as the Project Company submits a bank guarantee in respect of its obligation to achieve Financial Close. The amount of the Bank Guarantee is calculated at PKR 10,500,000/. The Letter of Support provides the Project Company with a continued mandate to develop the Project, and provides certain assurances of support from governmental entities and departments. The Letter of Support remains valid until the effectiveness of the EPA and IA.

### 3 (2) – Energy Purchase Agreement (EPA)

The agreement between the Power Purchaser and the Project Company is called the Energy Purchase Agreement (EPA). This agreement lists terms and conditions for the sale and purchase of electricity between the two parties. Discussions relating to the EPA normally commence as soon as the feasibility study is submitted and the tariff petition is filed with NEPRA.

#### 3.9 < http://www.entation.Agreement (IA)

The Implementation Agreement (IA) is an agreement between the Project Company and the GOP, where in the GOP mandates the Project Company to develop the power project, and provides certain assurances and concessions to the Project, its lenders, shareholders and contractors. Importantly, the IA provides certain guarantees in respect of the performance of the power purchaser. The IA also assures the project of compensation in case of any termination resulting from a default or force majeure. These discussions normally commence alongside the EPA.

### 3.4.6 Eman tai Close

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Upon approval of feasibility study, grant of generation license, approval of tariff, and the signing of Project documents (EPA and IA); the Project Company shall move forward to financial close.

## 3.10 NATIONAL AND INTERNATIONAL ENVIRONMENTAL STANDARDS

3 10.1 National Environmental Quality Standards, 2005

The National Environmental Quality Standards (NEQS) were first promulgated in 1993 and were last revised in 2010. The NEQS specify the standards for industrial and municipal effluents, gaseous emissions, ambient air requirements, vehicular emissions, noise levels and water quality standards.

The National Environmental Quality Standards (NEQS), promulgated under the PEPA 1997, specify the following standards:

- Maximum allowable concentration of pollutants (16 parameters) in gaseous emissions from industrial sources,
- Maximum permissible limits for motor vehicle exhaust and noise,
- For power plants operating on oil and coal:
  - Maximum allowable emission of sulfur dioxide,
  - Maximum allowable increment in concentration of sulfur dioxide in ambient air,
  - Maximum allowable concentration of nitrogen oxides in ambient air
  - Maximum allowable emission of nitrogen oxide for steam generators as function of heat input.
  - Maximum allowable concentration of pollutants (32 parameters) in municipal and liquid industrial effluents discharged to inland waters, sewage treatment and sea (three separate set of numbers).

### **Applicability of NEQs**

**NEQs are the standard document** and would be applicable to all the projects and it can be further based on Environmental Quality standards set by the EPA. On the basis of these standards, the results of analysis would be compared with these standards to check the compliance of these standards.

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### 3.16.2 National Environmental Policy, 2005

The National Environmental Policy (NEP) was approved by the Pakistan Environmental Protection Council (PEPC) in its 10th meeting on 27th December 2004 under the chairmanship of the Prime Minister of Pakistan and thereafter approved by the Cabinet on 29th June 2005. NEP is the primary policy of Government of Pakistan that addresses the environmental issues of the country.

The broad Goal of NEP is, "{to protect, conserve and restore Pakistan's}" environment in order to improve the quality of life of the citizens through sustainable development". The NEP identifies the following set of sectorial and cross-sectorial guidelines to achieve its Goal of sustainable development.

### a. Sectorial Guidelines:

Water and sanitation; air quality and noise; waste management; forestry; biodiversity and protected areas; climate change and ozone depletion; energy efficiency and renewable; agriculture and livestock; and multilateral environmental agreements.

### b. Cross Sectorial Guidelines

Poverty; population; gender; health; trade and environment; environment and local governance and natural disaster management. The NEP suggests the following policy instruments to overcome the environmental problems throughout the country:

- Integration of environment into development planning
- Legislation and regulatory framework
- Capacity development
- Economic and market based instrument
- Public awareness and education
- Public private civil society partnership

### Applicability of NEP

NEP is a policy document and does not apply directly at the project directly. However, the development projects like power generation from solar energy should not add to the aggravation of the environmental issues identified in NEP. In any event, mitigation measures would be adopted to minimize or avoid any contribution of the projects and of course, being the Solar a renewable source of energy, Solar Power production can be considered as a means to integrate the environment into development planning.

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#### 3.10.3 Fond Acquisition Act, 1984.

The Land Acquisition Act (LAA) of 1894, amended from time to time, has been the de-facto policy governing land acquisition and compensation in the country. The LAA is the most commonly used law for acquisition of land and other properties for development projects. It comprises of 55 sections pertaining to area notifications and surveys, acquisition, compensation and apportionment awards and disputes resolution, penalties and exemptions.

For the proposed project, the proponents have leased land from the Government of Punjab and no settlement or any structure existed at the site. The LAA is not applicable to the acquisition of land for the proposed project.

### 3 10.4 Telegraph Act, 1985

This law was enacted to define the authority and responsibility of the Telegraph authority. The law covers, among other activities, installation and maintenance of telegraph lines and posts (poles). The Act defines the mechanism to determine and make payment of compensation associated with the installation of these lines and posts.

Under this Act, the land required for the poles is not acquired (or purchased) from the owner, nor the title of the land transferred. Compensation is paid to the owner for any structure, crop or tree that exists on the land; cost of the land is not paid to the owner.

### 3 Def. The Punjab Wildlife (Protection, Preservation, Conservation and Management Act), 1973.

This act was enacted on 1<sup>st</sup> February 1974. This law was enacted to protect the province's wildlife resources directly and other natural resources 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 meat. The Act also defines various categories of wildlife protected areas i.e. National Parks, Wildlife Park, zoological garden or zoo and safari park, Wildlife Sanctuaries and Private Game Reserve.

#### **Applicability on the Project**

This Act will not be applicable to the proposed project because there is not any national and wildlife park in the vicinity of the project area. The letter of wildlife department is attached in **Annexures X**.

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### 3 10.6 Forest Act, 1927

The Forest Act, 1927 empowers authorizes Provincial Forest Departments to establish forest reserves and protected forests. The Act prohibits any person to set fire in the forest, quarry stone, remove any forest-produce or cause any damage to the forest by cutting trees or clearing up area for cultivation or any other purpose.

### **Applicability on the Project**

As there is no forest or plantation grow in the project area, so no need to implement but as per the requirement of CSR, the plantation will be grown in the surrounding area during the construction phase of the project. The consultation with the forest department has been conducted and discuss the project.

### 3.107 Canal and Drainage Act. 1873

The Canal and Drainage Act (1873) prohibits corruption or fouling of water in canals (defined to include channels, tube wells, reservoirs and watercourses), or obstruction of drainage.

This Act will be applicable to the construction and O & M works to be carried out during the proposed project. As per the proposed location of the project, there is no canal or any surface water body passing in the surrounding area.

### 3:10.8 Antiquity Act, 1975.

The Antiquities Act of 1975 ensures the protection of cultural resources in Pakistan. The Act defines "antiquities" as ancient product of human activity, historical sites, or sites of anthropological or cultural interest, national monuments, etc. The Act is designed to protect "antiquities" from destruction, theft, negligence, unlawful excavation, trade and export. Antiquities have been defined in the Act as ancient products of human activity, historical sites, or sites of anthropological or cultural interest, national monuments, etc. The law prohibits new construction in the proximity of a protected antiquity and empowers the Government of Pakistan to prohibit excavation in any area that may contain articles of archeological significance.

Under this Act, the project proponents are obligated to:

• Ensure that no activity is undertaken in the proximity of a protected antiquity, and if during the course of the project an archeological discovery is made, it should be protected and reported to the Department of Archeology, Government of Pakistan, for further action.

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There is no any antiquity or archeological site present in the project area.

5-30.9 Mines, Oil Fields and Mineral Development Act, 1948

This legislation provides procedures for quarrying and mining of construction material from state-owned as well as private land.

These procedures will have to be followed during the construction and operational phase of proposed project.

### Dibuille Factories Act (1934

The clauses relevant to the proposed project are those that address the health, safety and welfare of the workers, disposal of solid waste and effluents, and damage to private and public property. The Act also provides regulations for handling and disposing toxic and hazardous substances. The Pakistan Environmental Protection Act of 1997 (discussed above), supersedes parts of this Act pertaining to environment and environmental degradation.

### **Applicability on Project**

As the solar power project is the source of clean energy and it will not create any impact on the project land. This law is not applicable for this project because it cannot generate any toxic and hazardous emissions during the construction phase and neither generate any waste that effect the environment. It generate only packing materials, plastic pallets and cardboard materials etc.

### Republic Pakistan Explosive Act, 1884

This Act provides regulations for the handling, transportation and use of explosives during quarrying, blasting and other purposes. The transmission line tower installation sometimes needs blasting at rocky/mountainous areas. However, for the proposed project, no such blasting is envisaged.

### STORE Simployment of Child Act, 1991

Article 11(3) of the Constitution of Pakistan prohibits employment of children below the age of 14 years in any factory, mines or any other hazardous employment. In accordance with this Article, the Employment of Child Act (ECA) 1991 disallows the child labor in the country. The ECA defines a child to mean a person who has not completed his/her fourteenth years of age. The ECA states that no child shall be employed or permitted to work in any of the occupation

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set forth in the ECA (such as transport sector, railways, construction, and ports) or in any workshop wherein any of the processes defined in the Act is carried out. The processes defined in the Act include carpet weaving, bidi (kind of a cigarette) making, cement manufacturing, textile, construction and others.

Zorlu Solar Pakistan Ltd and its contractors will be bound by the ECA to disallow any child labor at the project sites or campsites.

### A realized Civil Aviation Rules, 1994

These rules apply to flight operations within Pakistan by aircrafts other than military aircrafts and, except where otherwise prescribed, to flight operations by aircrafts registered, acquired or operating under these rules, wherever they may be. The rules with relevant significance to the power project:

- No person shall erect any temporary or permanent structure, nor position a vehicle or other mobile object on or in the vicinity of an aerodrome (airport), that will be within the clearance area, or will protrude through an obstacle limitation surface, at that aerodrome.
- No person shall operate a light in the vicinity of an aerodrome which because of its glare is liable to dazzle pilots of aircraft taking off from or landing at that aerodrome; or which can be mistaken for an aeronautical ground light. If such a light is operated it shall be extinguished or satisfactorily screened immediately upon notice being given to the person or persons operating the light, by the Director-General or by the Manager or by a person authorized by him.
- No person or persons shall operate a radio station or electrical equipment in the vicinity
  of an aerodrome or of a radio aid to navigation serving an airway or an air route in
  Pakistan which is liable to cause interference with radio communications between
  aircraft and an Air Traffic Services Unit, or which is liable to disturb the signal from a
  navigational radio aid.
- A Captive balloon or a kite shall not be flown at a height above 200ft within 6km of an aerodrome, and a free balloon shall not be flown at any place, except with the express permission of the Director-General and in compliance with the conditions attached to such permission.
- An aircraft shall not be flown over congested areas of cities, towns, or settlements or over an open air assembly of persons, except by permission of the Director-General,

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unless it is at such height as will permit, in the event of an emergency, a landing to be made without undue hazard to persons on the ground, and except when it is taking off or landing, shall not be flown closer than 500ft to any person, vessel, vehicle or structure.

However, there is no airport in close proximity to the project area, therefore, it is highly unlikely that Solar Power Project construction and operation activities might be affected by any of the Aforementioned rules. The project site is not located in the vicinity of any aircrafts pathways so that there is no need to require any precautionary measures related to aircraft and the reflections through solar panels.

### BERLE Pakistan Pena' Code, 1860

The Code deals with the offences where public or private property or human lives are affected due to intentional or accidental misconduct of an individual or organization.

The Code also addresses control of noise, noxious emissions and disposal of effluents. Most of the environmental aspects of the Code have been superseded by the Pakistan Environmental Protection Act, 1997.

3.10.15 National Resettlement Policy / Ordinance

The Ministry of Environment, Local Government and Rural Development formulated a draft policy in 2004 on involuntary resettlement with technical assistance from ADB. The policy aims to compensate for the loss of income to those who suffer loss of communal property including common assets, productive assets, structures, other fixed assets, income and employment, loss of community networks and services, pasture, water rights, public infrastructure like mosques, shrines, schools and graveyards. The government has also developed a document entitled "Project Implementation and Resettlement of the Affected Persons Ordinance, 2002", later referred to as the "Resettlement Ordinance", for enactment by provincial and local governments, after incorporating local requirements. The Ordinance, being a new law, shall be supplementary to the LAA as well as other laws of Pakistan, and wherever applicable under this policy. However, if necessary, appropriate amendments to the LAA 1894 will also be proposed to facilitate the application of the Resettlement Ordinance. There has not been much progress on the enactment of the Resettlement Ordinance; hence this is not relevant for the proposed project.

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# 3 10 16 Provincial Local Government Ordinance, 2001

These ordinances were issued under the devolution process and define the roles of the local governments. Under this Ordinance, three tiers of the local governments have been introduced at the district, tehsil and union levels. The top most tiers are the district government, followed by the Tehsil (subdivision of a district) government, known as the Tehsil Municipal Administration (TMA). The lowest tier of the local government is the Union Administration. In addition to the local governance and municipal administration functions, the local government ordinances also address the land use, conservation of natural vegetation, air, water and land pollution, disposal of solid waste and wastewater effluents, as well as matters relating to public health.

# 3 10.17 Motor Vehicles Ordinance, 1965, and Rules, 1969

The Motor Vehicles Ordinance, 1965, was extended in 1978, to the whole of Pakistan. The ordinance deals with the powers of motor vehicle licensing authorities and empowers the Road Transport Corporation to regulate traffic rules, vehicle speed and weight limits, and vehicle use; to erect traffic signs; and to identify the specific duties of drivers in the case of accidents. It also describes the powers of police officers to check and penalize traffic offenders at the provincial level. At the same time, the ordinance also empowers the Regional Transport Authority to operate as a quasi-judicial body at the district level to monitor road transport, licensing requirements, and compensations for death or injury to passengers on public carriers.

# 3.10.18 Cutting of Trees (Prohibition) Act, 1975

This Act prohibits cutting or chopping of trees without permission of the Forest Department. During the site survey conducted by the team of environmentalist and socialist, there is no tree on the site. Hence this law is not relevant to the proposed project.

# 3.11 ASIAN DEVELOPMENT BANK (ADB) POLICIES & STANDARDS

ADB policies and standards to manage social and environmental risks and impacts are considered;

- Safeguards Policy Statement
- Policy on Gender and Development
- Social Protection Strategy

Public Communications Policy

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### Core Labor Standards

# STEP 2009 Safeguard Policy Statement

ADB operational policies include three basic safeguard policies mentioned below. This safeguard policy statement applies to all ADB-financed and/or ADB-administered sovereign and non-sovereign projects, and their components regardless of the source of financing, including investment projects funded by a loan; and/or a grant; and/or other means, such as equity and/or guarantees (hereafter broadly referred to as projects).

## The Involuntary Resettlement Policy

Minimize, mitigate and/or compensate for adverse project impacts, on the environment and affected people when avoidance is not possible.

## **Policy of Indigenous Peoples**

Help burrowers/clients to strengthen their safeguard system and develop the capacity to manage environmental and social risks.

## **Environmental Policy**

Avoid adverse impacts of projects on the environment and affected people where possible.

## street Policy on Gender and Development

The Asian Development Bank (ADB) first adopted the Policy on the role of the Women in Development (WID) in 1985 and over the passage of time has progressed from WID to Gender and Development (GAD) approach that allows gender to be seen as a cross cutting issue influencing all social and economic processes.

ADB's Policy on GAD will adopt mainstreaming as a key strategy in promoting gender equity. The key elements of ADB's policy will include the following;

**Gender sensitivity:** to observe how ADB operations affect women and men, and to take into account women's needs and perspectives in planning its operations.

Gender analysis: to assess systematically the impact of a project on men and women, and on the economic and social relationship between them.

Gender planning: to formulate specific strategies that aim to bring about equal opportunities for men and women.

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**Mainstreaming:** to consider gender issues in all aspects of ADB operations, accompanied by efforts to encourage women's participation in the decision making process in development activities.

**Agenda setting:** to assist Developing Member Country (DMC) governments in formulating strategies to reduce gender discrepancies and in developing plans and targets for women's and girl's education, health, legal rights, employment, and income-earning opportunities.

# state Point, on Gender and Development

It is the set of policies and programs designed to reduce poverty and vulnerability by promoting efficient labor markets, diminishing people's exposure to risks and enhancing their capacity to protect themselves against hazards and interruption/loss of income. Social Protection consists of five major elements

Labor Markets policies and programs designed to facilitate employment and promote efficient operation of labor markets;

Social Insurance programs to cushion the risks associated with the unemployment, health, disability, work injury and old age.

Social Assistance and Welfare Service program for the most vulnerable groups with no other mean of adequate support.

Micro and Area Based Schemes to address vulnerability at the community level and

Child Protection to ensure the healthy and productive development of future Asian Workforce.

# Social Protection System in Asia and Pacific Region

In considering the demand of social protection with Asian sub regions, it is important to identify the circumstances faced by their vulnerable groups. A common trait to all countries in the region is the need to address child and youth priorities, extend coverage to poorer communities, improve governance, and promote institutional development.

# 3.11.4.2005 Pable Communications Policy

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The 2005 policy requires a comprehensive review to be conducted 5 years after its effective date. Accordingly, ADB launched a review in February 2010 to assess the policy's efficacy and recommend changes as necessary to improve and strengthen it. The review engaged interested individuals and organizations. Consultation drafts were released in June and November 2010. Extensive discussions of the policy were held with a wide range of stakeholders in a number of ADB member countries within and outside Asia and the Pacific. ADB also undertook two global surveys of its stakeholders to gauge their perceptions of ADB's performance and communications. This paper takes into account the internal and external comments received, the findings of the global perception surveys and also updates the Public Communications Policy that the Asian Development Bank (ADB) adopted in 2005.

ADB's public communications policy provides a framework to enable ADB to communicate more effectively. The policy aims to enhance stakeholder's trusts in an ability to engage with ADB. The policy promotes

- Awareness and understanding and results of ADB activities, policies, strategies, objectives and result;
- Sharing and exchange of development knowledge and lessons learned, so as to provide fresh and innovative perspectives and development issues;
- Greater two-way flow of information between ADB and stakeholders' including project affected people, in order to promote participatory development; and
- Transparency and accountability of ADB operations

### STEE LOEP Lobor Standard

ADB adopted a commitment to Core Labor Standards (CLS) as part of its Social Protection Strategy in 2001. Since then, ADB ensures that CLS are duly considered in the design and implementation of its investment projects. In this regards a handbook for CLS has been developed by ADB with cooperation of International Labor Organization (ILO). The objective is to convince decision makers that the introduction of CLS and labor standards in general will not impede development. The labor standards are simple the rules that govern how people are treated in a working environment. Labor standards cover a very wide variety of subjects, mainly concerning basic human rights at work, respect for safety and health and ensuring that people are paid for their work. CLS are a set of four internationally recognized basic rights and principles at work.

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- Freedom of association and the effective recognition of the right to collective bargaining;
- Elimination of all forms of forced or compulsory labor;
- Effective abolition of child labor; and
- Elimination of discrimination in respect of employment and occupation

# 3.12 Equator Principles

The Equator Principles are a set of guidelines, promoted by the International Finance Corporation (IFC) that address the environmental and social issues associated with major development projects worldwide. They provide a common baseline and framework for the implementation of internal environmental and social procedures and standards for project financing activities across all industries.

Principle 1: Review and Categorization (of projects)

Principle 2: Social and Environmental Assessment

Principle 3: Applicable Social and Environmental Standards

Principle 4: Action Plan and Management System

- Principle 5: Consultation and Disclosure
- Principle 6: Grievance Mechanism
- Principle 7: Independent Review
- **Principle 8: Covenants**
- Principle 9: Independent Monitoring and Reporting

Principle 10: EPFI Reporting

### **Review and categorization**

An EPFI will categorize a project, based on the magnitude of the potential social or environmental impacts and risks of that project, in accordance with IFC classification criteria.

These categories are:

Category A: Projects with potential significant adverse social or environmental impacts that is diverse, irreversible or unprecedented.

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Category B: Projects with limited adverse social or environmental impacts that is few in number, generally site specific, largely reversible and readily addressed through mitigation measures.

Category C: Projects with minimal or no social or environmental impacts.

Solar Energy projects, by their nature; tend to fall into Categories B or C, being medium or low risk. Certain EPFIs as a matter of policy for example treat every solar power project as Category D: The Equator Principles apply to project a second

Category D: The Equator Principles apply to projects over 10 million US dollars. The Principles state that adopting financial institutions will provide loans directly to projects only under the following circumstances:

This IEE study has adequately addressed the Equator Principles applicable to risky projects as stated hereunder:

# Principle 1 (Review and Categorization): The study has reviewed the National and

International Laws and Guidelines on different environmental aspects and has categorized the Zorlu Solar Power Pakistan Pvt. Ltd Solar Power Project in Category C (Low Hazard) as mentioned in Section 03.

**Principle 2 (Social and Environmental Assessment):** The Study has been prepared to respond to the National and International requirements and to satisfactorily address the key environmental and social issues as mentioned in the report of Section 07.

# Principle 3 (Applicable Social and Environmental Standards): For the purpose of this IEE

Study, primary data on the baseline environmental and social conditions have been generated wherever necessary to address the requirements of National laws and regulations; applicable International Treaties and Agreements; sustainable development and use of renewable natural resources; protection of human health, cultural properties, and biodiversity and other physical, ecological and socioeconomic issues required to be addressed under this Principle. The baseline data is also provided in Section 05 of the IEE report.

**Principle 4 (Action Plan and Management System):** Section-6 of this study screens the potential environmental impacts and proposes/provides Mitigation Measures to reduce the severity of impact. The study also includes the Environmental Monitoring and Management Plan.

**Principle 5 (Consultation and Disclosure):** Being a project of Category C, the public consultation is limited to the scoping sessions with stakeholders and an extensive socio economic survey of the villages/hamlets that are all outside the boundary of the Project area. The surveys and consultation meetings have established that no settlements or temporary relocation or acquisition of land is involved in the project area. This has mentioned in Section 08 of the IEE report and briefly explain this matter.

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**Principle 6 (Grievance Mechanism):** This Principle will not apply since 'no' resettlement or temporary relocation or acquisition of land is involved. It not only restrict the resettlement issues but also include the issues related to public complaints and some other related issues. A separate register will be maintained on site during the construction phase of the project.

Principle 7 (Independent Review): Being placed in Category C, an independent review is not required.

**Principle 8 (Covenants):** The IEE study has incorporated Covenants linked to compliance. Moreover, No Objection Certificates are issued to Proponents of Project under conditions of compliance with the Mitigation and Performance Monitoring Plan during the construction and operational phase of the project. Needless to say that if the proponent does not comply with the agreed terms, Punjab EPA is authorized to take corrective and even coercive action.

**Principle 9 (Independent Monitoring and Reporting):** This Principle will be applicable to the Zorlu Solar Power Pakistan Pvt. Ltd for Solar Power Project since it falls in category C of projects requiring an IEE.

**Principle 10 (EPFI Reporting):** The concerned EPFI may safely commit to report publicly at least annually about its Equator Principles implementation processes and experience.

# 3.13 IFC Performance Standards on Social and Environmental Sustainability

International Finance Corporation (IFC) applies the Performance Standards to manage social and environmental risks and impacts and to enhance development opportunities in its private sector financing in its member countries eligible for financing. The Performance Standards are also applied to the projects in emerging markets. Together, the eight Performance Standards establish standards that the Proponent is to meet throughout the project.

The objectives of Performance standards are given below:

To identify and assess social and environment impacts, both adverse and beneficial, in the project's area of influence

To avoid, or where avoidance is not possible, minimize, mitigate, or compensate for adverse impacts on workers, affected communities, and the environment

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# To promote improved social and environment performance of companies through the effective use of management systems.

# Performance Standard-1: Social & Environmental Assessment and Management System

This Performance Standard seeks to:

- Identify and assess social and environment impacts in the project's area of influence;
- Avoid, minimize, mitigate, or compensate for adverse impacts on workers, affected communities, and the environment;
- Ensure that affected communities are appropriately engaged on issues that could potentially affect them; and
- Promote improved social and environment performance of the project through the effective use of management systems.

Under this Standard, the project is required to establish and maintain a social and environmental management system appropriate to the nature and scale of the project and in accordance with the level of social and environmental risks and impacts. The management system is required to incorporate the following elements:

- Social and Environmental Assessment;
- Management program;
- Organizational capacity;
- Training;
- Community engagement;
- Monitoring; and
- Reporting

This IEE study has been conducted to respond to requirements of national legislation and international Guidelines as well fulfills the above requirements of the IFC Performance Standards PS1.

# Performance Standard-2: Labor and Working Conditions

This PS seeks to establish, maintain and improve the worker-management relationship; promote fair treatment, non-discrimination and equal opportunity for workers, and

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compliance with national labor and employment laws; protect the workforce by addressing child labor and forced labor issues; and promote safe and healthy working conditions, and to protect and promote the health of workers.

The Sponsors of proposed project and their contractors will be required to adhere to this PS, in particular with regard to compliance with national labor and employment laws; employment of child labor, and promoting safe and healthy working conditions, besides protecting and promoting the health of workers.

# Performance Standard-3: Pollution Prevention and Abatement

The PS 3 seeks to avoid or minimize adverse impacts on human health and the environment by avoiding or minimizing pollution from project activities, and to promote the reduction of emissions that contribute to climate change. The Standard requires the project to consider during its entire lifecycle ambient conditions and apply pollution prevention and control technologies and practices that are best suited to avoid or, where avoidance is not feasible, minimize or reduce adverse impacts on human health and the environment while remaining technically and financially feasible and cost-effective.

PS 3 will be applicable to all stages of the Zorlu Solar Power Pakistan Pvt. Ltd for the Project. Various aspects of pollution prevention and abatement of the proposed project are discussed separately in this report.

# Performance Standard-4: Community Health, Safety and Security

The PS 4 seeks to avoid or minimize risks to and impacts on the health and safety of local community during the project lifecycle from both routine and non-routine circumstances, and to ensure that the safeguarding of personnel and property is carried out in a legitimate manner that avoids or minimizes risks to the community's safety and security. The PS requires the project to evaluate the risks and impacts to the health and safety of the affected community during the design, construction, operation, and decommissioning of the project and establish preventive measures to address them in a manner commensurate with the identified risks and impacts.

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The present assessment addresses the requirement of PS 4 for the proposed project, and has evaluated the impacts of sitting the project on health, safety and security of the community in the microenvironment as well as the macro environment. The Environmental Management Plan also addresses company community aspects.

# Performance Standard-5: Land Acquisition and Involuntary Resettlement

This PS aims to address the adverse impacts associated with land acquisition and involuntary resettlement caused by the project. The PS seeks to:

- Avoid or at least minimize involuntary resettlement wherever feasible by exploring alternative project designs.
- Mitigate adverse social and economic impacts from land acquisition or restrictions on affected persons' use of land by: (i) providing compensation for loss of assets at replacement cost; and (ii) ensuring that resettlement activities are implemented with appropriate disclosure of information, consultation, and the informed participation of those affected.
- Improve or at least restore the livelihoods and standards of living of displaced persons.
- Improve living conditions among displaced persons through provision of adequate housing with security of tenure at resettlement sites.

The project site is the Zorlu Solar Power Pakistan Pvt. Ltd. Moreover there is no permanent settlement or hamlet within the designated area nor its surroundings. Project Land has been leased by the Government of Punjab to Zorlu Solar Power Pakistan Pvt. Ltd.

## Performance Standard-6: Biodiversity Conservation and Sustainable Natural Resource Management

The PS 6 seeks to protect and conserve biodiversity, and promote sustainable management and use of natural resources through adoption of practices that integrate conservation needs and development priorities.

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The present environmental assessment addresses the potential impacts of the proposed project on the biodiversity. This IEE has recommended measures for the conservation of flora, fauna and other natural resources.

# Performance Standard-7: Indigenous Peoples

The PS 7 seeks to address the impacts of the project on the indigenous people. Specifically, the objectives of the PS are to:

- Ensure that the development process fosters full respect for the dignity, human rights, aspirations, cultures and natural resource-based livelihoods of Indigenous Peoples.
- Avoid adverse impacts of projects on communities of Indigenous Peoples, or when avoidance is not feasible, to minimize, mitigate, or compensate for such impacts, and to provide opportunities for development benefits, in a culturally appropriate manner.
- Establish and maintain an ongoing relationship with the Indigenous Peoples affected by a project throughout the life of the project.
- Foster good faith negotiation with and informed participation of Indigenous Peoples when projects are to be located on traditional or customary lands under use by the Indigenous Peoples.
- Respect and preserve the culture, knowledge and practices of Indigenous Peoples

No indigenous people - with a social and cultural identity distinct from the existing dominant society that makes them vulnerable to being disadvantaged in the development process of the proposed project are known to exist in and around the proposed site. No such people were found in the area during the present study either. Therefore, this PS is not applicable for the proposed project.

# Performance Standard-8: Cultural Heritage objectives have been set in the IFC performance standards to achieve sustainable development.

The objectives of this PS-8 are to protect cultural heritage from the adverse impacts of project activities and support its preservation, and to promote the equitable sharing of benefits from the use of cultural heritage in project activities.

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No sites of cultural heritage are known to exist at or in the immediate vicinity of the project location. There are also no indications of any old settlement in the area, nor is there any site covered under the listing of cultural heritage sites. This PS will therefore not be applicable to the Project.

# 3.14 INSTITUTIONAL SETUP FOR ENVIRONMENTAL MANAGEMENT

The apex environmental body in the country is the Pakistan Environmental Protection Council (PEPC), which is presided by the Chief Executive of the Country. Other bodies include the Pakistan Environmental Protection Agency (Pak-EPA), provincial EPAs (for four provinces, AJK and Northern Areas), and environmental tribunals. The EPAs were first established under the 1983 Environmental Protection Ordinance; the PEPA 1997 further strengthened their powers. The EPAs have been empowered to receive and review the environmental assessment reports (IEEs and EIAs) of the proposed projects, and provide their approval (or otherwise). The proposed project would be located in Punjab Province, hence this IEE report will be sent to the Punjab-EPA for review.

# 3.15 OBLIGATION UNDER INTERNATIONAL TREATIES

Pakistan is signatory of several Multilateral Environmental Agreements (MEAs), including:

- Basel Convention on the Control of Trans-boundary Movements of Hazardous Wastes and their Disposal,
- Convention on Biological Diversity (CBD),
- Convention on Wetlands (Ramsar)
- Convention on International Trade in Endangered Species (CITES),
- UN Framework Convention on Climate Change (UNFCCC),
- Kyoto Protocol,
- Montreal Protocol on substances that deplete the ozone layer,
- UN Convention to Combat Desertification,
- Convention for the Prevention of Pollution from Ships (MARPOL),
   IN Community
- UN Convention on the Law of Seas (LOS),
- Stockholm Convention on Persistent Organic Pollutants (POPs),
   Contine During Pollutants
- Cartina Protocol.

These MEAs impose requirements and restrictions of varying degrees upon the member countries, in order to meet the objectives of these agreements. However, the implementation

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mechanism for most of these MEAs is weak in Pakistan and institutional setup nonexistent. Although almost all of the above MEAs would apply to the projects in one way or the other, the ones which have direct relevance for the proposed project include the Basel Convention Montreal Protocol, Stockholm Convention, UNFCCC and Kyoto Protocol. Kyoto protocol apply for the proposed project because it's used in CDM (Clean Development Mechanism) A CDM project activity might involve, for example, a rural electrification project using solar panels or the installation of more energy-efficient supply system. The mechanism stimulates sustainable development and emission reductions, while giving industrialized countries some flexibility in how they meet their emission reduction or limitation targets.

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# **SECTION 4**

# **ANALYSIS OF PROJECT ALTERNATIVES**

# **4 ANALYSIS OF PROJECT ALTERNATIVES**

Setting up of a solar power project involves selection of environmentally and techno economically suitable site, land characteristics, meteorology, infrastructure, grid availability, water availability, rail and road connectivity, accessibility and shading aspects etc. This chapter elaborates analysis of project alternatives which can be considered in the project area.

# 4.1 WITH OR WITHOUT PROJECT

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

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

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

In view of the above, the "Without Project" option is not a preferred alternative.

## 4.2 ALTERNATIVE FUEL

The only viable generating options for energy production to meet the supply-demand gap in project region are fossil fuel energy. Pakistan is already facing huge short fall in fulfilling the coal requirement for already existing thermal power plant. The quality of coal is also low to medium in Punjab region resulting in fly ash, carbon footprints and sulphur fume emission when it's burnt. So, it is imperative to look for alternatives to fossil fuel based power generation to achieve long term power solution of the country.

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# **SECTION 5**

# **PROJECT DESCRIPTION**

# **5 PROJECT DESCRIPTION**

## 5.1 LOCATION OF PROJECT

The Project Site is acquired in Quaid-e-Azam Solar Park (Extension) Lal Sohanra, District Bahawalpul-Punjab. The project site is located around 37 kilometers away from Bahawalpur City. The land area of about 500 acres is leased by the Government of Punjab to the project owners, for the implementation of 100 MW solar PV project. The total boundary of land and the portion selected for project site is shown in the **Figure 5.1**.

Bahawalpur was a princely state of the Punjab in what is now Pakistan, stretching along the southern bank of the Sutlej and Indus Rivers. It became part of Pakistan in 1947 and is divided into three districts: Bahawalpur, Rahimyar Khan and Bahawalnagar. Bahawalpur is located in Punjab and its a 12th largest city in Pakistan. The city is capital of Bahawalpur District. The city was once the capital of the former princely state and later the province of Bahawalpur. The city was home to various Nawabs (rulers) and counted as part of the Rajputana states (now Rajasthan, India). The city is known for its famous palaces such as the Noor Mahal, Sadiq Ghar Palace, and Darbar Mahal, as well as the ancient fort of Derawar in the Cholistan Desert bordering India. The city is home to one of the few natural safari parks in Pakistan, Lal Suhanra National Park.

The princely state of Bahawalpur was founded in 1802 by Nawab Mohammad Bahawal Khan II after the break-up of the Durrani Empire. The city is over 4.51 kilometres long. Nawab Mohammad Bahawal Khan III signed a treaty with the British on 22 February 1833, guaranteeing the independence of the Nawab. The state acceded to Pakistan on 7 October 1947 when Nawab Sadiq Muhammad Khan Abbasi V Bahadur decided to join Pakistan at the time of independence. The predominantly Muslim population supported Muslim League and Pakistan Movement. After the independence of Pakistan in 1947, the

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minority Hindus and Sikhs migrated to India while Muslims refugees from India settled down in the Bahawalpur state. Bahawalpur became a province of Pakistan in 1952 and was merged into the province of West Pakistan on 14 October 1955. When West Pakistan was divided into four provinces Sindh, Balochistan, Khyber Pakhtunkhwa, and Punjab Bahawalpur was merged in Punjab.

The location of site can be viewed in Figure 5.1 and Figure 5.2. Nearby areas of the project site is shown in Figure 5.3.



Figure 5.1: Location of Site on Pakistan Map

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The coordinates of Project Site are given in Table 5.1 and marked in Figure 5.4;

Table 5.1:	<b>Geographical Coordinates of Project Site</b>
------------	---

	Roundam, Daint	Geodetic	Geodetic	
	boundary Point	Latitude	Longitude	
	1.	29°16'50.10"N	71°47'19.98"E	
	2.	29°16'50.10"N	71°48'22.08"E	
	3.	29°16'30.54"N	71°48'22.08"E	
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		······································
4.	29°16'30.54"N	71°48'9.66"E
5.	29°16'20.76"N	71°48'9.66"E
6.	29°16'20.76"N	71°47'57.24"E
7.	29°16'1.20"N	71°47'57.24"E
8.	29°16'1.20 <b>"N</b>	71°47'13.98"E





## 5.2 SCOPE & LAYOUT

A 100 MW solar PV plant will be constructed and operated on the site. Each array is one mechanical assembly and has 869,701 solar panels; each of First Solar FS4112-3, FS4115-3 and FS4118-3 SEGP6-60 (260W). Modules from the PV manufacturer First Solar with a power rating of 112.5 Wp, 115 Wp & 117.5 Wp, are being considered to be installed for the Project. The modules will be mounted on fixed installed structures in portrait position, 2 modules rows per mounting table.

The Quality of Solar panels are thin films CdTe Cadmium telluride (CdTe) photovoltaics and the number of panels will be installed are 869,701.

The electricity generated will be directly fed into the new Grid Station located around 500 meters from the site.

Interconnection of PV modules and information of arrays is shown in Figure 5.6.



## 5.3 ROAD ACCESS

The Project Site is easily accessible. Going from Bahawalpur city, there is two main roads Canal Road and Hasilpur Road towards project site and the panels will be import through ships Via Qasim Port (Karachi) and will be transported on project site by using trailer (heavy vehicles). The movement is planned from Port Qasim to the site using National Highway (N-5) and Super Highway (M-9). The major track from Karachi to site is multi-lane as well as single carriage road.

The track towards the project site from Canal Road is shown with blue path in Figure-5.7.



Figure 5.7: Road Access to Project Site through Canal Road

Distance from Bahawalpur City to Lahore is approx. 635 kms. One way from Lahore to Bahawalpur City, then and goes towards Multan Road N-5. Continue towards Multan Road N-5 and take turn on left onto Noorpur Thal – Shergarh Road N-5. After this move towards the Okara Bypass Road and then Sahiwal Bypass and also touched from Multan Road then goes on Multan Road. Then move toward the Chichawatni Bypass and continue move towards the Multan Lahore Road N-5. After that cross the Mian Channu Bypass and after that move left towards Multan-Faisalabad Motorway (M-4). Then take left from M-4 to N-5 National highways

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Multan Road towards Bahawalpur City. From Bahawalpur City to project site reached through Canal Road. It took around six to seven hours to reach on project site from Lahore through this track.



Figure 5.8: Road Access to Project Site through Lahore-Bahawalpur Road

Ariel distance of the port from the site is approximately 660 km. Total track length between Port Qasim and site is approximately 855 km. There are few bridges on the way from Bin Qasim port to the site. The load bearing capacity of the bridges in between the site and the port is reliable. Considering, the track has already been used for heavy transportation therefore road conditions are reasonable for transportation of equipment.

The track starts from Port Qasim and after covering 10 km distance through Pakistan Steel Mills Road, it joins National Highways (N5). After 08 km on N5 the track moves to N5-M9 Kathore link Road and covers around 20 km and joins Super Highway M9. After distance of almost 120 km on M9, the track joins N5 again after Hyderabad Bypass. After almost 670 km on N5, the track moves towards Site through Canal Road and after 23 km the track enters Quaid-e-Azam Solar Park road and reaches the Site after 15 km on QASP Main Road. Detailed access to the site from Port Qasim Karachi is shown in 5.9.

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## 5.4 LOCATION OF GRID

Pakistan has a vast transmission and distribution system ranging from Northern areas to the farthest corner of Balochistan and Sindh. National Transmission and Dispatch Company (NTDC) is the main authority which manages all the transmission facilities and the National Grid with the help of 08 distribution companies, the MEPCO.

The project site is located around 500 meters from the nearest 220 kVA Lal Suhanra – Bahawalpur Grid Station. The power generated from this Solar PV plant will be transmitted or supply to the Lal Suhanra – Bahawalpur Grid Station. A separate electrical and grid interconnection study will be conducted for the project including Power Quality, Load Flow, Short Circuit and Power Evacuation. Generally the transmission line is constructed by the NTDC and not the project company. Also it is part of the Energy purchase Agreement, which is signed between NTDC and the project company at a much later stage.

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# **SECTION 6**

# **BASELINE ENVIRONMENTAL CONDITIONS**

# **6 BASELINE ENVIRONMENTAL CONDITIONS**

## 6.1 **PROJECT AREA**

The Project Site is acquired in Quaid-e-Azam Solar Park (Extension) in Lal Sohanra, District-Bahawalpur Punjab. The project site is located around 35- 40 Kilometers away from Bahawalpur City.

The total land area for the implementation of 100 MW Solar PV project is about 500 acres and the land is leased by the Government of Punjab to the project owners. Bahawalpur is one of the oldest cities of Pakistan and is located at 40 km away from project site. Bahawalpur is located near the Cholistan Desert and it is situated on the south of Sutlej River.

There is no settlements are present in the vicinity of the project area nor in its radius of 2-5 km. The settlements visited to get the environmental and social baseline information are far away. An Area of 5 Km from the project site is considered as influence zone shown in **Figure 6.1** and hence it has been taken as study area during site survey and collection of primary and secondary environmental and social data.

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Figure 6.1: Boundary of Project Influence Zone

## 6.2 **TOPOGRAPHY AND GEOGRAPHY**

Geographically speaking, location of Bahawalpur division appeared as follows: in the north its boundaries were limited to River Sutlej, Panjnad and Indus River, which separates Multan and Dera Ghazi Khan, (where the adjacent districts of Sahiwal, Vehari, Multan, Lodhran, Muzaffargarh and Dera Ghazi Khan are located); while Sukkur Division of Sind province lies in south west. The East Punjab province of India and ex-princely states of Bekaneer and Jessalmer were adjacent to the south of Bahawalpur. This area is extremely important regarding national defense and from a strategic point of view. Three districts of Division Bahawalpur are integral part of it: Bahawalnagar, Raheemyar Khan and Bahawalpur District. Bahawalpur division was an administrative unit of the Punjab Province of Pakistan, until the reforms of 2000 when the third

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tier of government was abolished. Bahawalpur got the charge of district, and it was bound on North by Lodhran District, on the East by Bahawalnagar District and India, on the South by India and on the West by Rahimyarkhan and Muzafar Garh Districts. Bahawalpur is one of the largest districts of the Punjab covering an area of 24,830 square miles. It has peculiar demographic, topographic and geographical characteristics. The district is situated almost in the center of the country at an elevation of 152 meters from the sea levels. It has Five Tehsils; Bahawalpur, Ahmad Pur East, Yazman (i/c Cholistan), Khair pur Tamewali, Hasilpur.

Its topography comprises of sand dunes that are sparingly dotted with wild bushes. Owing to scanty rainfall the vast expanse of land remains largely uncultivated, but the banks of the river are lined with cultivation and vegetation. Some areas have been made cultivatable by means of canals and tube wells. The Lal Sohanra is almost barren and consists of small bushes and sand dunes. But the proposed location for the installation of plant is totally barren land and there is no plantation in the vicinity of the project area. The site is already allocated for the Quaid-e-Azam Solar Park and there are already four projects are developed in the project area.

The water level in this area is higher than in the upland. The soil is sandy. The upland is flat plains. The general height of the area is from 118 to 127 meters above the sea level. Topographic map of Bahawalpur derived from satellite mapping is shown in **Figure 6.2**.

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Figure 6.2: Topographic Map of Bahawalpur District

## 6.3 CLIMATOLOGY

The climate of Bahawalpur is hot because, being adjacent to Rajputana desert, this area overall resembles the dry climate of an arid desert. The summer season lasts from the month of March to October for almost eight months, while the weather is pleasant and cold from November to February. The average temperature in the summer season remains between 40 and 50 degree centigrade, while during winter it is between 5 and 15 degree centigrade, which ruins the crops. Before the launching of canal system, when the Bahawalpur region mostly comprised of sand dunes, the temperature of Fort Abbas and Khanpur sometimes used to match that of Jacobabad and became the cause of sand storms.

Bahawalpur has 5-7 hours of sunshine daily on average. As there will be no rise in temperature due to reflections of the panels on the atmosphere because the panels are lined with anti-reflection coating (ARC) on the surface which help to reduce the reflection of the panels to almost zero. Adopted measures during rain and sandstorm are to generate or produce

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electricity is to be reduced. The weather data is gathered from Pakistan Meteorological Department. The letter is attached in **Annexures XI.** 

The detailed data are given in Table 6.1:

Table 6.1:	Rainfall Statistics for Bahawalpur District in 2016
------------	---

Item	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Average Precipation (mm)	0.2	4.0	31.6	4.2	2.0	33.1	34.1	4.9	0.0	0.0	0.0	0.0



Average Rainfall (mm)

Figure 6.3: Monthly Average Rainfall Profile of Bahawalpur

Maximum and Minimum Temperature Regime Map of Pakistan is shown in Figure 6.4, Figure 6.5 & Figure 6.6.

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## 6.4.2 Fauna

There are different birds and mammal species are present in the area. Like; Caracal, Chinkra, Houbara Bustard, Great Indian Bustard, Sand, Groud, Desert Costal, Grey Baridrige, Doves, Raptors, Vultures, Diversified Lizards and snakes, Diversified song birds, different types of shrikes, Jackal and Jungle cat. As for the birds, there is no impact on the birds due to the solar panels; the panels that are used in the project are lined with anti-reflection coting which helps to reduce the reflection of the panels to almost zero. The fences will be made at the project boundary to control the movement of animals in the area.

## 6.5 HUMAN SETTLEMENT PATTERN

Bahawalpur is one of the largest district of the Punjab covering an area of 24830 Sq.km. The district is situated almost in the center of the country at an elevation of 152 meters from the sea levels. It has Five Tehsils. Bahawalpur its area is 2372 Sq.km and its population is 7,98,509, Ahmad Pur East, area is 1707 Sq.km and its population is 7,14,102, Yazman (i/c Cholistan) area 18491 Sq.km and its population is 4,02,573, Khair pur Tamewali area 888 Sq.km and its population is 1,83,250 and Hasilpur area 1372 Sq.km and its population is 3,12,132. That covers the total area is 24830 and the population is 2410,566.

The population of Bahawalpur district has increased from 1.453 million in 1981 to 2.411 million in 1998 showing a growth rate of 3.88 % per year as compare with 3.3 % of Punjab. Population density has increased from 59 in 1981 to 97 in 1998 as compared with 353 of the Punjab.

The is no population and settlements located near to the project site within the radius of approximately 2 to 5 km out from the boundary of the project area. These are the Chak 40 DB and Chak 41 DB having population of 200-300 peoples.

## 6.6 SOCIO-ECONOMIC ENVIRONMENT

# Main occupation of the residents of Bahawalpur district is agriculture. The agricultural area of District is 155,648 acres. As per the consensus of 1998, the total employed persons, 44.7% had

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elementary occupations followed by 34.8% skilled agricultural and fishery workers, service workers, shop and market sales workers, representing 3.5% and 19.2% respectively. In rural areas people having elementary occupations were again in majority, followed by skilled agriculture and fishery workers and service workers, shop and market sales workers representing 56.3%, 31.7% and 5.3% respectively. The highest percentage in urban area is of elementary occupation; followed by service workers, shop and market sales workers having 43.1% and 19.4% respectively.

Bahawalpur district is essentially agrarian. Agriculture is the backbone of its economy and main source of earning for almost entire 78% rural population directly or indirectly. It is well known cotton and wheat growing area and produces 14% of cotton and 4% of wheat of the total Punjab's production. Rice, Sugarcane, Gram, Pulses and Sunflower/Soybean/Canola (oil seed) are the other major crops. The total cropped area in Bahawalpur equals 696,000 hectares. Out of this irrigated area is 686,000 hectares and 10,000 hectares is unirrigated land.

With the exception of few big units, industrial activities in the district are restricted to agrobased industry dealing with the processing of basic raw material. Bahawalpur has 232 large, medium, and small sector industries including that of Caustic Soda, Cotton Ginning & Pressing, Flour Mills, Fruit Juices, General Engineering, Iron & Steel Re-rolling Mills, Looms, Oil Mills, Poultry Feed, Sugar, Textile Spinning, Textile Weaving and Vegetable Ghee & Cooking Oil.

 $(x,y) = \{A_i\}_{i \in I} \{x_i\} \in \{i\}$ 

Local people of the nearby villages have access to urban areas through link roads and public transport available. Electricity is available in the area. However, Sui gas facility is yet not available in the villages and people are using wood as a source of fuel. PTCL telephone services are available and no PTCL access in village level mobile services are available at village level only.

### Contract Residence and Although

The district has literacy rate of 35% (1998 census) with male literacy rate at 44.9% and female at 24%. Looking across regions, 57% of urban population (Male: 52.9%; Female: 47.1%) and 26.3% rural population (Male: 36.4%; Female: 15.1%) of Bahawalpur are literate. However, according to (Multiple Indicator Cluster Surveys) MICS 2007-08 survey, the literacy rate above 10 years is 45% (Male 51.66%; Female: 48.34%). Similarly, urban rural distribution shows 65% urban population (Male: 52.5%; Female: 47.5%) and 37% rural population (Male: 51.3%; Female: 48.7%) is literate.

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There are over 1600 government primary schools- 45% of which are for girls. Middle schools are 226, over 60% are for girls, and 39% for boys, while high schools are 125 and 62% are for boys. As level of education increases, percentage of boys schools increases in the district. However, higher secondary schools are the same in the district, 14 each. Total number of arts and science degree colleges are 18 having enrolment of almost 20,000 students and teaching strength of 543. The higher education institutions in Bahawalpur district include; Islamia University of Bahawalpur, Asian college of Technology Hasilpur Road Bahawalpur, Rise School of Accountancy, Tebiya College, Four Elementary colleges for teaching training, Quaid-e-Azam Medical College (QAMC), Government Sadiq Egertin College (SE College), Government Sadiq Degree College for Girls, Millat College and Post Graduate College Baghdad Road.

The district has 187 health facilities including 4 Tehsil Headquarter Hospitals, 1 Police Hospital, 11 Rural Health Centers, 80 Basic Health Units, 70 Dispensaries, 10 Mother and Child Health Centers, and 3 T.B. Clinics.

## 6.6.4 Protected Sites

There is no protected area in the vicinity of project site.

## 6.7 COMMUNICATION NETWORK

## 6.7.1 Road Links

The District Bahawalpur lies south of the Sutlej River. It is situated in the south of Punjab province, 90 km from Multan, 420 km from Lahore, 122 km from Burewala, 90 km from Vehari, 270 km from Faisalabad and about 700 km from Islamabad. It is linked to these other cities by major railway.

Bahawalpur lies at the junction of trade routes from the east, south-east, and south. It is also an important marketing center for the surrounding areas and is located on the crossroads between Peshawar, Lahore, Quetta and Karachi.

## 6.7.2 Rail Links

The national express railway line is passing through the city. The district is linked with Multan & Karachi through railway network.

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## 6.8 WATER RESOURCES

Most of the town is served with water supply system whereas rest of the area is without it and people have their own sources of water mostly hand pumps / power pumps. Some areas are partly served with this facility Existing Condition. The present main source of water in Bahawalpur is ground water. Water table is 40-50 feet below the ground level. The underground water of the district is mostly brackish.

Drinking water supply situation of Bahawalpur is much below as compared to all other cities; the service coverage is about 3% of population. The city faces similar issues related to drinking water supplies i.e, Low coverage ratio, Poor water quality delivered to users, Illegal connections, not enough trained and qualified staff, the water quality is reported to be poor. PCRWR carried out a survey of major cities in the Punjab among which was Bahawalpur. The results of the survey indicated that around 24% of the sampled water was polluted with E.Coli, 52% samples were found to be contaminated with Coliform bacterium, and 76% possessed excess Arsenic (As) - most of the samples contained more than 50 ppb which is 5 times more than the limits set by the WHO.

The water supply network covers 10% of the town and serves 3% of the total population. Ground water in the Municipal area is generally saline except along the irrigation canals and the river. Presently PHED is executing rehabilitation and augmentation of Urban Water Supply Scheme for Bahawalpur City. This would help in drinking water supply needs and increase in service coverage. Southern Punjab Basic Urban Services Project (SPBUSP) also helping in water supply service provision and expenditure has been made of PKR 414.203 million and physical progress is 93%.

Main Components of the existing system include tube wells, overhead reservoir and distribution network. The maintenance level of pumping machinery is not so reasonable. Privately installed hand pumps / power pumps have been installed. Evidently, during post irrigation phase, the water table has been raised, thereby improving the sub soil water quality.

The project is located on the south of the Sutlej River and lies in the Cholistan region near the Thar Desert, where effect of recharge is significant. As such, the sub soil water quality has improved over the period. The Aerial distance from project site to the River Indus is approximately 20 km away as shown in figure.

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the alluvial deposits of the recent geologic times.

The soil of central Bahawalpur mostly consists of the plains of Indus basin, which is at the height of not more than 150 meters above sea level. But the southwestern desert, which is called Rohi or Cholistan, is mostly undulated due to the presence of sand dunes. The height of the sand dunes does not exceed 150 meters

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Main soil types of Cholistan desert are sand dunes (44%), sandy soils (37%), loamy soils (2%) and saline-sodic clayey soils (17%).

The average water table in Chak 40 DB is 40-50 feet. The water of shallow wells present in the expansion areas contains higher values of TDS and therefore is not suitable for human consumption.

The depth of water table is also depleting over the period. Due to increased number of private tube wells being installed in the location of sub project, the ground water is depleting. Recharge from surface /rain water is helping in reduction of depth of sub soil water table. During dry periods, the situation sometimes becomes quite serious.

## 6.10 AIR QUALITY

To check the air quality of the area, the Ambient Air monitoring were conducted in the project vicinity by the 3<sup>rd</sup> party (SGS) on 18<sup>th</sup> February, 2017 and the reports are attached in the **annexures III**. Beside this, no authentic data is available regarding air quality measurements specifically of Lal Suhanra, Bahawalpur. However comparing with other cities like Lahore the air quality in Bahawalpur is far better and comparatively less polluted. Major air pollution contributors are the motor vehicle emissions. As the city is surrounded by agricultural land, a number of trees and vegetation is there to minimize the impacts of gaseous emissions.

## 6.11 NOISE QUALITY

The project area is completely quite area. There is no traffic or industrial activity in the vicinity of 5 Km of the project site. The report of noise monitoring is attached in **annexures III.** 

## 6.12 SEISMIC HAZARDS

According to Seismic Zoning map of Pakistan, Project area falls in Zone 2A which is minor to moderate damage area. There is no earthquake recorded in the history of region above Richter scale 4.5. Also no damage to the infrastructure and human settlement is reported in the area.

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Figure 6.7: Seismic Hazard Zones of Pakistan

## 6.13 FLOODS

Bahawalpur is situated on the south of SUTLEJ River. History is evidenced that Bahawalpur is seldom faced flood hazard. First mentionable flood came in 1945 when the city was the part of Bahawalpur state (abolished in 1954) and affected the areas nearby river Sutlej i.e. Khanwah Khander, Goth Laskder, Jhangiwala, Dera Bakha etc. The next devastating flood was witnessed in 1988 and at that time much more damages have been occurred on both sides of the river Sutlej and people homes, installed tube wells, standing crops, model colonies and small industrial estate badly flooded.

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In 2013, a flood likes 2010 damages many districts of Punjab including Bahawalpur, Vihari, Dera Ghazi Khan, Rajanpur, Narowal, Multan, Sahiwal, Muzaffargarh etc. Early estimates have shown that 25 districts in Pakistan have been affected by floods according to WHO Report of 2013 where 207 people have been died and 1,122 had injured in flood. More than 13,33,066 people have been affected in country due to flooding and over 12,48,644 acres of standing agricultural crops have been damaged. Among all provinces and territories in Pakistan, Punjab has been severely affected by flood in all sectors (National Disaster Management Authority (NDMA), 2013). Later, on the basis of updates from different sources it is found that about 46 districts in Pakistan have been flooded in 2013 flood where 25 were located in Punjab province

After passing 25 years in 2013, heavy monsoon rains in upper parts of the country and huge volume of water released by India in river Sutlej (that is almost abandon from many years) caused flood in nearby areas of Goth Laskder, Jhangiwala, Dera Bakha etc. in Bahawalpur city. Due to high flood in river Sutlej, erosion had been inundated several villages and destroyed thousands of acres of crops from Minchinabad to Ahmadpur East in Bahawalpur. In the consequence of a high tide in river Sutlej, several villages have been submerged due to breaches in embankments in different areas as hundreds of acres were submerged due to flood in river Sutlej and Chenab at Mauza Kachi Shikrani near Uch Sharif, Ahmedpur East due to a breach in an embankment. Thus, Ahmedpur East is one of the flood prone area in Bahawalpur that is regularly been facing severe flood damages since 2010. Flood 2013 also brought similar destruction in Ahmedpur East's many Union Councils (UCs) and Mouzas. Therefore, damages assessment of flood is essential to saving these financially backward and flood prone areas to formulate a comprehensive flood prevention plan and preparedness strategy to cope up the flood risks.

Floods can be critical natural hazard in the project with respect to solar PV project due to River Sutlej flowing around 20-30 Km away from the project area. Bahawalpur is considered as not flood prone districts of Pakistan according to the map released by Emergency Resource Center (ERC). Below maps in **Figure 6.8** shows Flood Prone districts of Pakistan developed by World Food Programme.

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## 6.14 MINES & MINERALS

There are no mines or minerals found in the district of Bahawalpur.

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# **SECTION 7**

# ANTICIPATED IMPACTS AND MITIGATION MEASURES

# 7 ANTICIPATED 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 5 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.

## 7.1 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. The impacts of the project are envisaged during the design and planning, during pre-construction phase, construction phase.

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

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• 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 Annexure-I

## 7.2 IMPACTS DURING PLANNING AND DESIGN PHASE

The potential adverse environment impacts associated with project have been avoided or minimized through careful route selection. The alignment is sited away from major settlements, whenever possible, to account for future urban expansion.

## 7.3 IMPACTS DURING CONSTRUCTION PHASE

The environmental impact during construction phase is localized and of short term magnitude. However, as this project land is vacant land or 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. There are no major impacts from dust emission on workers during to construction phase and mitigation measures as mentioned in the EMP of the report. The details of the activities and probable impact are brought out in **Table 7.1**:

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Construction Environment Activities Attribute		Probable Impact		
Land Acquisition	Land	No significant in	npact on land-use is exp	ected.
	Socio-Econom	s S In pact due to Resettlement is leased by the Grand vacant land	o Rehabilitation & sues is expected as the lovt. of Punjab and its ba	and is Irren
Site clearing and Leveling (cutting, stripping,	Air	<ul> <li>Fugitive Dust Em</li> <li>Air Emissions fro and machinery.</li> </ul>	issions m construction equipme	ent
excavation,	Water	Run-off from Cor	struction Area.	
earth movement,	Land	Loss of Top Soil.		
compaction)	Ecology	<ul> <li>Loss of diversity vacant land.</li> </ul>	and it's a barren land or	
Transportation and	Air	Air Emissions fro	m vehicles.	
Storage of Construction		Fugitive Dust Em movement.	issions due to traffic	
Material/ Equipment	Water	<ul> <li>Run-off from sto material.</li> </ul>	rage areas of construction	on
	<b>Public Utilities</b>	Increased flow of tra	affic.	
Civil Construction Activities	Air	<ul> <li>Air Emissions fro</li> <li>Fugitive Dust Em</li> </ul>	m construction machine issions.	ery.
	Water	Run-off from Cor	struction Areas.	
Mech. and Elec. Erection Activities	Air	<ul> <li>Air Emissions fro</li> </ul>	m Machinery /activities	
Influx of Labor and	Socio-econom	s 🔹 🕹 Employment opp	ortunities shall increase	e.
construction of	Land	Change in land u	se pattern of the area.	
temporary houses Transportation and Disposal of Construction Debris	Water	<ul> <li>Sanitary effluent</li> </ul>	s from labor colonies.	
Transportation and	Air	Air Emissions fro	m Transport Vehicles.	
Disposal of		Fugitive Dust Em	issions due to Movemer	nt of
Construction Debris		Trattic.	ive emissions of debris.	
ment Title:	Со	sultant Name:	Document No	Date of Approv

Water Soil Run-off from disposal areas. No impact

ng - an Leona

The mobilization of construction equipment and construction materials will require space for storage and parking of construction vehicles and equipment, construction material storage yards, disposal sites, and labor camps for human resource to avoid environmental impact and public inconvenience. These locations shall comply with the local laws and regulations and need approval from authorities to utilize these facilities (access roads, telecommunication, and pipe borne water supply). The selection of temporary lands shall be made in such a way that it is at least 500 meters away from nearby populated areas, water bodies, natural flow paths, agricultural lands, important ecological habitats and residential areas.

The total land allocated for the Project is 500 acres. At the Project site, there has been an absence of the following since the past few decades:

- Any agricultural activity on the land
- Any commercial activity on the land to support the livelihood of local residents nearby
- Any green field, wetland or protected area.

There are no settlements or Katchi Abadis found near the project area nor its surroundings, the settlements found in the nearby area which is approximately 3 to 5 km Arial distance away from the project boundary. In Chak # 40-DB, having population of approx. 200-300 persons and around 50 to 60 houses is located around the project boundaries, and Chak # 41-DB, having population of approx. 300-400 persons and 60 houses is located around the project site which will not be affected due to the construction and operation activities. Therefore, there is no threat to the existing land use or degradation, and there is no net impact on the land use.

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.

💫 Low Impact

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As the construction activities for the main plant units of project would be confined in the land, the impact on soil will be minimal and confined. Only cutting and filling is required during construction. No adverse impact on soil in the surrounding area is anticipated as the area.

Impact on Soil Cov	er		$\diamond$	Low Impac	t	
$\sim$	=+;	gh	<b></b>	- <del>-</del>		
$\sim$	=Mi	edium				
$\diamond$	=_c	NV.				
O	=Nc	mpact				
$\Delta$	=.0	cally Favorable				
र्द्ध	=26	gionally Favora	ble			
194 <u>1</u> ()	XUND D S S					
Solid waste during excess concrete a materials (pallets,	g the constru and cement, crates, Styro	ction phase co rejected comp foam, plastics e	nsists p ponents etc.) and	rimarily of and mate human w	scrapped building ma erials, packing and s aste. During the const	aterials, hipping truction
cument Title:		Consultant Nar Renewable Reso	me: urces (Pvt	.) Ltd	Document No RE2-131-202-001	Date of Approval February,2017
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there will be generation of garbage, for which designated practices of solid waste disposal shall be followed.

Solid waste disposal will be done as follows;

- 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 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 bounded area and subsequently sold to authorized recyclers.

The complete details of scrap metal details will be given as; 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 as per to manage the solid waste handling team. A separate yard area will be allocated for storing the waste material as per the required industrial practice. Also approved contractor will be hired for the recycling of waste appropriately during construction phase. Waste handling agency will be hired at the start of project construction to manage the waste generating during the construction and operational phase of the plant and the practices used for handling the waste disposal to manage proper waste management through different mechanisms like, make a proper dumping site for the disposal of waste, handling of waste or discharge water through point sources. The wastes which are recyclable are sold to the external contractors and the non-hazardous waste will be dumped through municipal waste collection system and services. The solid waste will be dumped away from the project site and where nearby no settlements or any other affected environment is present. It may the proper dumping site that is used for local municipality. Although the PV cells will not be disposed but sent back under as warranty is for 25 years.

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There are some solid wastes in the project site, including the packing material for the equipment, like the wooden pallets and carton boxes. Solid waste management plan will be followed third party EPA certified contractor will be hired for disposal of solid waste (No 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 of green dust control cloth 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. Also the project company has conducted the Ambient Air Monitory before the construction of the project by the third party (SGS). The report of analysis are attached in the **Annexures III.** 

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Net inpacts

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 and vehicular traffic will be routed away from the nearest settlement, Chak # 40-DB and 41-DB, which is approximately 03 to 05 kilometers away from the boundary of power plant site. 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. The noise monitoring has been conducted for the baseline studies as per the guidelines of IFC standards in different points with different time durations. The reports are attached in the **Annexure III**.

Impact on Noise Quality during	Construction No Impac	No Impact	
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#### to a collect Maximum annual

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 water so that such water 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 washroom (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 wastewater 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.

Impact on Water Environment	No Impact	No Impact	
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#### 2377 Ecological Impact

The project site is barren land leased by the government of Punjab for the installation of 100MW solar power project to the project sponsors therefore no impact on project site. The small bushes on the site may be cleared during the project construction activity, but it will be ensured that as soon as the project is operational, plantation is re-grown in and around the plant. Also the project company make a plantation plan for the project after completion of the construction. Thus, the site development works would not lead to any significant loss of important species or ecosystems.

Ecological Impact		Low Impa	act	
$\sim$	=High	1		
$\sim$	=Mec	lium		
$\diamond$	=L <b>o</b> \v			
0	=No h	mpact		
<b>A</b>	=Loca	lly Favorable		
***	=Regi	onally Favorable		
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#### 2.3.d - Impact due to Transmission Lines during Construction Phase

The project activities during construction phase will involve clearing of area along the route alignment wherever required, excavation for civil works related to transmission line and line stringing.

**Impact on Topography:** During the construction of the transmission line, the topography will change due to excavation and fill and cut for leveling the tower erection place.

**Impact on Climate:** The Transmission lines area consists of uncultivated lands. Also, there will be few removals of small bushes 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 Level:** 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 vacant, there will be no residential areas exposed to noise generated during the construction phase and the noise produced during the construction period will have negligible impact on residents.

**Impact on Surface and Ground Water Quality:** There are no any surface water bodies in the way of transmission line .The construction and operation of the transmission lines will not have any major impact on the surface and ground water quality in the area.

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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.

In Transmission line construction activity, no chemical substance or oil is used hence there is no Impact on ground water quality.

**Impact on Ecological Resources:** Since there is no inhabited area along the route of transmission line, there will be no displacement of people or animals. It will also not cause any disturbance to the life of people, local animals and birds' movement. In transmission there is no dynamic equipment and moving machinery causing noise pollution, water and air pollution. There is no national wildlife park, bird sanctuary, wetland in the route alignment of the proposed transmission line. None of the declared environmentally sensitive areas is located within the route alignment. It is not expected that any flora and fauna that are rare, endangered, endemic or threatened will be affected. Migratory paths of small mammals and reptiles may be affected due to construction activities. However noise, vibration and emission from construction vehicles, equipment will occur during construction and pre-construction stages in temporary manner.

The impacts related to above activities are temporary and can be mitigated through following measures:

- Strict attention on worker force regarding disturbance to surrounding habitats, flora and fauna including hunting of animals,
- Selection of approved locations for material storage yards and labor camps away from the environmental sensitive areas, and
- Avoid entering of construction waste (cement particles, rock, rubbles and waste water) and sanitary waste to the surrounding water bodies.

**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 electrocutting, 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

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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 during the construction and operation phase.

**Socio-Economic Impact:** 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.

**Cultural Sites:** There are no archaeological, historical or cultural important sites along the route alignment; hence no impact on these sites is envisaged.

#### Sanitary Waste Disposal at Construction Site and Labor Camp:

The labor camps at construction site will be temporary in nature and the human excreta will not be significant to cause contamination of ground water. Those places where most labor will be staying will be near hamlets which shall use the community services for solid waste, water and sanitation. Adequate drinking water facilities, sanitary facilities and drainage in the temporary sheds of the construction workers should be provided to avoid the surface water pollution.

Provision of adequate washing and toilet facilities should be made obligatory. This should form an integral component in the planning stage before commencement of construction activity. There shall be proper solid waste disposal procedure to enhance sanitation of workers who stay in camps. Septic tank will be used for sanitation purpose. Thus possibilities of infecting water borne diseases or vector borne diseases (Parasitic infections) will be eliminated by adopting proper solid waste disposal procedure. Unacceptable solid waste disposal practices such as open dumping of solid waste and poor sanitation facilities will lead to pollution of surrounding environment, contamination of water bodies and increase adverse impact to the aquatic; terrestrial lives (if present) and general public inhabited in the area. Surrounding of labor camps, garbage disposal sites and material storage yards provide favorable habitats for vectors of diseases such as mosquitoes, rats and flies.

Thus following measures are needed to protect and enhance the quality of environment during the construction stage:

- A better way to overcome garbage disposal as mentioned above by reducing or avoiding the need to construct labor camps, thus the selection of the majority of skilled and unskilled workers from the project area of influence will be a proper measure in this regard.
- Contractor shall provide adequate facilities, soak pits to manage liquid waste.

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- Provision of the solid waste disposal, sanitation and sewage facilities at all site of the construction/labor camps to avoid or minimize health hazards and environmental pollution.
- Contractor should handle and manage waste generated from the construction/labor 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 worker's accommodation.
- Contractor shall provide garbage bins to all worker's accommodation and construction sites, for dumping wastes regularly in a hygienic manner in the area.

## 7.4 IMPACTS DURING OPERATION PHASE

Various activities of operation and maintenance phase and their probable impacts on various Sectors of environment are presented in table below.

O & M Activities	Environment Attribute	Probable Impact	
Waste water	Water	Generation of Waste water during cleaning of modules.	
		Domestic waste generated by staff employed during operations.	
Visual Impact		Visual and reflection of solar modules impact on nearby traffic.	
Socio-economic	Socio-economics	<ul> <li>Generate employment in the area.</li> <li>Fast Development in the area.</li> </ul>	
Air	Air	No emissions from solar PV plant.	
Ecology	Birds/Animals	No impact on fauna and flora.	

### Table 7.2: Identification of Activities and Potential Impact (0 & M Phase)

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#### "it Impact on Land Use

The proposed project will be set up on vacant land or barren land. 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.

#### 2.4.2 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 areas would be restored and such portions of the site would be replanted with appropriate plantation or afforestation inside the boundary of the project.

During operation of a project, no appreciable adverse changes in the soils are anticipated.

#### 7.43 Air Pupacts

Plant operation would not significantly affect the air quality, as solar project is green field project & there are no any gaseous emissions during operation phase from the proposed project.

#### 7.4.1 Noise impact.

During plant operations, there would be no significant noise generated activity expected. There might be use of machinery during maintenance of plant, but the activity will be restricted to day time. The noise generated will not exceed 65 db(A) which is the permissible limit for residential areas as per NEQs for noise.

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## 7.4.5 Impact on Water Environment and Cleaning Mechanism of PV Panels

No ground water due to plant operation will be drawn during operation phase for any purpose. There shall be minimal discharge of wastewater from cleaning of Solar PV modules. The wastewater emanating from cleaning operations shall be recycled for plantation around the plant. For 01 MW, one vehicle of water is required for the cleaning and duration of the cleaning for 100 MW is required approximately 10 days.

During the operation & maintenance period, natural underground water can be used for cleaning the modules with manual washing. The water for cleaning the module doesn't include any chemical agents, so the untreated underground water will be used for cleaning. Based on our project circumstances, modules shall be cleaned twice in every month. The water supply system will be installed along the solar panel array and will be used by the cleaning staff to use the tap water for manual cleaning.

There are two advantages:

- 1. Water consumption is very less, this can conserve water.
- 2. The cost is low, and can create the job opportunities for local people.

The following is the pictures of cleaning method and cleaning equipment as shown below:

(1) (Cleaning method)



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(mop)

(Tap water)

#### \* Lo Feelegy

There is no sensitive ecological area / protected forest area such as national wildlife park, bird Sanctuary near the project area. The area is vacant land and removal of small bushes during initial period of construction will be minimal and will be reversed through re-plantation. There will be no impact on the ecology of the area during operation phase.

#### 747 Visitel impact

The site, after completion of its development, would consist of built structures, landscaped to give a pleasing outlook.

The potential impacts could be visual and reflection. However, as the project site and the surrounding areas provide no significant aesthetic value, the sights of a large area covered with solar PV panels will have no visual impact. With the old design of solar PV arrays, reflected

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sunlight may cause problems if the system is close to a road and is facing in a direction which the reflected sunlight may cause problems. This problem will not occur in this Project as its surface of solar PV panels is designed to absorb sunlight and minimize sunlight reflections. The panels which are being used have a negligible silicon inhalation and from that the workers are used to wear masks during working hours in the project area.

#### 7.4.8 impact of Transmission Lines during Operation Phase

**Electric Shock:** This may lead to death or injury to the workers and public in the area. This shall be minimized or avoided by;

- Security fences around substation
- Establishment of warning signs
- Careful design using appropriate technologies to minimize hazards.

**Noise Generation:** Nuisance to the community around the substation site can occur during the project operation stage. Provision of appropriate noise barriers at substations shall be made in this regard.

**Maintenance of Transmission Line and Substation:** Possible exposure to electromagnetic inter phase could occur during these activities. Design of transmission line shall comply with the limits of electromagnetic interference from overhead power lines.

**Oil Spillage:** Contamination of water on land by the transformer oil can occur during operation due to leakage or accident. Substation transformers are normally located within secure and impervious areas with a storage capacity of 100% spare oil. Also proper drainage facilities will be constructed during the construction stage to avoid overflow or contamination with natural flow paths especially during the rainy season.

## 7.5 IMPACTS DURING DECOMMISSIONING PHASE

Dismantling operation however will have impact on environment due to noise and dust arising out of it. During de-installation, a specific strategy shall be adopted in order to handle the each type of item to keep the impact during the actual activity low. The decommissioning will also have social impact. The decommissioning of the power house which was a part of the local social fabric for many years will certainly create vacuum in the lives of the people directly and

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indirectly connected with it. The impact due to decommissioning on power, social and environmental scenario will be guided by applicable laws and guidelines. These will be addressed appropriately.

Impacts during decommissioning phase are mentioned below;

2.5.1 Acoustic (Noise).

Sources of noise during decommissioning would be similar to those during construction, and would include equipment (rollers, bulldozers, and diesel engines) and vehicular traffic. If near a residential area, noise levels from some equipment operation could exceed the EPA guideline, but would be intermittent and occur for a limited time.

#### 2.5.2 Air Quality:

Emissions from decommissioning activities include vehicle emissions; diesel emissions from large construction equipment and generators; and fugitive dust from many sources such as land clearing, structure removal, backfilling, dumping, restoration of disturbed areas (grading, seeding, planting), and truck and equipment traffic. Permitting would be required (as during construction), and therefore these emissions would not likely exceed air quality standards or impacts.

#### 753 Ecological Impacts

Impacts to biological resources from decommissioning activities would be similar in nature to impacts from construction, but of a reduced magnitude.

#### To F. Waste Management

Substantial amounts of solid waste would be generated during the decommissioning and dismantling of the facility. Much of the solid material (e.g., concrete and masonry, steel, power cable etc) could be recycled and sold as scrap or the remaining nonhazardous waste would be sent to permit disposal facilities.

The separate numeric figures for plant decommissioning waste. i.e. Concrete waste is approx.. 10 Ton and the way of Disposal is at Landfill Site shall be made within project premises of 1.2m X 0.6m (Length x Width), Steel 5 Ton and way of Disposal is Reuse and selling out as scrap, Cables 40 Kg and the way of Disposal is Reuse and Selling out. PV for Solar 12 Kg weight

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and the way of Disposal is to dispose off as per standard industrial practice and the implementation of international protocols; Basal Convention and the Trans boundary movement of hazardous wastes and their disposal May 5, 1992 would be preferred for the decommissioning of PV Plant.

## 7.6 SOCIAL IMPACTS

#### 7.6.1 Englisyment Generation

The project will generate employment opportunities for the local population. Even indirect job opportunities will be created outside the project boundary. The project will improve the basic infrastructure and the people of nearby villages can also use these amenities.

Zorlu Energy will give priority to the skilled, un-skilled labor of the nearby villages. Overall, it is anticipated that there will be marginal impacts on the socio-economic conditions of the locality and the impact will be mostly positive.

#### T.e./ Development of Intrastructure

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.

#### 5.63 Resotdement

There are no indigenous peoples living on the project site. Therefore, the Project has no resettlement and indigenous people issues.

#### Tiel 4 Contribute to Economic Growth and Poverty Reduction

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The project's impact will result from the demonstration effect and sustainability of a large-scale private sector solar farm, a model that can be replicated by other private sector investors in Pakistan. Through the project itself, as well as through the anticipated replication, Pakistan's energy mix will be diversified by adding renewable energy capacity, thereby contributing the country to meet its target of 5% of energy coming from renewable energy by 2020. The project will improve the country economic growth and also decrease poverty level.

#### 7.6 % Private Sector Development

Solar energy holds the most potential of all renewable energy sources in Pakistan, possibly offering at a rate of 1000 watts per square meter. The project will be the first to demonstrate this unrealized potential for large-scale solar projects to meet power needs in the region. The project will establish the commercial viability of large-scale solar farms connected to the grid and set off the necessary growth in the sector by advancing a model that can be replicated by other private sector investors throughout the region.

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## **SECTION 8**

# INFORMATION DISCLOSURE, CONSULTATION AND PARTICIPATION

# 8 INFORMATION DISCLOSURE, CONSULTATION AND PARTICIPATION

The field studies were conducted by for preliminary scoping, survey and assessment activities and coordinate the field survey and analysis.

A questionnaire was developed to assess the general concerns of the local resident of nearby villages about this project. Mr. Irfan Parvez of RE2 team himself filled the questionnaires after asking the questions to the native people. Filled questionnaires are attached in Annexure-IV and snapshots of consultative meeting are also attached in Annexure V.

A community consultation consisted of formal and informal meetings at nearest residential area, and project vicinity. The consultation exercise was conducted in both Punjabi and Urdu languages. A non-technical oral description of the project was given providing an overview of all likely positive and negative impacts. Following which, an open discussion was held so that the participants could voice their concerns and opinions. All participants were encouraged to voice their concerns and opinions. Participants were also asked to suggest alternatives where they had particular concerns.

Feedback obtained from the stakeholders was documented like WWF Pakistan, Bahawalpur Wildlife Department, Bahawalpur Forest department, Lal-Sohanra Forest Department, District Office Environment Department, Bahawalpur, and all issues and suggestions raised were recorded in survey forms. Both social and environmental issues were raised. Mr. Irfan and our team has performed the consultations with different departments and officials.

The people interviewed (Table 8-2) had worries /concerns related to basic needs and generally agreed that most of the effects would be temporary only during construction. Some common concerns regarding the lack of educational facility, shortage of clean drinking water, lack of basic health unit, lack of waste disposal, lack of electricity, poor roads condition and minimal employment opportunities issues were raised. None of these issues related specifically to

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proposed solar power project but were general complaints. Most of the participants appreciated the project and said that it would boost the local employment opportunities, while some said that business and economic situation in the area will also improve.

During construction phase, Residents of the local; area, elected representatives, local councilors and informal community leaders including members of NGO's will be asked to state their current perceptions of priorities for improvements to the urban environmental infrastructure in their areas and about the likely impacts of the Project during construction and operation phases.

The stakeholder consultation is a continued process, and should be maintained throughout the project. The consultations carried out during the present IEE and reported in this Chapter are essentially a first step in this process.

During the present IEE, the stakeholder analysis was carried out to identify relevant stakeholders on the basis of their ability to influence the project or their vulnerability to be negatively impacted from it. This approach ensured that no relevant groups were excluded from the consultations, and appropriate engagement strategies were developed for each stakeholder.

Since the project would not directly affect them, the villagers generally did not have any apprehension or reservation about the project. On the contrary, they expected that the project would bring employment and small business/trade opportunities for the local population.

A matrix of concerns by community members was prepared as given in Table 8.1. The register of attendance is provided as Table 8.2. A pictorial record of the meetings is included as **Annexure VI.** 

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## Table 8.1: Summary of Concerns Raised during Stakeholder Consultation

Issues	Concerns raised by community	Remarks
Health Care	Healthcare centers particularly	Basic health unit is available in
Facilities	for women and children	the area with very little
	Schools	facilities, A dispensary may be
		provided.
Employment	Provision of semi-skilled and	Unskilled jobs will be given to
	unskilled jobs for local labor in	locals people where possible.
	the project construction period.	Training will be provided.
Safety of	Comply with the traffic	Proper traffic management will
Community	management rules.	be resorted to during the
		construction period.
Drinking	Community member rated Safe	As part of the Social
water	drinking water at highest	development program Zorlu
	priority during our survey.	Solar shall provide the safe
		drinking water through RO filter
		plant to nearby communities
Educational	Unavailability of Teachers, and	NGO working in social sector
Facility	School (Primary and	and proponent shall provide the
	Secondary)	required facilities for the local
	Vocational training	peoples.

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S.NO	NAME	OCCUPATION	LOCATION
1	Abdul Majeed	Labour	Chak # 41-DB
2	Muhammad Mushtaq	Labour	Chak # 41-DB
3	Akhtar Hussain	Labour	Chak # 40-DB
4	Muammad Maqbool	Labour	Chak # 40-DB
5	Amir Hussain	Labour	Chak # 40-DB
6	Muneer Ahmed	Farmer	Basti Naseerabad, Chak 9-BC
7	Muhammad Imran	Farmer	Basti Naseerabad, Chak 9-BC

#### Table 8.2: General Public Interviewed during Public Consultation at project Surrounding

#### 81.1 Government Agencies

Stakeholders including provincial government officials, NGOs, and related stakeholders were consulted at their offices. All the stakeholders were given maximum project information and were shown a detailed map of the area. Their concerns and suggestions are reproduced below. Attendance lists of the stakeholders consulted in the proposed project was collated and reproduced in Table 8.3. Pictures of the meetings are provided in **Annexure-VI**.

#### a) Bahawalpur Wild Life Department (Deputy Director)

A consultation meeting was held on February, 2017 with Mr. Anwar Maan Deputy Director Wildlife Department & also regional Head of Bahawalpur Division at his Bahawalpur office along with his team. The project team provided information about the proposed project site with the help of the project area map and requested the officers to identify any protected wildlife sanctuary or other concerns of the Department. During the meeting the Deputy Director expressed his views regarding the project and overall appreciated project activities. Their views and concerns / suggestions are re-produced as follows;

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- Mr. Anwar Maan along his team identified the desert area that are already allotted by the government to the foreigners for the recreational purposes and he briefed about its importance but the Quaid-e-Azam Solar Park is under the Energy department, Government of Punjab.
- He also proposed that to provide the basic facilitates to the communities like jobs opportunities, clean drinking water and sanitation etc.
- Solar panels will occupy very large area of the natural habitat for animals and plants. Care may be taken to avoid the principal of main wildlife habitats in the project area.

#### b) Lal Sohanra and Bahawalpur Forest Department (Bahawalpur Office)

A consultation meeting was held on February, 2017 with Divisional Forest Officer of both the regions. Mr. Tajamal Husain, Divisional Forest Officer, Bahawalpur and Mr. Syed Jawad Hassan, Divisional Forest Officer of Lal-Sohanra at his Bahawalpur offices along with his teams. The project team provided information about the proposed project site with the help of the project area map and requested the officers to identify any protected wildlife sanctuary or other concerns of the Department. During the meeting the forest officers expressed his views regarding the project and overall appreciated project activities. They do not have any issue / objection with the project in Solar Park. As they know that this is the barren land and there is very rare vegetation or even no vegetation. Only the concern was, Frash, Kareer and Jand (Tree species) is very common in that area, so be careful with the removal.

#### 8.1.2 Non-Governmental Organizations

A number of NGO's, other than the government sector were consulted for the proposed projects who are highly involved in protection of wildlife and nature conservation.

#### WWF (World Wide Fund)

A consultation meeting was held on February, 2017 with Senior Manager WWF-Pakistan Mr. Asad Imran and Manager WWF Mr. Liaqat Ali Khan. The team provided information about the proposed project site with the help of the project area map and requested the experts to share their views / concerns /suggestions as the expert conservationist. Mr. Liaqat and his team supported and appreciated the project activities; they do not have any objection / issue even

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they are well satisfied with the green energy project and the way the consultant (RE2) making consultation with all concern departments. They also gave the briefing of their projects in Bahawalpur Area like; Better Cotton Projects of WWF-Pakistan, Promotion of Water Management at Irrigation Source Level in Cotton Growing Areas of Punjab, Pakistan (Sustainable Agriculture Program) and Indus River Dolphin Conservation Project.

#### a) List of Public and NGO Sector Stakeholder Consulted

A number of stakeholders, other than the general public, who are likely benefitted be involved during the project execution phase, were also consulted (Table- 8.3)

Name of Stakeholder Representative	Type of Stakeholder	Department / Occupation/ Designation
Mr. Muhammad Amir Irshad	District Office EPA- Bahawalpur	District Government, Assistant Director EPA, Bahawalpur
Mr. Ansar Abbas	District Office EPA- Bahawalpur	Environment Inspector, EPA, Bahawalpur
Mr. Nadeem	District Office EPA- Bahawalpur	Environment Inspector, EPA, Bahawalpur
Rasheed Ahmed	District Office EPA- Bahawalpur	Field Assistant, EPA, Bahawalpur
Mr. Anwar Maan	Wildlife Department Bahawalpur	Deputy Director/ Regional Head Wildlife Department, Bahawalpur
Mr. Khursheed Azam	Wildlife Department Bahawalpur	Assistant Director/ Wildlife Department, Bahawalpur
Mr. Tajamal Hussain	Bahawalpur Forest department	Divisional Forest Officer, Bahawalpur
Mr. Syed Jawad Hassan	Lal-Sohanra Forest department	Divisional Forest Officer, Lal- Sohanra
Mr. Asad Imran	WWF, Pakistan	Senior Manager WWF, Bahawalpur
Mr. Liaqat Ali Khan	WWF, Pakistan	Manager WWF, Bahawalpur

#### Table 8.3 List of Public and NGO Sector Stakeholders

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## Conclusion

The Project activities will not affect the wildlife of the area as only the barren land Project Area will be utilized for establishing solar panels, which do not pose any threat to the species except loss of land of the barren habitat.

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# **SECTION 9**

## **ENVIRONMENT MANAGEMENT PLAN**

## **9 ENVIRONMENT MANAGEMENT PLAN**

#### PURPOSE AND OBJECTIVE OF EMP 9.1

This Environmental Management Plan (EMP) provides the delivery mechanism to address the adverse environmental as well as social impacts of the proposed project during its execution, to enhance project benefits, and to introduce standards of good practice to be adopted for all project works.

The purpose of Environmental Management Plan (EMP) is to provide a summary of the predicted impacts associated, mitigating measures and monitoring actions so as to minimize potential negative impacts and enhance positive impacts from the Project. The EMP will provide a guide (almost checklist) for the main stakeholders, namely the owner, contractor and operator of the Solar Power Project, on what mitigating actions need to be taken and where and when they are needed. It will thus help to improve the likelihood that adverse impacts are mitigated, project benefits are showcased, and an environmentally beneficial standards of best practice is provided to all those involved. In particular, the EMP:

The specific objectives of the EMP are to:

- Define the roles and a responsibility for those involved in the implementation of the EMP and identifies areas where these roles and responsibilities can be shared with other stakeholders.
- Define the implementation mechanism for the mitigation measures identified during the present study.
- Provides concise instructions to project personnel and contractors regarding procedures for protecting the environment and minimizing environmental impact, making these legally binding through their inclusion in contract specifications.
- Define the monitoring mechanism and identify monitoring parameters in order to:

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- > Ensure the complete implementation of all mitigation measures, and
- Ensure the effectiveness of the mitigation measures.
- Provide the mechanism for taking timely action in the face of unanticipated environmental or social situations,
- Identify environmental as well as social training requirements at various levels.

## 9.2 COMPONENT OF EMP

The EMP consists of the following:

- Institutional Arrangements
- Mitigation and Monitoring plan
- Grievance Redressing Mechanism
- Reports and Documentation
- Environmental and social trainings,
- Public disclosure requirements
- Budgetary estimates for EMP implementation.

All the components of EMP are discussed from Section 8.3 to 8.9.

## 9.3 INSTITUTIONAL ARRANGEMENT

Zorlu Solar Power will establish an Environment & Social Management Cell (ESMC) at Corporate and Site level, headed by a Project Director to be responsible for day-to-day implementation of the Project. Zorlu Solar Power is responsible for undertaking the project in accordance with the Initial Environment Examination (IEE) and implementing the Environmental and Social Management Plan as per ADB's Safeguard Policy Statement (2009) which will be consistent with the standards set by IFC and World Bank Group.

The ESMC is responsible for coordinating and implementing all environmental and social activities. During project implementation, the ESMC will be responsible for reflecting the occurrence of new and significant impacts resulting from project activities and integrating sound mitigation measures into the EMP. The ESMC includes a safeguard specialist and supporting staff, together forming the Environmental and Social Unit, appointed by Zorlu

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Energy Solar Power to look after environmental, social and safety issues. The ESMC will be empowered to implement safeguards planning and monitor implementation.

The safeguards specialist gives guidance to the Project Manager and his staff to adopt the environmental good practice while implementing the project. The safeguard specialist is responsible for implementing safeguard issues associated with the project through a site team composed of Zorlu Solar Power site staff and contractor's staff, to be assigned by the ESMC as necessary.

The duties of the Environmental and Social Unit of the ESMC at corporate level are to:

- Monitor the implementation of mitigation measures during construction and operation phases of the project.
- Prepare suitable environmental management reports at various sites.
- Advise and coordinate field unit's activity towards effective environment management.
- Prepare environment health and safety manual for the operation of transmission lines/substations.
- Advice during project planning/design cells on environmental and social issues while route selection of the alignment at the planning/design stage to avoid negative environmental impact.
- Provide training and awareness rising on environmental and social issues related to power transmission projects to the project/contract staff.

The duties of the Environmental and Social Unit at site level are to:

- Implement the environment policy guidelines and environmental good practices at the sites.
- Advise and coordinate the contractor(s) activity towards effective environment management.
- Implement environment health and safety manual.

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- Carry out environmental and social survey in conjunction with project planning cell while route selection of the alignment at the planning stage to avoid negative environmental impact.
- Make the contractor staff aware of environmental and social issues so that EMP could be managed effectively.

#### 9.3 Supervision Consultant (RE)

The supervision consultant / Project Monitoring Consultant (PMC) (RE) has qualified environment health and safety staff on board to which will be responsible for overseeing the implementation of the EMP during the construction.

#### 93.2 Lead Contractor

The contractor will be responsible for the following:

- Overall construction programme, project delivery and quality control for the construction for the solar project.
- Overseeing compliance with the Health, Safety and Environmental Responsibilities specific to the project management related to project construction.
- Promoting total job safety and environmental awareness by employees, contractors and sub-contractors and stress to all employees and contractors and sub-contractors the importance that the project proponent attaches to safety and the environment.
- Ensuring that each subcontractor employ an Environmental Officer to monitor and report on the daily activities on-site during the construction period.
- Ensuring that safe, environmentally acceptable working methods and best practices are implemented and that sufficient plant and equipment is made available properly operated and maintained, to facilitate proper access and enable any operation to be carried out safely.
- Meeting on site with the Environmental Officer prior to the commencement of construction activities to confirm the construction procedure and designated activity zones;
- Ensuring that all appointed contractors and sub-contractors are aware of this
- Environmental Management Plan and their responsibilities in relation to the plan;
- Ensuring that all appointed contractors and sub-contractors repair, at their own cost, any environmental damage as a result of a contravention of the specifications contained

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in the Environmental Management Plan, to the satisfaction of the Environmental Officer.

At the time of preparing this draft EMP, the appointment of a lead contractor has not been made and will depend on the project proceeding to the construction phase.

The Framework of Environment and Social Management Cell are shown in **Figure 9.1** and Key responsibilities of ESMC are summarized in **Table 9.1** 



S. No	Designation	Responsibility
1	Project Director (01)	Environment and Social Policy and Directions
2	EHS Engineer (01)	<ul> <li>Overall in-charge of operation of environment &amp; social management facilities</li> </ul>
		Ensuring legal compliance by properly undertaking activities as laid down by regulatory agencies from time to time and interacting with the same
3	Social and Environmental Monitoring Expert (01) (from contractor side)	<ul> <li>Secondary responsibility for environment &amp; social management and decision making for all environmental issues including Safety and Occupational Health</li> </ul>
		<ul> <li>Ensure environmental monitoring and social issues related to project as per appropriate procedures</li> </ul>

#### Table 9.1: Identification of Activities and Potential Impact (O & M Phase)

## 9.4 MITIGATION & MONITORING PLAN

The mitigation plan is a key component of the EMP. It lists all the potential effects of each activity of the project and their associated mitigation measures identified in the IEE.

For each project activity, the following information is presented in the plan:

- \* A listing of the potential impact associated with that project activity
- A comprehensive listing of mitigation measures (actions)
- The person(s) responsible for ensuring the full implementation of the action
- The person(s) responsible for monitoring the action
- The timing of the implementation of the action to ensure that the objectives of mitigation are fully met.

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It should be emphasized that the mitigation measures will have to be translated into environmental as well as social requirements and specifications to be made part of the contracts for the construction activities, with legal binding.

The objective of environmental and social monitoring during the various phases of the Proposed project will be as follows:

- Ensuring that the mitigation measures included in the IEE are being implemented completely.
- Ensuring the effectiveness of the mitigation measures in minimizing the project's impacts on social and environmental resources.

To achieve these objectives, the Environmental Management Plan (EMP) for construction and operation phase is given in **Annexure-I**.

## 9.5 GRIEVANCE REDRESSAL MECHANISM

Environmental and social grievances will be handled in accordance to the project grievance redress mechanism. Open and transparent dialogue will be maintained with project affected persons as and when needed, in compliance with ADB safeguard policy requirements. The Grievance Redress Mechanism (GRM) for the project provides an effective approach for complaints and resolution of issues made by the affected community in reliable way. This mechanism will remain active throughout the life cycle of the project.

Zorlu Solar Power Pakistan shall have a standard mechanism to

- i. inform the affected people (AP) about GRM and its functions,
- ii. set the procedures and mechanisms adopted for making the complaints,
- iii. support the complainants in communicating their grievance and attending the GRM meetings and
- iv. Implement compliance with a GRMs' decision, its monitoring and communication to the people.

Under the GRM, the ESMC will maintain the Social Complaint Register (SCR) at the sites to document all complaints received from the local communities or any other stakeholder. The information recorded in the Register will include date of the complaint, particulars of the complainant, description of the grievance, actions to be taken, the person responsible to take

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the action, follow up requirements and the target date for the implementation of the mitigation measure. The register will also record the actual measures taken to mitigate these concerns.

As soon as a complaint is received, the ESMC will determine the remedial action. If required, consultations will also be undertaken with the contractor's site manager. Once the remedial action is decided, implementation responsibility as well as schedule will be determined.

The proposed remedial action will be documented in the SCR, with complete details (by whom and by when). The proposed remedial action will be shared with the complainant. Similarly, the actual action taken will also be documented in the Register and shared with the complainant. The complainant's views on the remedial action taken will also be documented in the Register.

The SCR will be reviewed during the fortnightly meetings at the site during the project, and the action items discussed. The progress on the remedial actions will also be reviewed during the meetings.

## 9.6 REPORTS AND DOCUMENTATION

The ESMC will produce periodic reports based on the information collected. These will include reports for:

- Project initiation meetings with each contractor,
- Non-compliances,
- Effects monitoring
- Summary of SCR under GRM

The reports will also be made available for review, to the external monitoring teams, and to any other stakeholders who visit the site. In addition, the Social and Environmental Monitoring expert will prepare report for each monitoring visit.

At the end of the construction phase, a final report will also be prepared.

## 9.7 ENVIRONMENTAL AND SOCIAL TRAININGS

Environmental and social trainings will help to ensure that the requirements of the IEE and EMP are clearly understood and followed by all project personnel throughout the project period. The primary responsibility for providing training to all project personnel will be that of the ESMC.

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The environmental and social training program will be finalized before the commencement of the project, during the detailed design phase. The training will be provided to the Zorlu Solar Power Pakistan staff, the construction contractors, and other staff engaged for the project. Training will cover all staff levels, ranging from the management and supervisory to the skilled and unskilled personnel. The scope of the trainings will cover general environmental awareness and the requirements of the IEE and the EMP, with special emphasis on sensitizing the project staff to the environmental and social aspects of the area.

During the O&M phase of the project, these trainings will continue to be conducted by ESMC for all relevant staff of the Company.

## 9.8 PUBLIC DISCLOSURE REQUIREMENTS

Zorlu Solar Power Pakistan will disclose this IEE and EMP to all the stakeholders before the commencement of the proposed project. The IEE report will be made available to the stakeholders at the sites designated by the EPA, in accordance with the national legislation (PEPA 1997). In addition, the executive summary of the IEE will be translated into Urdu language (if necessary), and made available to the affected communities (and also kept at the project sites). This will ensure that the local communities are aware of the project, its key impacts, the mitigation measures and the implementation mechanism. In addition, the Executive Summary will be disclosed through the Zorlu Solar Power Pakistan official website.

## 9.9 BUDGETARY ESTIMATES FOR EMP IMPLEMENTATION

The primary component of the environmental and social management cost pertains to the personnel dedicated for EMP implementation. The overall estimated cost of EMP implementation is given in **Annexure-II.** 

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# **SECTION 10**

# **CONCLUSION AND RECOMMENDATION**

# **10 CONCLUSION AND RECOMMENDATION**

Prime benefit of the Project will be the replacement of conventional power generation with renewable energy. Solar energy will replace fossil fuel powered generation, and therefore reduce suspended particulate matter and greenhouse gas emissions into the atmosphere.

Impacts are manageable and can be managed cost effectively - Environmental impacts are likely to result from the proposed Power project. Careful mitigation and monitoring, specific selection criteria and review/assessment procedures 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. Since proposed land is covered with shrubs, thus there is no need for removal for the construction of the Solar PV project.

- The proposed project will have number of positive impacts and negligible 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.
- The Project Area does not fall under any sensitive, protected area.
- No threatened / Near-Threatened species of wildlife was recorded in the Project Area.
- There is negligible removal of trees for the project, which is the main positive impact to the proposed project area.
- 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 with mitigations being properly taken care.

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Proper GRM will have to be implemented by Zorlu Solar Power Paistan to overcome public inconvenience during the proposed project activities.

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 Zorlu Solar Power Pakistan to cover the environmental mitigation and monitoring requirements, and their associated costs.

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 Zorlu Solar Power Pakistan, 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 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 near project sites.

Adequate provisions have been made for the environmental mitigation and monitoring of predicted impacts, along with their associated costs. Adverse impacts if noticed during implementation will be mitigated using appropriate design and management measures. The potential cumulative and residual impacts of the project as a whole indicate the project classifies as a category "B", in accordance with ADB's Safeguards Policy Statement 2009. The Project is not considered highly sensitive or complex. Mitigation measures related to

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construction, as specified in the EMP, will be incorporated into civil works contracts, and their implementation will be primarily the responsibility of the contractors. Hence, the proposed project has limited adverse environmental and social impact which can be mitigated following the EMP & shall be pollution free Renewable source of Power.

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