

BEFORE
THE NATIONAL ELECTRIC POWER REGULATORY AUTHORITY (NEPRA)

APPLICATION FOR A GENERATION LICENSE FOR
SOLAR POWER GENERATION FACILITY

FOR THE GRANT OF A GENERATION LICENSE UNDER SECTION 15 OF THE REGULATION OF
GENERATION, TRANSMISSION AND DISTRIBUTION ACT 1997 OF NATIONAL ELECTRIC POWER
REGULATORY AUTHORITY (NEPRA)

&

THE FEDERAL GOVERNMENT'S
'POLICY OF RENEWABLE ENERGY FOR POWER GENERATION 2006'

ON BEHALF OF

ARTISTIC SOLAR ENERGY (PRIVATE) LIMITED

POWER PROJECT OF 50 MWp (THE PROJECT)

AT

SALEH PAT, DISTRICT SUKKUR, PROVINCE OF SINDH, PAKISTAN

DATED: 24th June, 2019

ARTISTIC SOLAR ENERGY (PRIVATE) LIMITED

POSTAL ADDRESS : PLOT No.3A, MACHS, MAIN SHARAH-E-FAISAL , KARACHI

REGISTERED OFFICE : REGISTERED OFFICE : PLOT 4 & 8, SECTOR-25, KORANGI INDUSTRIAL AREA,
KARACHI

PHONE # : 92-21-38709711

FAX # : 92-21-34321940

ARTISTIC SOLAR ENERGY (PVT) LTD.

Postal office : Plot 3A, M.A.C.H.S. Main Shahrah-e-Faisal, Karachi-75350 Pakistan
Phone : 92-21-38709711, Fax : 92-21-34321940, Email : energy@artisticmilliners.com

Dated: 24th June, 2019

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

Subject: Application for "Generation License of Artistic Solar Energy (Pvt.) Limited" 50MWp Power Project at Salehpat, District Sukkur, Sindh.

I, Muhammad Rafique, Chief Financial officer (CFO) and Company Secretary, being the duly authorized representative of **Artistic solar Energy (Pvt.) Limited** by virtue of Board Resolution dated 10th June, 2019 hereby apply to the National Electric Power Regulatory Authority for the grant of a Generation License to Artistic Solar Energy (Pvt.) Limited pursuant to section 15 of the Regulation of Generation, Transmission and Distribution of Electric Power Act, 1997.

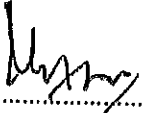
I certify that the documents-in-support attached with this application are prepared and submitted in conformity with the provisions of National Electric Power Regulatory Authority Licensing (Application and Modification Procedure) Regulations, 1999, and undertake to abide by the terms and provisions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

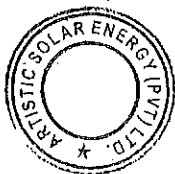
Two Bank Drafts #06598511 dated 10th June, 2019 & # 06598836 dated 24th June, 2019 total in the sum of Rupees 314,169/- (PKR Three hundred Fourteen thousand and One hundred sixty Nine only), after deduction of 8% WHT as per income ordinance rules 2001, being the non-refundable license application fee calculated in accordance with Schedule-II to National Electric Power Regulatory Authority Licensing (Application and modification Procedure) regulations 1999.

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

Yours sincerely,

For & On Behalf of Artistic Solar Energy (Pvt.) Limited


.....
Mr. Muhammad Rafique
CFO and Company Secretary



ARTISTIC SOLAR ENERGY (PVT) LTD.

Registered office : Plot 4 & 8, Sector-25, Korangi Industrial Area, Karachi-74400 Pakistan
Phone : 92-21-111 016 016 Fax : 92-21-35075446 Email : energy@artisticmilliners.com

EXTRACT OF THE MINUTES OF THE BOARD OF DIRECTORS MEETING OF THE COMPANY HELD ON MONDAY JUNE 10, 2019

"RESOLVED THAT the Company do file an application to the National Electric Power Regulatory Authority for seeking a generation license for the development of **50 MW Solar power project at Salehpat, District Sukkur, Sindh**, pursuant to and under Sections of the NEPRA Act read with other enabling provisions of the NEPRA Act, the National Electric Power Regulatory Authority Licensing (Application & Modification Procedure) Regulations 1999, National Electric Power Regulatory Authority Licensing (Generation) Rules 2000, and in accordance with the Policy for Development of Renewable Energy for Power Generation 2006 and to enter into any subsequent modifications, and in relation to the foregoing, enter into and execute all required documents, make all filings and pay all applicable fees, in each case, of any nature whatsoever, as required."

"FURTHER RESOLVED THAT in respect of filing of application for Generation License (including any subsequent modifications) for submission to National Electric Power Regulatory Authority, MR. YAQOOB AHMED (Chief Executive Officer) and/ or MR. MUHAMMAD RAFIQUE (Chief Financial Officer and Company Secretary) be empowered and authorized for and on behalf of the Company to:

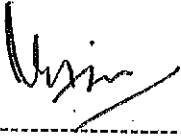
- (i) Review, execute, submit, and deliver the application for Generation License (including any subsequent modifications) and any related documentation required by National Electric Power Regulatory Authority for the determination of the application for generation license, including any contract, documents, power of attorney, affidavits, statements, letters, forms, applications, deeds, guarantees, undertakings, approvals, memorandum, amendments, letters, communications, notices, certificates, requests, statements and any other instruments of any nature whatsoever;
- (ii) Represent the Company in all negotiations, representations, presentations, hearings, conferences and /or meetings of any nature whatsoever with any entity (including, but in no manner limited to National Electric Power Regulatory Authority, any private parties, companies, partnerships, individuals, governmental and/or semi-governmental authorities and agencies, ministries, boards, departments, regulatory authorities and/or any other entity of any nature whatsoever)
- (iii) Sign and execute the necessary documentation, pay the necessary fees, appear before the National Electric Power Regulatory Authority as needed, and do all acts necessary for completion and processing of the application for Generation License including any modifications;
- (iv) Appoint or nominate any one or more officers of the Company or any other person or persons, singly or jointly, in his discretion to communicate with, make presentations to and attend the National Electric Power Regulatory Authority hearings;
- (v) Do all such acts, matters and things as may be necessary for carrying out the purposes aforesaid and giving full effect to the above resolutions/resolution.

ARTISTIC SOLAR ENERGY (PVT) LTD.

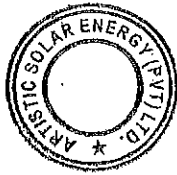
Registered office : Plot 4 & 8, Sector-25, Korangi Industrial Area, Karachi-74400 Pakistan
Phone : 92-21-111 016 016 Fax : 92-21-35075446 Email : energy@artisticmilliners.com

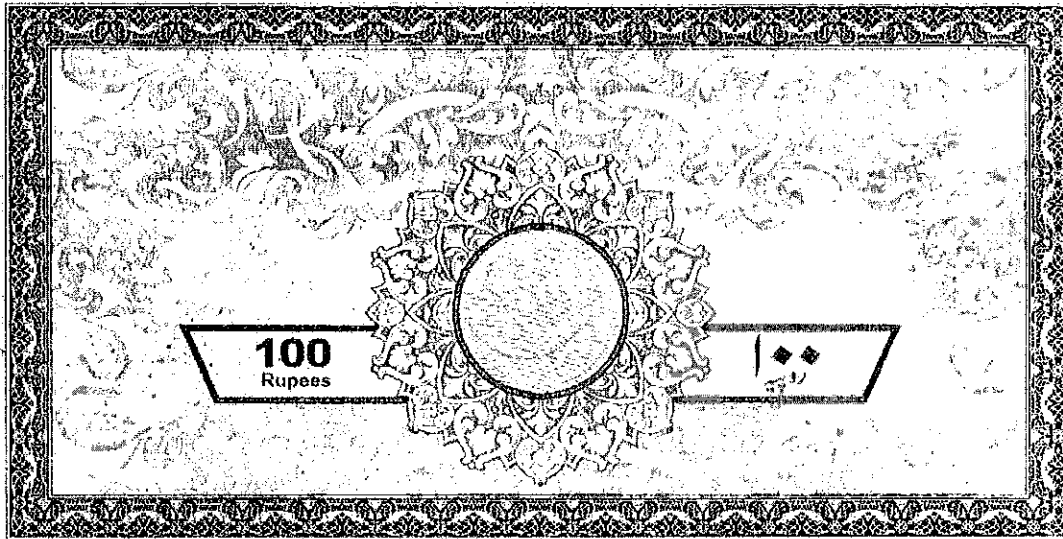
"AND FURTHER RESOLVED THAT MR. YAQOOB AHMED (Director) and/or MR. MUHAMMAD RAFIQUE (Chief Financial Officer and Company Secretary), be and are hereby authorized to delegate all or any of the above powers in respect of the forgoing to any other officials of the Company as deemed appropriate.

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



Muhammad Rafique
Company Secretary





ALI MUHAMMAD STAMP VENDOR

Shop No. 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60, 61, 62, 63, 64, 65, 66, 67, 68, 69, 70, 71, 72, 73, 74, 75, 76, 77, 78, 79, 80, 81, 82, 83, 84, 85, 86, 87, 88, 89, 90, 91, 92, 93, 94, 95, 96, 97, 98, 99, 100

20/06/2018
 MUHAMMAD NAEBM
 Advocate HC-326

20/06/2018
 LAHORE DIVISION OF THE DISTRICT COURT

30 JUN 2018

30 JUN 2018



BEFORE

THE NATIONAL ELECTRIC POWER REGULATORY AUTHORITY

AFFIDAVIT

AFFIDAVIT of MR. MUHAMMAD RAFIQUE, CNIC No. 42101-1625029-7, Chief Financial Officer & Company Secretary of M/s Artistic Solar Energy (Private) Limited, Plot 4 & 8, Korangi Industrial Area, Karachi Pakistan,

I do hereby solemnly affirm and declare that:

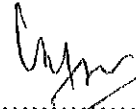
I am the Chief Financial Officer & Company Secretary of M/s Artistic Solar Energy (Private) Limited, Plot 4 & 8, Korangi Industrial Area, Karachi Pakistan, and I am fully conversant with the affairs of the said company.

1. I am the authorized representative of the Company by virtue of Board Resolution dated June 10, 2019
2. The contents of accompanying Generation License Application dated JUNE 24, 2019 to the National Electric Power Regulatory Authority (NEPRA) along with the supporting documents are true and correct to the best of my knowledge and belief and nothing material or relevant thereto has been concealed or withheld therefrom.
3. I also affirm that all further documentation and information to be provided by me in connection with the aforesaid Generation License Application shall be true and correct to the best of my knowledge and belief.

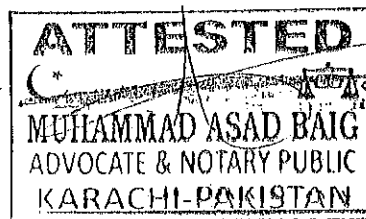
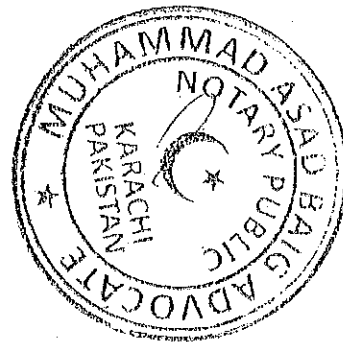
Signature
 DEPONENT

VERIFICATION

It is hereby verified on solemn affirmation at **JUNE 24, 2019**, that the contents of the above Affidavit are true and correct to the best of my knowledge and belief, and that nothing material or relevant thereto has been concealed or withheld therefrom.



DEPONENT



Introduction

1. The Project

- Artistic Solar Energy (Pvt) Ltd (herein after "ASEPL") is developing a **50MWp** solar PV plant at Salehpat, District Sukkur, Sindh.
- The company obtained LOI from Government of Sindh ("GoS") dated 13th April, 2016 extended twice on **15th January, 2018** and on **26th April, 2019** respectively, and is actively working towards Implementation of subsequent milestones.
- Power produced by the project will be exported at 132KV via a power evacuation point within the project site.
- The plant and its equipment will be designed, manufactured, assembled, and tested in accordance with internationally recognized standards and statutory regulations. Plant operations shall be compliant to Pakistan National Environmental Quality Standards (NEQS).

2. The Project Company

- As required under the **Section 24** of Regulation of Generation, Transmission, and Distribution of Electric Power Act, 1997 (the 'Act') of National Electric Power Regulatory Authority ('NEPRA' or the 'Authority'), ASEPL is an entity incorporated under the Companies Ordinance, 1984 on **18th August, 2015** to act as a Special Purpose Vehicle (the 'SPV') and develop the Project, Sponsored by **Artistic Milliners (Pvt) Ltd ("The Sponsor")**.

3. The Sponsor

- Artistic Milliners (Pvt) Ltd was established in 1949, and is today one of Pakistan's leading business houses and one of the largest premium quality denim cloth and finished products mills in the country. The company is engaged in the manufacturing and trading of denim, garments and fabrics and has the distinct privilege of being one of the few mills that are completely export oriented.
- The subsidiaries/ Associated companies of AM are:

Artistic Energy (Pvt) Ltd : 49.3 MW Wind Power Plant located in Jhimpir, Sindh; Started commercial activity in March, 2018. The project has 29 GE 1.7MW wind turbines.

Artistic Wind Power (Pvt) Ltd : 50 MW Wind Power Plant In Jhimpir, Sindh. The project is in the development stage with Generation License and Tariff already granted.

The project is on track to achieve financial close by November, 2019. The project will consist of Goldwind wind turbines.

Artistic Hydro I (Pvt) Ltd : Approximate 63 MW hydro power project located at Panjkora River, Upper Dir, KPK. The company has been registered under the Companies Act 2017 in 2019 and has been issued LOI by Pakhtunkhwa Energy Development Organization (PEDO), currently feasibility study has been carried out by renowned international consultant DOLSAR Mühendislik in collaboration with BAK Consulting Engineers. The project intends to achieve financial close by March, 2021 and achieve commercial operations by March, 2024.

Artistic Hydro II (Pvt) Ltd : Approximate 55 MW at Ushu River, Swat, KPK. The company has been registered under the Companies Act 2017 in 2018 and has been issued LOI by Pakhtunkhwa Energy Development Organization (PEDO), currently feasibility study has been carried out by renowned international consultant DOLSAR Mühendislik in collaboration with BAK Consulting Engineers. The project intends to achieve financial close by March, 2021 and achieve commercial operations by March, 2024.

4. The Project Site

- The project Site is located in Salehpat, District Sukkur, Sindh, The Site is approximately 500Km from Port Qasim.
- The coordinates of the proposed land are attached in **Annexure XII Sch-I**

5. Current Status of the Project

- The Project is being developed and managed by experienced Project team of ASEPL which has been working diligently for its early implementation. Refer **Annexure V** for the Resumes of management.
The Project has already reached an advanced stage and accomplished the following
- Initial Environmental Examination has already been submitted to SEPA, submission letter is attached with IEE report, **Annexure X**.
- Grid Interconnection Study is approved by SEPCO and under review by NTDC, approval and submission letters attached with GIS study, **Annexure VIII**.
- Feasibility study has been submitted to Renewable Energy Department GOS, submission letter is attached with Feasibility Study, **Annexure IX**
- The Company is on course for tariff negotiation and financial close.

6. The Purchaser

- The Company is to enter into a Energy Purchase Agreement (EPA) with CPPA-G for the sale of energy generated by the Project for a term of twenty five (25) years.

Technical Description

The details on technology and its configuration, grid interconnection electrical diagrams, plant characteristics etc., are available in the Reports attached as Annexure VIII, IX & X; however a brief technical summary of the Project is given hereunder:

1. Technology

The maximum power plant capacity of plant is 50 MWp. The power plant will be based on Photovoltaic (PV) technology with single axis tracking. The plant will have central inverters to convert the Direct Current (DC) current to Alternate Current. The Project company has selected **Timec 1500V 5.1 MVA Solar ware station inverter & JA- Solar Polycrystalline Half-Cell Module JAP72S10 340W solar panels.**

2. Grid Interconnection

The Project will transmit power via its 132kV switchgear and the interconnection would be made at 132kV NARA-C1 grid, The transmission line would be double circuit line consisting of 8KM. Refer to **Annexure-XII, Sch-I** for interconnection scheme.

3. Project Timeline

The Project life and EPA term has been assumed as 25 years from COD and Post Financial Close project construction duration is approximately 12 months.

Financial Close is targeted in **2020** with a target Project Commercial Operations Date ("COD") of **2021**.

4. Project Costs.

The initial cost of project is estimated at **USD 45 Million**, The project financing will be based on debt to equity ratio of 80:20, consisting of **USD 36 Million** as debt and **USD 9 Million** as equity from the Sponsor company.

The proposed Solar Project uses clean and renewable solar resource with zero emission, when put into operation, the project will 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 and play a part in social amelioration of local population. In conclusion the project has no adverse social or environmental implications.

Annexure- 1:
Project Information

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Annexure -1-A
Technology of Panels.

Harvest the Sunshine

Poly

350W Half-Cell Module

JAP72S10 330-350/SC Series

Introduction

The modules assembled with half cells not only generate more power output, but also perform better during daily operation as a result of lower temperature coefficient of power, along with reduced shading effect on the energy generation, lower risk of hot spot, and enhanced tolerance for mechanical loading.



Higher output power



Lower temperature coefficient



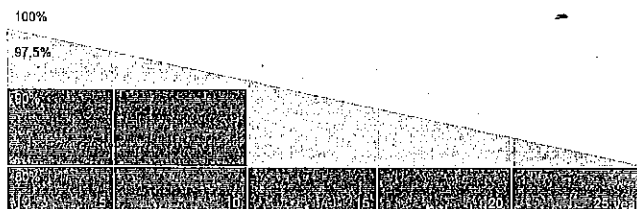
Less shading effect



Better mechanical loading tolerance

Superior Warranty

- 12-year product warranty
- 25-year linear power output warranty



■ JA Linear Power Warranty ■ Industry Warranty

Comprehensive Certificates

- IEC 61215, IEC 61730
- ISO 9001: 2015 Quality management systems
- ISO 14001: 2015 Environmental management systems
- OHSAS 18001: 2007 Occupational health and safety management systems
- IEC TS 62941: 2016 Terrestrial photovoltaic (PV) modules – Guidelines for increased confidence in PV module design qualification and type approval



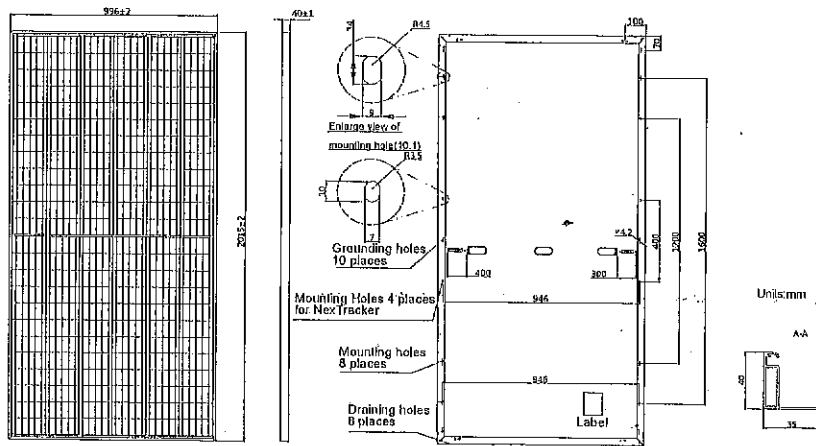
JA SOLAR

www.jasolar.com

Specifications subject to technical changes and tests.
JA Solar reserves the right of final interpretation.



MECHANICAL DIAGRAMS



Remark: customized frame color and cable length available upon request

SPECIFICATIONS

Cell	Poly
Weight	22.7kg±3%
Dimensions	2015±2mm×936±2mm×40±1mm
Cable Cross Section Size	4mm ²
No. of cells	144 (6×24)
Junction Box	IP68, 3 diodes
Connector	QC 4.10(1000V) QC 4.10-35(1500V)
Packaging Configuration	27 Per Pallet

ELECTRICAL PARAMETERS AT STC

TYPE	JAP72S10 -330/SC	JAP72S10 -335/SC	JAP72S10 -340/SC	JAP72S10 -345/SC	JAP72S10 -350/SC
Rated Maximum Power(P _{max}) [W]	330	335	340	345	350
Open Circuit Voltage(V _{oc}) [V]	45.54	45.73	45.89	46.07	46.27
Maximum Power Voltage(V _{mp}) [V]	37.72	37.90	38.08	38.25	38.43
Short Circuit Current(I _{sc}) [A]	9.26	9.35	9.43	9.50	9.58
Maximum Power Current(I _{mp}) [A]	8.75	8.84	8.93	9.02	9.11
Module Efficiency [%]	16.4	16.7	16.9	17.2	17.4
Power Tolerance	0~+5W				
Temperature Coefficient of I _{sc} (α _{Isc})	+0.054%/°C				
Temperature Coefficient of V _{oc} (β _{Voc})	-0.300%/°C				
Temperature Coefficient of P _{max} (γ _{Pmp})	-0.370%/°C				

STC

Irradiance 1000W/m², cell temperature 25°C, AM1.5G

Remark: Electrical data in this catalog do not refer to a single module and they are not part of the offer. They only serve for comparison among different module types.
*For NexTracker installations static loading performance: front load measures 2400Pa, while back load measures 2400Pa.

ELECTRICAL PARAMETERS AT NOCT

TYPE	JAP72S10 -330/SC	JAP72S10 -335/SC	JAP72S10 -340/SC	JAP72S10 -345/SC	JAP72S10 -350/SC
Rated Max Power(P _{max}) [W]	244	248	252	256	260
Open Circuit Voltage(V _{oc}) [V]	43.98	44.17	44.35	44.51	44.66
Max Power Voltage(V _{mp}) [V]	35.36	35.53	35.69	35.85	36.01
Short Circuit Current(I _{sc}) [A]	7.35	7.43	7.51	7.59	7.67
Max Power Current(I _{mp}) [A]	6.90	6.98	7.06	7.14	7.22

NOCT

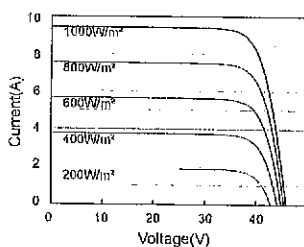
Irradiance 800W/m², ambient temperature 20°C,
wind speed 1m/s, AM1.5G

OPERATING CONDITIONS

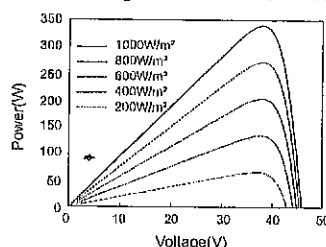
Maximum System Voltage	1000V/1500V DC(IEC)
Operating Temperature	-40°C~+85°C
Maximum Series Fuse	20A
Maximum Static Load, Front*	5400Pa
Maximum Static Load, Back*	2400Pa
NOCT	45±2°C
Application Class	Class A

CHARACTERISTICS

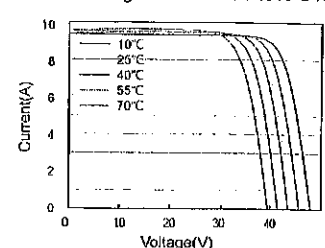
Current-Voltage Curve JAP72S10-340/SC



Power-Voltage Curve JAP72S10-340/SC



Current-Voltage Curve JAP72S10-340/SC



Annexure -1-B
Technology of Inverters

Technical Specification

1500V 5.1MVA SOLAR WARE STATION

Pakistan 50MW PV Project

G0-L0-ES-20190513-001-A

Toshiba Mitsubishi-Electric Industrial Systems (China) Corporation

Energy & Industrial Products Division

PV Team

General Specification

This specification describes the general data of the proposed 1500V 5.1MVA SOLAR WARE STATION (SOLAR WARE STATION) utilized TMEIC's large scale PV inverter, type PVH-L2550E.

The detail specifications of the SOLAR WARE STATION are described in other documents. The reference numbers of them can be found below.

1. Project Name: Pakistan 50MW PV Project
2. Capacity: ☒ 5.1MW/5.1MVA
3. Type of inverter: ☒ PVH-L2550E (Input: 1500Vdc, Output: 2550kW/2550kVA)
4. Numbers of Station:

Type of Station	Inverters	Qty
5.1MW/5.1MVA station	2 sets of PVH-L2550E	10

5. AC Frequency: ☒ 50Hz / ☐ 60Hz
6. AC nominal voltage: ☐ 11kV / ☐ 22kV / ☒ 33kV / (☐ Other: kV)
7. Type of MV switchgear (RMU): ☒ 2L+C (2*Load Switch + 1*Circuit Breaker)
8. Auxiliary Transformer: ☒ Standard 10kVA / ☐ Non-Standard ... Capacity: kVA
9. UPS: ☐ No / ☒ Yes ... Capacity: 1 kVA
10. DC input monitoring: ☒ No / ☐ Yes (sensor per input)
11. Night Var Compensator: ☒ No / ☐ Yes
12. Negative Grounding: ☒ No / ☐ Yes
13. Insulation monitoring: ☐ No / ☒ Yes
14. Transformer:
 - a) Coil material ☐ Aluminum / ☒ Copper
 - b) Biodegradable oil for transformer ☐ No / ☒ Yes
 - c) Transformer with 50°C ☐ No / ☒ Yes
 - d) With altitude of over 1000m ☐ No / ☒ Yes
 - e) ECO design transformer ☐ No / ☒ Yes
15. RMU
 - a) Type: SF6 aeration tank ☐ No / ☒ Yes
 - b) RMU remote on/off: ☐ No / ☒ Yes
 - c) Short Circuit current: 20kA(3s): ☐ No / ☒ Yes

1. General

1-1. Technical Specification of SOLAR WARE STATION

This electrical equipment technical specification describes our proposed 1500V 5.1MVA SOLAR WARE STATION with PVH-L2550E Inverter for photovoltaic power plant.

Table 1-1 lists the scope of SOLAR WARE STATION. Please refer to attachment A for the single line diagram. All the necessary cables, cabling works within SOLAR WARE STATION and commissioning works are included in this proposal.

Table 1-1 BOM of 1500V 5.1MVA SOLAR WARE STATION with PVH-L2550E

No	Item	Description	Qty	Section
1	Package	ISO standard size 40'HC container	1 pc	Section 2-1
2	PVH-L2550E	2550kW/2550kVA inverter (including integrated DC box)	2 pcs	Section 2-2
3	MV Transformer	Three-phase, 50/60Hz, Dy11y11, 5.1MVA, 33/0.63/0.63kV (*Frequency and voltage of HV side depend on the requirement)	1 pc	Section 2-3
4	MV Switchgear	50/60Hz, 36kV, 630A, 2L+C or L+C (*Frequency and voltage requirements depend on the local power grid)	1 pc	Section 2-4
5	LV panels	Low voltage distribution panels, outlets (*Type depends on the requirements)	1 set	-
6	Cables	Connection / cabling between LV panels, inverter, MV transformer and MV switchgear are included.	1 set	Section 2-1
7	Ventilation Systems	Louvers, inverter fans, exhaust fan and filters	1 set	-
8	Auxiliary Transformer	Three-phase, 50/60Hz, Dyn11, 10kVA-380V	1 pc	-
9	Lighting	Lamps fitted with light bulbs and emergency light	1 set	-
10	Safety Equipment	Gloves, insulated stool, CO ₂ fire extinguisher, etc.	1 set	-
11	Others	UPS can be supplied as an option.	1 set	-

1-2. Installation and Operation Environment

When installing or operating the SOLAR WARE STATION and related devices, ensure that the installation and operation environment complies with Table 1-2.

Failing to observe these standards may deteriorate insulation, causing short life and malfunctions. Before installation, measure and evaluate the environment of the installing location. If the standards are not satisfied, it is recommended to take necessary action before installing or operating the SOLAR WARE STATION. The SOLAR WARE STATION must be protected from marine environment and must be sealed from corrosive gas and salty air in accordance with Table 1-2.

Table 1-2 Power Conditioning System installation and operation environment

No	Item	Environment standard
1	Installation location	Outdoor
2	Ambient Temperature Range	-20°C to +50°C Temperature rise in container shall be within 5°C.
3	Relative Humidity	The relative humidity must be held between 5 and 95% @ No condensation.
4	Altitude	Up to 1000m above sea level. 2000m as an option
5	Vibration	Static acceleration 1.0G (Horizontal)
6	IP	IP54 (Equivalent)
7	Salt Area	No Salt area (More than 10km away from sea.)
8	Flammability	There should be no inflammable/explosive gas.
9	Maintenance Space	1500mm for left and right, 1000mm for front and rear.

2. Specification of the equipment

2-1. SOLAR WARE STATION

The SOLAR WARE Station is a fully integrated 5.1MVA power station. It is designed based on the principle of "plug and play". The inverter, transformer, RMU and the auxiliary equipment are all integrated, installed, tested and shipped as a complete unit.

The system consists of an ISO standard size 40ft High Cube container with an external dimension of 12m x 2.4m x 2.8m. The inside of the container and the layout are shown in Figure 2-1(for reference).

Cable entry is from the bottom of the container (refer to attachment B.).

The appearance of the SOLAR WARE STATION is shown on attachment C.

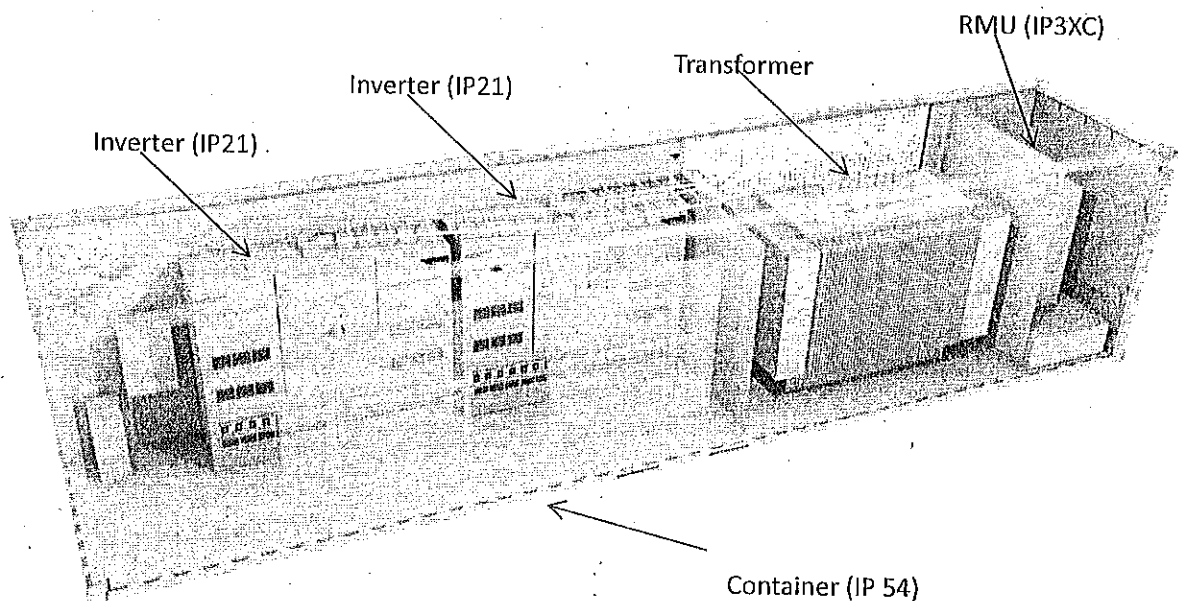


Figure 2-1. Layout of 5.1MW SOLAR WARE STATION (For reference)

A. Control Circuit for supplied equipment

The Single Line Diagram is shown in attachment A. This is for reference only.

B. Communication Wiring

- Communication cabling in SOLAR WARE STATION is not included.
- (Optical) cable to the outside of SOLAR WARE STATION is not included.
- TMEIC provide control, signal cable from RMU, Transformer, Inverter to RTU panel.

C. Cable

Cable and cabling work for outside of the SOLAR WARE STATION is not included.

- Both DC and AC cable entry of inverter are bottom entry.
- Cable and cabling work from PV panels to Inverter is not included.
- Cable and cabling work from SWGR to High voltage system is not included.

DC cable termination details are shown in Figure 2-2.

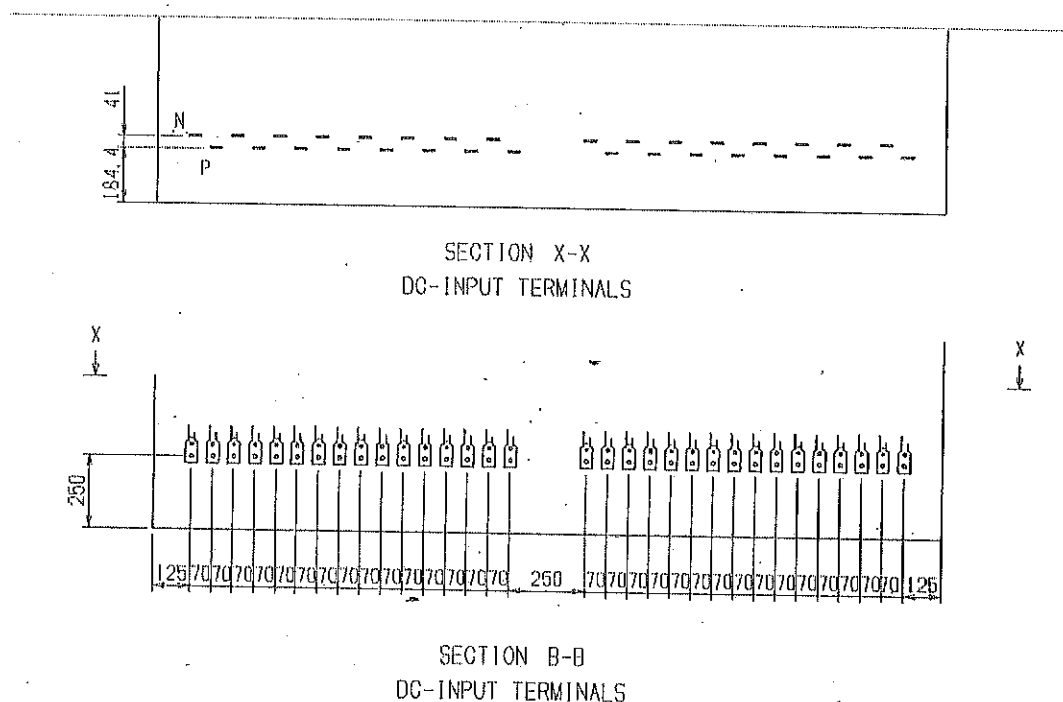


Figure 2-2. DC cable termination drawing

D. Customer Furnished Equipment (CFE)

SCADA, DAS and site data controller are not the scope of supply.

E. Stairs and Safety Railings

If the package(s) are to be mounted on piers requiring stairs and safety railings, the stairs and safety railings are not scope of supply and should be supplied by others.

F. Cooling Method

Forced air cooling.

2-2. Inverter and DC box

2 sets of PVH-L2550E inverter are integrated in SOLAR WARE STATION. Refer to Technical Specifications of PVH-L2550E.

DC-Box is integrated in each PV inverter. Number of inputs is 16 inputs as standard (Maximum 250A for each).

2-3. MV 3-Phase Transformer

Specification of transformer for PVH-L2550E is described in below Table 2-1.

Table 2-1 Transformer for PVH-L2550E

No	Items	Specification
1	Standard	IEC60076
2	Capacity	5100/2550/2550kVA
3	Rated HV Voltage	33kV
4	Low Voltage	630-630V
5	Rated Frequency	50/60Hz
6	Number of phases	3
7	Number of winding	3
8	Vector group symbol	Dy11y11
9	Temperature Rise	Oil 55°C, Winding 60°C (in case of Maximum 45°C of ambient temperature)
10	Cooling Class	ONAN
11	Insulating Fluid	Mineral Oils (biodegradable oil can be supplied as an option)
12	Winding material	Aluminum/Copper
13	Ambient Temperature	Maximum 45°C (50°C as options and specification will change accordingly)
14	Elevation	Designed for operation at 1000 m above sea level (Over 1000m above sea level can be supplied as an option)
15	Corrosivity category	C4

Note: Secondary oil container is not included with the package. If required, provision should be made onsite by others.

2-4. MV Switchgear

Specification of switchgears is described in below Table 2-2.

Table 2-2 Switchgear specification

No.	Items	Specifications
1	Standard	IEC62271-200
2	Rated voltage	36kV
3	Model	SF6 Breaker Protection
4	Type	2L+C (2*Load Switch + 1*Circuit Breaker) or L+C
5	Number of phases	3
6	Rated currents	630A (400A as optional)
7	Short Circuit current	20kA/3s
8	Rated frequency	50/60Hz
9	Ambient temperature	-5°C to 45°C
10	Protection Index	IP65 (Medium voltage compartment) IP3XC (Operating mechanism compartment) IP3XC (Cable compartment)

- ① VCB
- ② 3-position disconnector
- ③ 3-position switch disconnector
- ④ Voltage indicator
- ⑤ Self-powered protection relay
- ⑥ CT Ring type

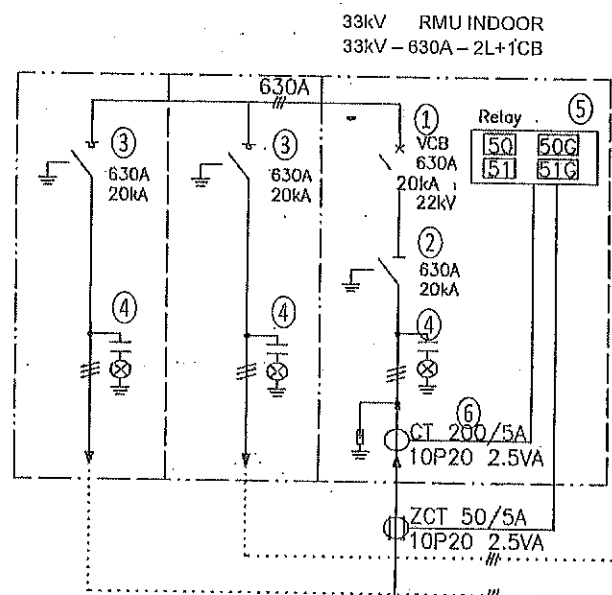


Figure 2-3. Single line diagram of RMU (for reference)

3. Communication

Communication system network structure

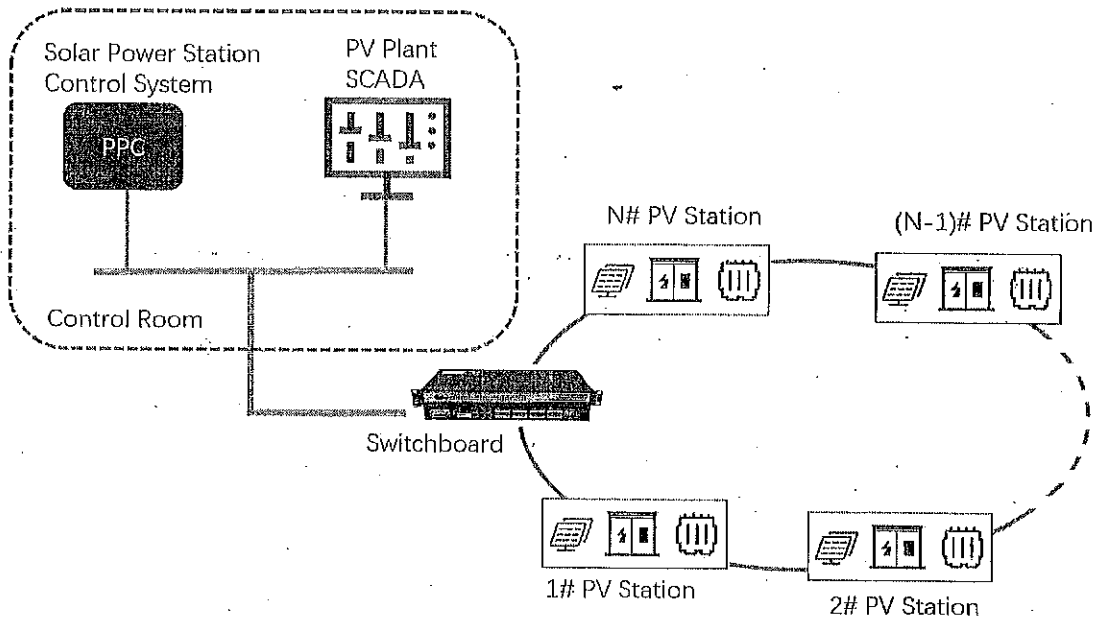


Figure 3-1. Example of high-level system architecture for the PV plant

Interface within SOLAR WARE STATION

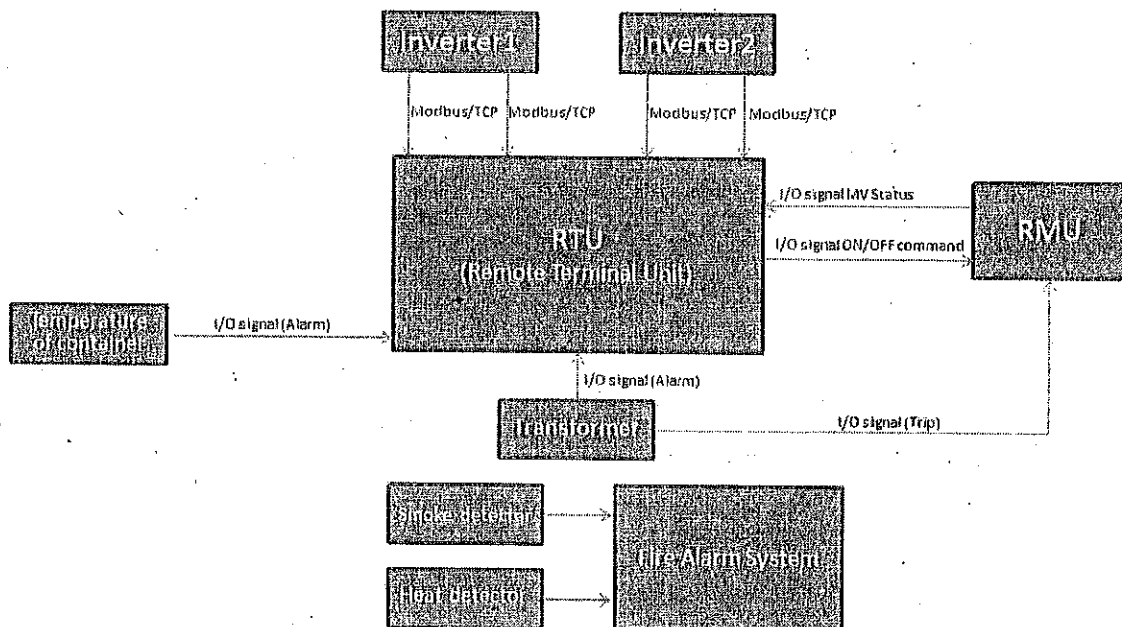


Figure 3-2. Interface within SOLAR WARE STATION for reference

4. Commissioning

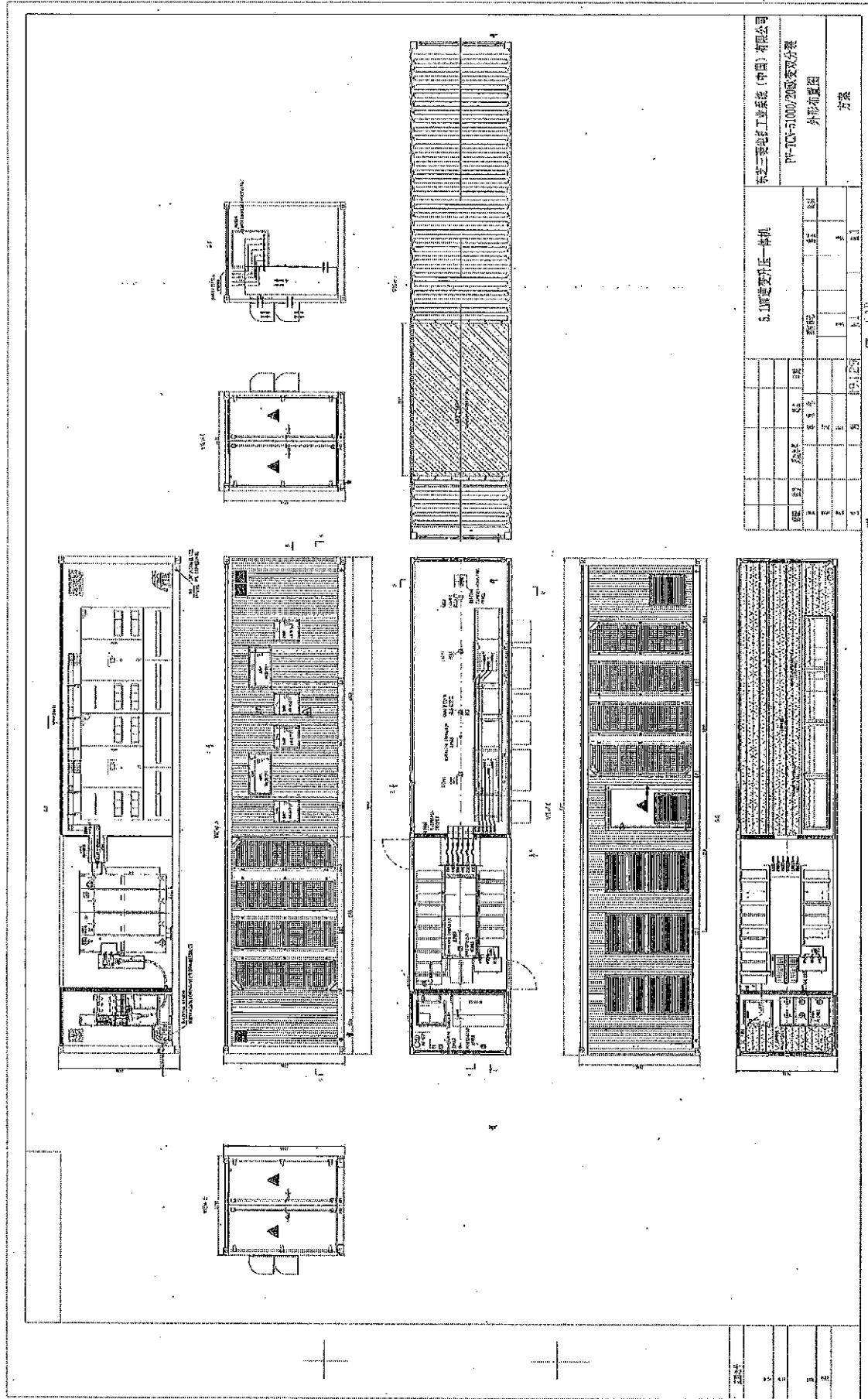
- A Certified Field Engineer will perform all startup and commissioning services for SOLAR WARE STATION.
- Commissioning is in accordance with TMEIC's standard procedure.
- Commissioning time exclude time constrained by following conditions: waiting time for grid connection, bad weather to clear out, other related equipment required for PV inverter commissioning to be installed, and any other condition that requires technician to wait.
- Any additional work generated because of above reasons is subject to extra charge.
- Please inform approximate date of commissioning in order to secure technicians in advance.
- Testing of grid protection relay is not included.

Notes:

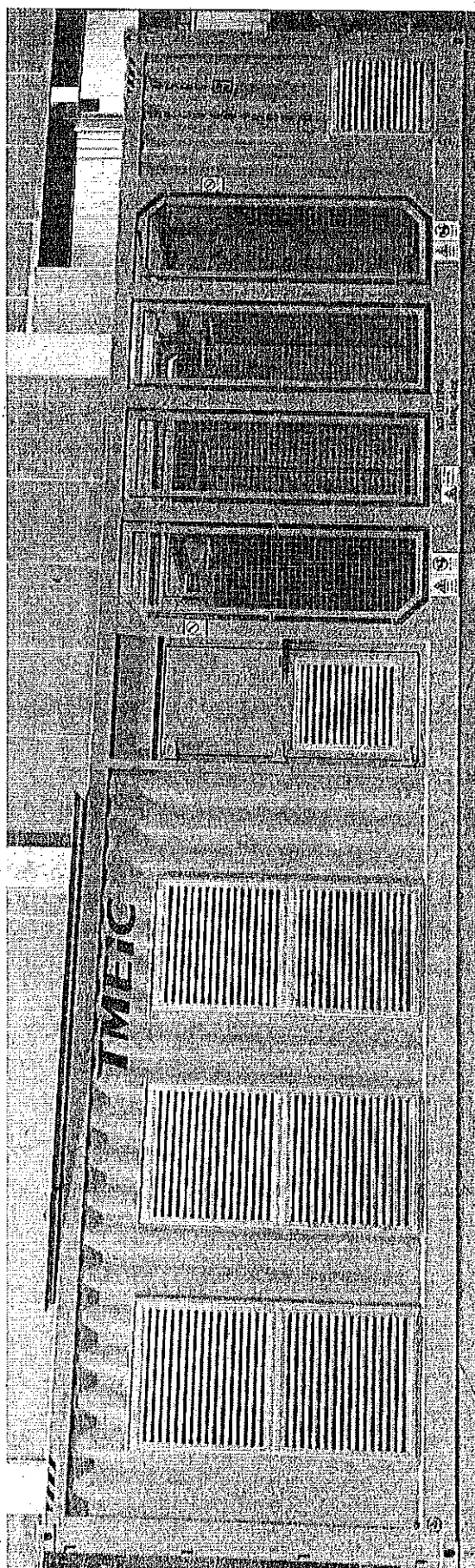
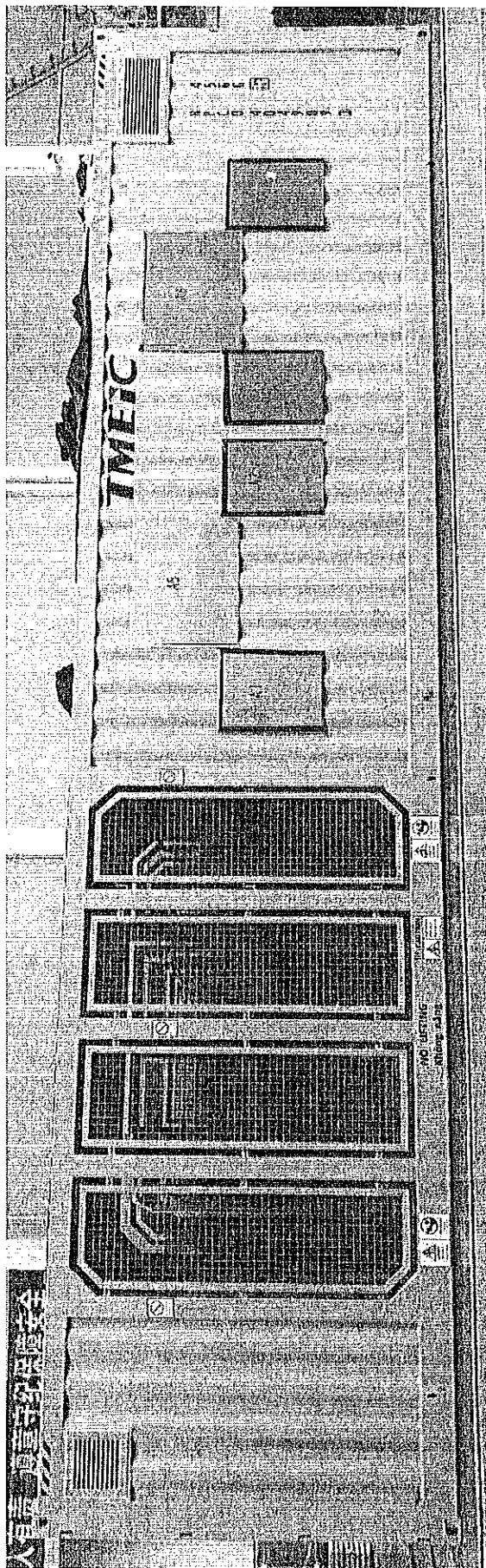
- Both cold commission and hot commissioning schedule have to be conduct according to the agreed schedule with TMEIC and Client in advance.
- Both cold and hot commissioning is based on assumption that DC side (PV arrays) and AC side are ready to be synchronized.
 - Cold Commissioning: (For Package)
 - TMEIC's activity to set up the provided solution properly for the client to terminate the DC and AC cable at site. (Example of the activity: remove the cover, install the duct, etc.) Cable termination activity of the DC cabling, AC Cabling is not TMEIC's scope.
 - Hot Commissioning: (For Inverter)
 - TMEIC's activity to confirm inverter is connected properly and works properly.
- Waiting time due to lack of readiness from either side is subject of additional charge.
- Pre-Commissioning or off-grid commissioning is not included.

[illegible]

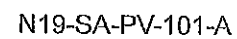
Attachment A. Single Line Diagram of 1500V 5.1MVA SOLAR WARE STATION (for reference only)



Attachment B. Layout of 1500V 5.1MVA SOLAR WAREHOUSE STATION for basement (for reference only)



Attachment C. Photos of 1500V 5.1MVA SOLAR WARE STATION (for reference only)



Revision Record

[illegible]

Annexure -II
Certificate of incorporation

A010447

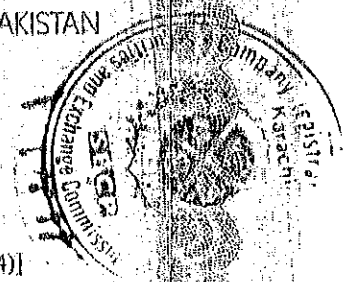


SECURITIES AND EXCHANGE COMMISSION OF PAKISTAN

COMPANY REGISTRATION OFFICE, KARACHI

CERTIFICATE OF INCORPORATION

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

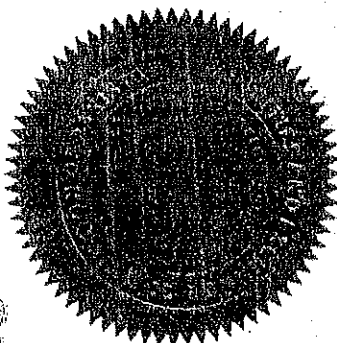


Corporate Universal Identification No. 0094806

I hereby certify that ARTISTIC SOLAR ENERGY (PVT.) LIMITED is this day incorporated under the Companies Ordinance, 1984 (XLVII of 1984) and that the company is limited by shares.

Given under my hand at Karachi this Eighteenth day of August, Two Thousand and Fifteen.

Incorporation fee Rs. 2,500/- only



(Signature)
(Saghir Ahmed Hashmi)
Joint Registrar of Companies
Karachi

Original to be kept in File Copy
Fazil 19/5
Assistant Registrar of Companies

Annexure -III

**Memorandum of Association –
Articles of Association**

The Companies Ordinance, 1984
(Private Company Limited by Shares)

MEMORANDUM OF ASSOCIATION

OF

ARTISTIC SOLAR ENERGY (PRIVATE) LIMITED

NAME

- I. The name of the Company is ARTISTIC SOLAR ENERGY (PRIVATE) LIMITED

REGISTERED OFFICE

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

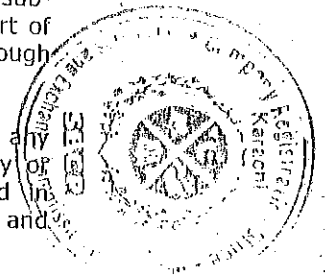
OBJECTS

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

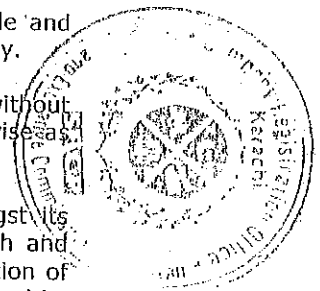
1. To carry on the business of power generation, operation and management of power generation projects anywhere in Pakistan or other countries of the world, and to develop, design, finance, engineer, negotiate, purchase properties etc. in regard to the development, installation, commissioning and operation of power projects.
2. To acquire on lease, construct new complex(s), design, insure, own, operate and maintain power generation complex(s) and to carry on the business of electricity generation, power transmission and distribution services, refurbishment and re-powering of power plants and to work generate, accumulate, distribute and supply electricity for the purpose for which electrical energy can be employed.
3. To carry on the business of manufacture and supplies of all apparatuses and things required for or capable of being used in connection with power generation, distribution, supply, accumulation and employment of electricity, and as supplier of electrical power produced through wind, coal, fuel, steam, gas, diesel, hydro-thermal power, solar, atomic power, and to buy, sell, manufacture, repair, convert, alter, let on hire, and deal in machinery used for the manufacturing and supply of electricity.
4. To enter into negotiation and agreements with government authorities / agencies, semi-government bodies or any other private associations, persons, corporations and companies to establish their own and acquire on lease power complex(s) and for the sale and purchase of fuel and / or electricity in any mode.
5. To acquire consultancy services and to enter into any power plant operations and maintenance (O&M) agreements or any other contract with regards to the power plants.
6. To apply for tender, offer, accept, purchase or otherwise acquire any contract and concessions for or in relation to the projection, execution, carrying out, improvements, management, administrations or control of works and conveniences and undertake, execute, carry out, dispose of or otherwise turn to account the same.



7. To acquire by concession, grant, purchase, exchange, barter, licence either absolutely or conditionally and either solely or jointly with other any lands, buildings, easements, machinery, plants, equipments, privileges rights, licences, trade marks, patent design, copyright, licence, concession, convenience, innovation and other movable and immovable property of any description which the Company may deem necessary or which may seem to the company capable of being turned to account, subject to any permission as required under the law.
8. To act as representative, for any person, firm or company and to undertake and perform subcontracts, and also act in the business of the company through sub-contractors and to do all or any of the things mentioned herein in any part of the world and either alone or in collaboration with others and by or through agents, sub-contractor or otherwise.
9. To acquire and carry on all or any part of the business or property of any person, firm, association suitable for any of the purpose of the Company or carrying on any business this Company is authorized to carry on and in consideration for the same to pay cash or to issue shares of the Company, and to undertake the liabilities of associated undertakings.
10. To enter into arrangements with the government or authority (supreme, municipal, local or otherwise) or any corporation, company or persons that may seem conducive to the company's objects or any of them and to obtain from any such governments, authority, corporation, company or person any charters, rights, privileges and commission which the Company may think desirable and to carry on exercise and comply with any such charters, contracts, decrees, rights, privileges and concessions.
11. To carry on joint venture agreements, enter into partnership, to amalgamate or merge with other companies and / or to buy, all interests, assets, liabilities, stocks or to make any arrangement for sharing profits, union of interests, co-operation, joint venture, reciprocal concession or otherwise with any person, firm or company carrying on or proposing to carry on any business which this company is authorised to carry on or which is capable of being conducted so as directly or indirectly to benefit his company and to have foreign collaborations and to pay royalties / technical fees to collaborators, subject to the provisions of the Companies Ordinance, 1984.
12. To invest the funds of the Company not immediately required in the manner the company deems fit.
13. To Capitalize such portion of the profits of the Company as are not distributed among shareholders of the Company in the form of dividends as the Board of Directors of the Company may think fit, and to issue bonus shares, as fully paid-up in favor of the shareholders of the Company.
14. To grant pensions, allowances, gratuities and bonuses to the employees, officers, ex-employees and ex-officers of the Company or its predecessors in business or the dependents of such persons, and to take over, fund, establish, develop, endow or contribute to any plan, scheme or project or fund for any such purposes, or to any other welfare fund as super-annuation, sickness, provident, accident fund or scheme, and to support or subscribe to any charitable or other useful institutions, societies, clubs, organizations, associations, funds, and to subscribe or guarantee, money for or towards any national, charitable, benevolent, publicly beneficial or otherwise useful purpose, object, scheme, plan, fund or for any exhibition.



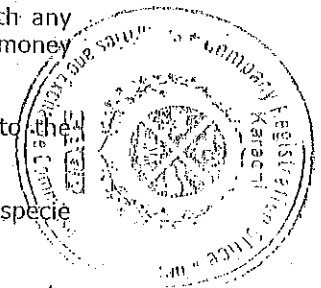
15. To ratify agreements or contracts executed by the promoters of this Company with various individuals, firms, corporations or government agencies in the interest of the Company prior to its incorporation.
16. To borrow, raise or secure the payment of money for the purpose of business of the Company in such manner as the Board of Directors of the Company may think fit and in particular by the issue of debentures or debenture-stock, whether perpetual or terminable or upon the whole or any part of the Company's assets both present and future and to purchase, redeem or pay off or discharge any such securities.
17. To mortgage and charge the undertaking and all or any of the moveable and immovable property (present and future) for the time being of the Company.
18. To borrow money for the purpose of business of the Company with or without giving any security thereof and upon such terms as to priority or otherwise as the Board of Directors shall think fit.
19. To distribute in specie or otherwise any assets of the Company amongst its members in the event of winding up and for such purpose to distinguish and separate capital from profits but so that no distribution involving a reduction of capital be made except with the sanction (if any) for the time being required by law.
20. To draw, make, accept, endorse, and negotiate negotiable instruments such as Bills of Exchange, promissory Notes, Cheques in connection with business of the Company.
21. To do all or any of the above things anywhere in Pakistan or in any place outside Pakistan and to employ agent and employees for the same.
22. Generally to do, carry out all such other things as may be considered necessary, incidental or conducive to the fulfillment of the objects or any of the objects above mentioned in this Memorandum of Association of the Company.
23. To do all or any of the things herein before authorized in any part of the world either alone or in conjunction with others as agents for others residing in any part of the world or by or through agents appointed in any part of the world.
24. To carry on any business, which may seem to the Company capable of being conveniently carried on in connection with any or calculated directly or indirectly, to enhance the value of or render profitable any of the Company's property or rights.
25. To enter into partnerships, or into any arrangement for sharing profits and losses, or for any union of interests, joint venture, reciprocal concession or co-operation with any person or persons, or companies carrying on, or engaged in or about to carry on, or engaged in or being authorized to carry on, or engaged in any business or transaction which this Company is authorized to carry on or engaged in, or in any business or transaction capable of being conducted, so as directly to benefit this Company.
26. To take, amalgamate or otherwise acquire and hold shares and/or other securities of any other Company having objects altogether or in part similar to those of this Company, or carrying on any business capable of being conducted so as directly or indirectly to benefit this Company.



27. To remunerate any person, firm or Company rendering services to this Company, whether by the payment of cash or by the allotment of shares or securities of the Company.
28. To sell or otherwise dispose of the whole or any part of the undertaking of the Company for such consideration as the Company may think fit, and in particular for shares, debentures or securities of any company purchasing the same.
29. To have, keep, maintain and float subsidiary companies with objects similar to its own and to have branches all over Pakistan or elsewhere.
30. To open any current, overdraft, cash-credit account or fixed account with any bankers, or merchants, of the Company and to pay money into and draw money out of such account.
31. To pay all the costs, charges and expenses preliminary and incidental to the promotion, formation, establishment and incorporation of the Company.
32. To distribute any of the property of the Company among its members in specie or otherwise in the event of winding up.
33. To act and / or undertake and / or carry on the office or offices so as to become, supervisors, promoters, executors, committee, delegates, substitutes, receivers, liquidators or agents (except managing agents) or any other office or situation of trust or confidence of any Company, firm or person either independently or jointly with any other company, firm or person and to perform and discharge the duties and functions incidental thereto, either gratuitously or otherwise.
34. To carry out the business of setting up retail or wholesale shops so as to be able to dispose off the various products this Company owns.
35. To operate, conduct, accomplish and establish service for and relating to the activities of the Company in any aspect of trade, business or commerce and otherwise relating to the same in Pakistan and abroad.
36. And generally to do and perform all such other acts as may be incidental or conducive to the attainment of the above objects or any of them.

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.

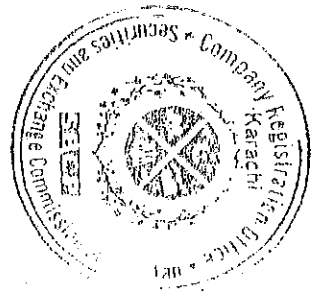


LIMITED LIABILITY OF MEMBERS

- IV. The liability of the members is limited.

CAPITAL

- V. The Authorized Capital of the Company is Rs. 100,000/- (Rupees One hundred thousand only) divided into 10,000 (Ten thousand) Ordinary shares of Rs.10/- (Rupees ten only) each. The Company shall have power by special resolution from time to time to increase, consolidate, sub-divide, and reduce, to divide the shares into several classes or other-wise re-organise the share capital of the company subject to the provisions of the Companies Ordinance, 1984.



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

Name and surname (Present and former) in full (In block letters) / Fathers Name / Nationality / NIC #	Occupation	Residential Address in Full	Number of shares taken by each subscriber	Signature
MR. YAQOOB AHMED S/O. AHMED OMER PAKISTANI CNIC # 42201-4651073-5	BUSINESS	HOUSE NO. 35, STREET # 10, KHAYABAN-E- MUHAFIZ, PHASE VI, DHA	= 100 = (One hundred shares)	
MR. MUHAMMAD OMER AHMED S/O. YAQOOB AHED PAKISTANI CNIC # 42201-4652023-5	BUSINESS	HOUSE NO. 35, STREET # 10, KHAYABAN-E- MUHAFIZ, PHASE VI, DHA	= 100 = (One hundred shares)	
MR. MUHAMMAD MURTAZA AHMED S/O. YAQOOB AHED PAKISTANI CNIC # 42201-8075257-7	BUSINESS	HOUSE NO. 35, STREET # 10, KHAYABAN-E- MUHAFIZ, PHASE VI, DHA	= 100 = (One hundred shares)	
TOTAL			=300 = (Three hundred shares)	

Dated this 29th day of July, 2015

Witness to the above signatures:

Full Name, Fathers' name in Block Letters	National Institutional Facilitation Technologies (Private) Limited
Occupation	
Full Address	5th Floor, AWT Plaza, I.I. Chundrigar Road, Karachi
Signature	

[Signature] 49/6
Assistant Registrar of Companies

The Companies Ordinance, 1984
Private Company Limited by Shares

**ARTICLES OF ASSOCIATION
OF**

ARTISTIC SOLAR ENERGY (PRIVATE) LIMITED

PRELIMINARY



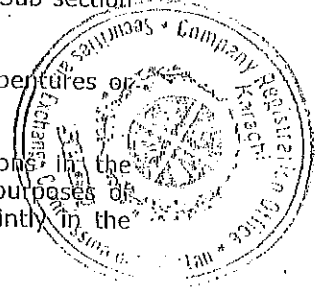
1. Subject as hereinafter provided, the regulations contained in Table 'A' in the First Schedule to the Companies Ordinance 1984, and other provisions in the Companies Ordinance 1984, shall apply to the Company so far those are applicable to private companies. In case of conflict between the provisions herein contained and the provisions contained in Table A, the provision herein contained shall apply.

DEFINITIONS AND INTERPRETATIONS

2. In these Articles unless there be something in the subject or context inconsistent therewith, words signifying the singular number only, shall include the plural and vice versa and words signifying males only shall extend to and include females and words signifying persons, shall apply mutatis mutandis to bodies corporate.
 - (a) "Articles" means the Articles of Association as originally framed or as altered from time to time.
 - (b) "Capital" shall mean the capital of the Company for the time being raised or authorised to be raised for the purpose of the Company.
 - (c) "Company" means "ARTISTIC SOLAR ENERGY (PRIVATE) LIMITED".
 - (d) "Dividend" includes bonus shares.
 - (e) "Member" means the member of the Company within the meaning of the provisions of Section 2(1)(21).
 - (f) "Month and year" shall mean the English calendar month and English calendar year respectively.
 - (g) "Office" means the registered office of the Company for the time being.
 - (h) "Ordinance" means the Companies Ordinance, 1984.
 - (i) "Register" means the register of members to be kept pursuant to Section 147 of the Ordinance.
 - (j) "Section" means Section of the Ordinance.
 - (k) "Seal" in relation to a Company means the Common Seal of the Company.
 - (l) "Shares" shall mean the shares in the capital of the Company.
 - (m) "Writing" includes printed, lithographed and typewritten or other modes of representing words in visible and legible form.

PRIVATE COMPANY

3. The Company is a Private Limited Company within the meaning of Clause (28) of Sub-section (1) of Section 2 and accordingly:-
- (a) No invitation shall be issued to the public to subscribe for any shares, debentures or debenture-stock of the Company.
 - (b) The number of the members of the Company (exclusive of the persons in the employment of the Company) shall be limited to fifty; provided that for purposes of this provisions, where two or more persons hold one or more shares jointly in the Company, they shall be treated as a single member; and
 - (c) The right of transfer of shares in the Company is restricted.



CAPITAL

4. The authorised share capital of the Company is such amount divided into such number of ordinary or other kinds / classes of shares as are set out in clause V of the Memorandum of association of the company.

SHARES

- 5. No shares shall be offered for subscription except upon the terms that the amount payable on application shall be full amount of the nominal value.
- 6. The shares in the capital of the Company may be issued or allotted in payment or part payment of any property, land, building, machinery, goodwill or goods supplied or any service rendered to the Company and any shares so allotted may be issued as fully paid up and not otherwise.
- 7. The shares shall be under the control of the Directors who may allot or otherwise dispose of the same as they may think fit.
- 8. The certificates of title to shares and duplicates thereof when necessary, shall be issued under the seal of the Company, and signed by any two Directors or officers of the Company duly authorised by the Board of Directors.
- 9. Every member shall be entitled to one certificate for all the shares registered in his name or to as many certificates as the Directors may from time to time decide. Every certificate of the shares shall specify the number and denote the number of the shares in respect of which it is issued and the amount paid up thereon.
- 10. A new certificate in lieu of one defaced, lost or destroyed on proof thereof to the satisfaction of the Directors and on such indemnity as the Directors may deem adequate shall be issued.

INCREASE, REDUCTION AND RE-ORGANIZATION OF SHARE CAPITAL

- 11. The Company may from time to time, by ordinary resolution, increase the shares capital by creation of new shares or consolidate, sub-divide or reorganize its capital in such manner as may be provided by law and as may be directed by the resolution passed at such meeting.
- 12. Subject to the provisions of the Ordinance, all new shares shall, before issue, be offered to such persons as at the date of the offer are entitled to receive notices from the Company of general meetings in proportion, as nearly as the circumstances admit, to the amount of the existing shares to which they are entitled. The offer shall be made by notice specifying the number of shares offered, and limiting a time within which the offer, if not accepted, will deemed to be declined, and after the expiration of that time, or on the receipt of an intimation

from the person to whom the offer is made that he declines to accept the shares offered, the Directors may dispose off the same in such manner as they think most beneficial to the Company. The Directors may likewise so dispose off any new shares which (by reason of the ratio which the new shares bear or shares held by persons entitled to an offer of new shares) cannot, in the opinion of the Directors, be conveniently offered under this regulation.

13. The new shares shall be subject to the same provisions with reference to transfer, transmission and otherwise as the shares in the original share capital.
14. The Company may, by special resolution, reduce its share capital in any manner and with, and subject to, any incident authorised and consent required, by law.

TRANSFER OF SHARES

15. No shares can be sold, mortgaged, or otherwise disposed off by any member to a non-member without previous sanction of the Directors.
16. No transfer of any share shall be made or registered without the previous sanction of the Directors.
17. Any member desiring to sell any of his shares must notify to the Directors the number of shares, the name, address and description of the proposed transferee, and if the Directors approve the desired transfer, an entry shall be made in the Register of members on payment of prescribed fee by the transferee and then the transfer shall be deemed to be duly effected.
18. 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 of members in respect thereof.
19. Shares in the Company shall be transferred in the form prescribed by Table 'A' in First Schedule or in any usual or common form which the Directors shall approve.
20. The transfer books and register of members may be closed during such time as the Directors think fit.

TRANSMISSION OF SHARES

21. The executors, administrators, heirs or nominees, as the case may be, of a deceased sole holder of a share shall be the only persons recognised by the Company as having any title to the share. In the case of a share registered in the name of two or more holders the survivors or survivor, or the executors or administrators of the deceased survivor, shall be the only persons recognised by the Company as having any title to the shares.
22. 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 transfer of share by the deceased or insolvent person before the death or insolvency.
23. 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 was 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 thereof to exercise any right conferred by membership in relation to meetings of the Company.

GENERAL MEETING

24. The first Annual General Meeting, shall be held within eighteen months from the date of incorporation of the Company and thereafter once at least in every calendar year and within a period of four months following the close of its financial year and not more than fifteen months after the holding of its last preceding annual general meeting.
- + 25. All general meetings of the Company other than annual general meetings shall be called extraordinary general meetings.

NOTICE AND PROCEEDINGS OF GENERAL MEETINGS

26. Atleast twenty-one day's notice, specifying the place and the day and hour of the meeting along with a statement of the business to be transacted at the meeting, and in case of special resolution; the general nature of that business, shall be sent to (a) every member of the Company (b) any person entitled to a share in consequence of death of a member and (c) to the auditors of the Company in accordance with the provisions of Section 50. Accidental omission to give such notice to or non-receipt of such notice by any member shall not invalidate the proceedings of the general meeting.
27. 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 consideration of accounts, balance sheet and the reports of Directors and auditors, election of Directors, appointment of auditors and fixing their remuneration, declaration of dividend.
28. No business shall be transacted at any general meeting unless a quorum of members is present. The quorum of the meeting(s) shall be governed according to the provisions of the Ordinance as applicable to this company.
29. At any general meeting, unless a poll is demanded, a resolution other than relating to appointment or removal of Directors, put to the vote of the meeting shall be decided by a show of hands and an entry under the proceedings of the Company shall be conclusive evidence of the fact.
30. Before or on the declaration of the result of the voting on any resolution on a show of hands, a poll may be ordered to be taken by the Chairman of the meeting of his own motion, and shall be ordered to be taken in accordance with the provisions of Section 167.
31. A poll demanded on the election of a Chairman or on a question of adjournment of a meeting shall be taken forthwith, and a poll demanded on any other question shall be taken at such time not more than fourteen days from the day on which it is demanded as the Chairman of the meeting may direct.
32. The result of the poll shall be deemed to be the resolution of the meeting at which the poll was demanded.

VOTES OF MEMBERS

33. Subject to any rights or restrictions for the time being attached to any class or classes of shares, on a show of hands every member present in person shall have one vote except for election of Directors 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.
34. 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 of members.
35. 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 poll, by his committee or other legal guardian, and any such committee or guardian may, on poll, vote by proxy.

36. 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 Directors in accordance with the provisions of Section 162 is in force.
37. (1) The instrument appointing a proxy shall be in writing under the hands of the appointer or of his attorney duly authorised in writing. A proxy must be a member.
- (2) 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 registered office of the Company not less than forty-eight hours before the time for holding the meeting at which the person named in the instrument proposes to vote and in default the instrument of proxy shall not be treated as valid.
38. An instrument appointing a proxy may be in the common form and shall be in writing:
39. A vote given in accordance with the terms of an instrument of proxy shall be valid notwithstanding the previous death or insanity of the principal or revocation of the proxy or the authority under which the proxy was executed, for 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.
40. The Chairman of any meeting shall be the sole judge of validity of every vote tendered at such meeting and at taking of poll he shall be the sole judge of validity of every vote tendered at such poll.

DIRECTORS

41. There shall be not less than two Directors of the Company. The Directors of the Company shall fix the number of elected Directors of the Company not later than 35 days before convening of the general meeting at which Directors are to be elected and the number so fixed shall not be changed except with the prior approval of the general meeting of the Company.
42. The following are the first Directors of the Company.
1. Mr. Yaqoob Ahmed
 2. Mr. Muhammad Omer Ahmed
 3. Mr. Muhammad Murtaza Ahmed
43. The Directors of the Company shall, unless the number of persons who offer themselves to be elected is not more than the number of Directors fixed under Article 41 be elected by the members of the Company in general meeting in the following manner namely:-
- a) a member shall have such number of votes as is equal to the product of the number of voting shares or securities held by him and number of Directors to be elected;
 - b) a member may give all his votes to a single candidate or divide them between more than one of the candidates in such manner as he may choose; and
 - c) the candidate who gets the highest number of votes shall be declared elected as Director and then the candidate who gets the next highest number of votes shall be so declared and so on until the total number of Directors to be elected has been so elected.
44. First Directors shall stand retired at the First Annual General Meeting of the Company and the Directors elected at the first Annual General Meeting or thereafter shall hold office for three years after their election. A retiring Director shall continue to perform his functions until

his successor is appointed. The retiring Directors shall be eligible for re-election.

45. Save as provided in Section 187, no person shall be appointed as a Director unless he is member of the Company.
46. The Directors of the Company elected under Article 43 shall hold office for three years except the Directors appointed against casual vacancy who shall be subject to retirement in terms of Article 49 hereof.
47. A retiring Director shall be eligible for re-election.
48. Subject to the provisions of the Ordinance, the Company may from time to time in general meeting increase or decrease the number of Directors.

CASUAL VACANCY

49. Any casual vacancy occurring amongst the Directors may be filled up by the Directors, and the person so appointed shall hold office for the remainder of the term of the Director in whose place he is appointed.

REMOVAL OF DIRECTOR

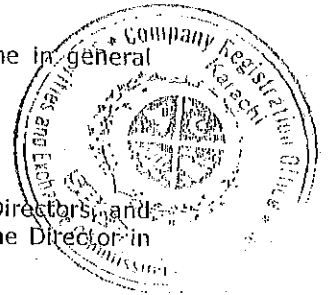
50. A Director elected may only be removed by a resolution of the Company in General Meeting but such a resolution shall not be deemed to have been passed if the number of votes against it equals to, or exceeds, the number of votes that would have been necessary for the election of a Director at the immediately preceding election of Directors.
51. A Director may retire from office upon giving prior notice in writing to the Company of his intention to do so, and such resignation shall take effect upon the expiration of such notice or its earlier acceptance.

REMUNERATION OF DIRECTORS

52. Each Director shall be paid out of the funds of the Company remuneration for attending the meetings of the Directors or a committee of Directors according to the scale as may from time to time be approved by the Board of Directors.
53. If a Director shall be called upon to perform any extra service, or make any special exertion, or to go out of the place of his ordinary residence for any purpose of the Company, or be actively engaged in the conduct and management of the business of the Company, he shall be paid such remuneration as may be determined by the Board of Directors.

POWERS AND DUTIES OF DIRECTORS

54. The business of the Company shall be managed by the Directors who may pay all such expenses preliminary and incidental to the promotion, formation, establishment and registration of the Company as they may think fit, and may exercise all such powers of the Company and do on behalf of the Company all such acts as may be exercised and done by the Company, and as are not by the statutes or by these Articles required to be exercised or done by the Company in general meeting, subject nevertheless to any regulations in these Articles, to the provisions of the statutes and such regulations as may from time to time 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 such regulation had not been made.



BORROWING POWERS

55. Subject to the provisions of the Ordinance, the Board of Directors shall have the powers to raise or borrow any sums of money for and on behalf of the Company from firms, companies, commercial banks, or financing institutions or the Directors may themselves advance money to the Company upon such terms and conditions as they may approve from time to time.
56. The Directors may from time to time secure the payment of such money in such manner and upon such terms and conditions in all respects as they may think fit and in particular by the issue of debentures or bonds of the Company or by mortgage or charge of all or any part of the property or assets of the Company.

PROCEEDINGS OF DIRECTORS

57. The quorum necessary for the meeting of the Board of Directors shall be the majority of the Directors present in person, not being less than two.
58. A resolution in writing signed by all the Directors shall be as effective for all purposes as a resolution passed at meeting of Directors duly called, held and constituted.
59. All acts done by any meeting of the Directors, shall notwithstanding that it shall afterwards be discovered that there was some defect in the appointment of any such Director or person acting as aforesaid, or that they or any of them were disqualified be as valid as if every such person has been duly appointed and was qualified to be Director.

DISQUALIFICATION OF DIRECTORS

60. A Director shall immediately cease to hold office on happening of any of the following events, that is to say:
- (a) On his becoming in-eligible to be appointed a Director on any one or more of the grounds enumerated in Clauses (a) to (h) of Section 187;
 - (b) On his resignation from office by notice in writing to the Company;
 - (c) On his removal by the Company in general meeting;
 - (d) On his being absent from three consecutive meetings of the Directors or from all meetings of Directors for a continuous period of three months, whichever is the longer, without leave of absence from the Board of Directors.

NOMINEE DIRECTOR

61. In addition to the elected Directors, the Financial Institutions shall be entitled, during the currency of their respective loan(s) to the Company, to appoint one person on the Board of Directors of the Company to be called Nominee Director and to recall and/or replace such a person from time to time. Such Nominee Director on the Board of Directors of the Company may not be holder of Shares in the Capital of the Company and other regulations and/or rules pertaining to the election, retirement, qualification and/or disqualification of the Director shall not apply to him.

MANAGEMENT

62. The business of the Company shall be managed and run by the Board of Directors who shall exercise such powers as are necessary and expedient to conduct and run the business of the Company, including the powers to make purchases and sales, appoint the officers and employees of the Company, correspond with the suppliers, clients and other customers, to make and sign all contracts and to draw, accept, endorse and negotiate on behalf of the

Company all bills of exchange, promissory notes, drafts, to institute, conduct or defend any proceedings for or against the Company before any Court, Government or Semi-Government authority; to operate bank accounts of the Company including the power to sub-delegate any of their powers to any Director or Directors or shareholder or other officer, employee or attorney of the Company and generally to exercise all such powers as are exercisable by the Board of Directors under the provisions of the Ordinance, or may be specifically delegated to them by the Company in general meeting from time to time.

CHAIRMAN

63. The Directors may elect one of their members to be the Chairman of the Company. He shall preside over all the meetings of Directors and shareholders. He shall conduct and supervise election of Directors. He shall exercise and perform all other powers and functions as may from time to time be delegated and assigned to him By the Board of Directors.

CHIEF EXECUTIVE

64. (a) Within 14 days from the day of each election of Directors, a Chief Executive will be appointed by the Directors for a period of not exceeding three years and on the expiry of the said period he will retire but he shall continue to act till the appointment of his successor. However, the first Chief Executive of the Company will hold office upto the conclusion of first Annual General Meeting.
- (b) A retiring Chief Executive will at all times be eligible for reappointment. The Chief Executive shall, if he is not already a Director be deemed to be a Director of the Company and be entitled to all the rights and privileges and be subject to all the liabilities of a Director. An elected Director is eligible for appointment as a Chief Executive.
- (c) A Chief Executive shall be paid such salary and allowances and enjoy such fringe benefits and facilities as may from time to time be fixed and allowed by the Board of Directors.
- (d) The chief executive of the company can be removed in accordance with the provisions of section 202 of the Ordinance.

THE SEAL

65. The Directors shall provide a common seal for purposes of the Company and shall have power from time to time to destroy the same and substitute a new Seal in lieu thereof and they shall provide for the safe custody of the Seal. The seal of the Company shall not be affixed to any instrument except by authority of a resolution of the Board of Directors and save as provided in Article 8, in the presence of at least one Director or officer and such Director or officer shall sign every instrument to which the seal shall be affixed in his presence, such signature shall be conclusive evidence of the fact that the seal has been properly affixed.

ACCOUNTS

66. 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 right of inspecting any account and books or papers of the Company except as conferred by law or authorised by the Directors or by the Company in general meeting.
67. The Directors shall in all respects comply with the provisions of Sections 230 to 236.

AUDIT

68. The auditors of the Company shall be appointed and their duties regulated in accordance with Sections 252 to 255.

INDEMNITY

69. 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 favour 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.

SECRECY

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

RECONSTRUCTION

71. On any sale of the undertaking of the Company, the Directors or the liquidator in a winding-up may, if authorised by a Special Resolution, accept shares, debentures or securities of any other Company, whether incorporated in Pakistan or not, 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 Liquidator (in winding-up), may distribute such shares, debentures or securities, or any other property of the Company amongst the members without realisation, or vest the same in trustees for them, and any resolution may provide for the distribution or appropriation of the cash, shares, debentures, 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 authorised, and waive all rights in relation thereto, save only in case the Company is proposed to be or is in the course of being wound up, such statutory rights (if any) under the law, as are incapable of being varied or excluded by these Articles.

WINDING UP

72. 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 the Ordinance, divide amongst the members, in specie or kind, the whole or any part of the assets of the Company, whether they consist of property of the same kind or not.
73. For the purpose aforesaid, the liquidator may 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 or different class of members.
74. The liquidator may, with the like sanction, vest the whole or any part of such assets in trustees upon such trusts for the benefit of the contributories as the liquidator, with the like sanction, thinks fit, but so that no member shall be compelled to accept any shares or other securities whereon there is any liability.

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

Name and surname (Present and former) in full (In block letters) / Fathers Name / Nationality / NIC #	Occupation	Residential Address in *Full	Number of shares taken by each subscriber	Signature
MR. YAQOOB AHMED S/O. AHMED OMER PAKISTANI CNIC # 42201-4651073-5	BUSINESS	HOUSE NO. 35, STREET # 10, KHAYABAN-E- MUHAFIZ, PHASE VI, DHA	= 100 = (One hundred shares)	
MR. MUHAMMAD OMER AHMED S/O. YAQOOB AHED PAKISTANI CNIC # 42201-4652023-5	BUSINESS	HOUSE NO. 35, STREET # 10, KHAYABAN-E- MUHAFIZ, PHASE VI, DHA	= 100 = (One hundred shares)	
MR. MUHAMMAD MURTAZA AHMED S/O. YAQOOB AHED PAKISTANI CNIC # 42201-8075257-7	BUSINESS	HOUSE NO. 35, STREET # 10, KHAYABAN-E- MUHAFIZ, PHASE VI, DHA	= 100 = (One hundred shares)	
TOTAL			=300 = (Three hundred shares)	

Dated this 29th day of July, 2015

Witness to the above signatures:

Full Name, Fathers' name In Block Letters	National Institutional Facilitation Technologies (Private) Limited
Occupation	
Full Address	5th Floor, AWT Plaza, I.I. Chundrigar Road, Karachi
Signature	

Fariz 14/9/15
Assistant Registrar of Companies



SUKKUR ELECTRIC POWER COMPANY

Phone: 0719310044
Fax: 071-9310342
Email: planningsepcogls@gmail.com

Planning Directorate,
2nd Floor, Al-Sehra Building,
Near Dist: Jail, Minara Road, Sukkur

No. CTO/SEPCO/SUK/M(P&E)/SSPL/

6748-51

Dated: 30-11-2018

Deputy General Manager (Tech)-II,
CPPA-G Ltd, Ground Floor
Enercon Building, G-5/2, Near SB, Islamabad

Subject: INTERCONNECTION STUDY APPROVAL OF 50 MW SOLAR PROJECT BY M/S ARTISTIC SOLAR ENERGY PVT LTD, AT SALEHPAT NARA, DISTRICT SUKKUR, SINDH

- Ref:
- Guidelines/SOP for power procurement issued by your good office vide No. CPP- G/CS/ 2018 /1985 dated 31/05/2018.
 - Your letter No CPPAGL/CTO/DGMT-II/MT-V/Solar/ASEPL/28501-03 dated 16/10/2018

M/s Artistic Solar Energy Pvt Limited is going to establish 50 MW Solar Power Project near Salehpat Nara, District: Sukkur for sale of 42.5 MW spillover power to national grid. Letter of Intent (LOI) has been issued by Directorate of Alternative Energy, Energy Department, Government of Sindh vide No. DAE/Solar/93/2015 dated 15/01/2018. The power will be evacuated at 132 kV Voltage level. SEPCO further certify that:

- SEPCO hereby give Grid Interconnection Study, approval for the subjected power plant as the power injected through above mentioned project will not have any adverse effect on SEPCO network. Moreover, comments of Planning NTDC must also be obtained as per policy.
- SEPCO hereby give its consent to CPPA (G) for purchase of 42.5 MW spillover power from M/S Artistic Solar Energy (Pvt) Ltd on behalf of SEPCO subject to approval from BOD SEPCO.
- A tripartite EPA/PPA will be negotiated and finalized with Project Company, including CPPA-G and SEPCO after approval from BOD SEPCO. All the obligations / liabilities pertaining to technical portion (Connection part) only will be the responsibility of SEPCO, whereas CPPA-G will have the obligations/liabilities related to the Commercial part of the agreement.
- SEPCO will construct, operate and maintain the purchaser Interconnection facilities in accordance with the project timelines agreed with the power producer as Project Director (GSC) SEPCO has confirmed that the proposed double circuit line from 132 kV Nara-I to Artistic Solar Energy Pvt Ltd on Lynx conductor measuring about 8.0 km will be completed before December, 2020 subject to provision of funds and completion of all codal formalities.

This issues with the approval of worthy GEO, SEPCO.

D #	DI:
DGM(C)	DGM(MD)
DGM(HC)	DGM(R)
DGMF-I	DGMF-II
DGHR&A	DGIT

[Signature]
Manager (P&D)
SEPCO Sukkur

Copy to:

- Chief Technical Officer SEPCO Sukkur,
- PSO to Chief Executive Officer, SEPCO, Sukkur.
- M/S Artistic Solar Energy (Pvt) Ltd, Plot 4 & B, Sector -- 25, Korangi Industrial Area, Karachi.
Master file/Relevant file.



Central Power Purchasing Agency Guarantee Limited

A Company of Government of Pakistan



Office of Chief Technical Officer

No. CPPA-G/CTO/DGM(Renewable)/ASEPL/ 2260-63

February 01, 2019

General Manager (Power System Planning) -

National Transmission & Despatch Co. Ltd.

4th Floor, PIA Tower, Egerton Road,

Lahore.


Subject:- Submission of Grid Interconnection Study Report of 50 MW Solar Power Project at Salehpat Nara, District Sukkur by M/s Artistic Solar Energy (Pvt.) Limited.

REF:- M/s Artistic Solar Energy (Pvt.) Limited letter no. AESPL/OUT/CPPA/011-2019 dated January 29, 2019.

This is with reference to above mentioned letter vide which M/s Artistic Solar Energy (Pvt.) Limited has submitted the Grid Interconnection Study Report for approval.

It is pertinent to mention here that procurement of power under the legal and regulatory framework required due consideration of the obligations placed under 'Planning Code (PC-04)' of the Grid Code as well as DPC-5 of the Distribution Code. The quantum for renewable energy has not been approved/finalized by the Grid Code Review Panel (GCRP).

It is also informed that carrying out, submission, review and approval of Grid Interconnection Study may not be consider as consent for Procurement of Power from Central Power Purchasing Agency.


Deputy General Manager (Renewable)

Copy to:-

1. Chief Executive Officer, CPPA-G Islamabad.
 2. Chief Technical Officer, CPPA-G Islamabad
 - ✓ 3. M/s Artistic Solar Energy (Pvt.) Limited, Plot 4 & 8, Sector-25, Korangi Industrial Area, Karachi.
- Master File



Power Planners International

50 MW Solar Power Plant at Rohri, Sindh

Report No. PPI-294.2-Draft/18

www.powerplannersint.com

**Interconnection Study of
50 MW Solar Power Plant**
by
Artistic Solar Energy (Pvt.) Ltd at Rohri, Sindh

Power Planners International (Pvt) Ltd.

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Version	Date	Authors	Checked By	Comments
1	3/10/2018	Aqsa Nadeem Ali Imran	Ameer Haider Ali	

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Executive Summary

- ❖ The Draft Report of 50 MW Solar Power Plant by Artistic Solar Energy (Pvt.) Ltd. at Rohri, Sindh, referred to as Artistic Solar PP, is submitted herewith. The maximum net AC output of this plant would be 42.5 MW.
- ❖ The latest generation, transmission plan and load forecast of NTDC has been used for the study, attached in Appendix – A.
- ❖ The study objective, approach and methodology have been described and the plant's data received from the Client validated.
- ❖ The nearest grid facilities are the 132 kV substations of Nara-C1 and Rohri. Nara-C1 is 8km from the site of Artistic Solar PP.
- ❖ Due to the location of Artistic Solar PP, the most feasible interconnection scheme would be direct double circuit from Nara-C1 grid. The looping distance is 8 km and Lynx conductor will be used. The upcoming chapters discuss in detail the location and interconnection of the Artistic Solar PP. A few approximate sketches are shown in Appendix-B.
- ❖ In view of planned COD of Artistic Solar PP in December 2020, the above proposed interconnection scheme has been assessed for steady state conditions through detailed load flow studies, short circuit analysis and stability criterion for Winter 2021 for maximum thermal power dispatches in the grid.
- ❖ Detailed load flow studies have also been carried out for peak and off-peak load conditions of Summer 2021, and for future scenario of Summer 2023 for the proposed scheme under normal and N-1 contingency conditions to meet the reliability criteria.
- ❖ Steady state analysis by load flow for all the scenarios described above reveals that the proposed scheme is adequate to evacuate the maximum power of 42.5 MW of the plant under normal and contingency conditions.
- ❖ The short circuit levels of the Artistic Solar PP 132 kV are 5.58 kA and 5.92 kA for 3-phase and 1-phase faults, respectively, in the year 2021. Therefore, industry standard switchgear of a short circuit rating of 40 kA would be sufficient for installation at 132 kV switchyard of Artistic Solar PP, as the maximum short circuit levels for the year 2023 were also found to be within this range, taking care of any future generation additions and system reinforcements in its electrical vicinity and also fulfilling the NEPRA Grid Code

requirements specified for 132 kV switchgears. There are no violations of the power rating of the equipment in the vicinity of Artistic Solar PP in the event of fault conditions.

- ❖ The dynamic stability analysis of proposed scheme of interconnection has been carried out. The stability has been tested for the worst cases, i.e. three phase fault right on the 132 kV bus bar of Artistic Solar PP substation followed by trip of a 132 kV single circuit from Artistic Solar PP to Rohri-New has been performed for fault clearing of 5 cycles (100 ms), as understood to be the normal fault clearing time of 132 kV protection system. Also the extreme worst case of stuck breaker (breaker failure) has been studied where the fault clearing time is assumed 9 cycles i.e. 180 ms for single phase fault. The stability of the system for far end fault of 3-phase occurring at Rohri-New 132 kV bus bar has also been checked. The system is stable for all the tested fault conditions.

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Appendices

Appendix - A: Generation, Transmission Schedule and Load Forecast

Appendix - B: Sketches

Appendix - C: Plotted Results of Load Flow for Chapter 5

Appendix - D: Results of Short Circuit Calculations for Chapter 6

Appendix - E: Plotted Results of Stability Analysis for Chapter 7

Appendix - F: Dynamic Data for Stability



1. Introduction

1.1. Background

Artistic Solar Energy (Pvt.) Ltd. Is developing a Photovoltaic (PV) based Solar Farm near Rohri, District Sukkur, Sindh. The site of the proposed project is located in the concession area of Sukkur Electric Power Company (SEPCO). A general idea of the grid stations in the vicinity of the plant can be viewed in Sketch-1 attached in Appendix - B.

The maximum net AC output of the solar plant will be 42.5 MW. The project is expected to start commercial operation by the end of December 2020. The electricity generated from this project would be supplied to the grid system of SEPCO through 132 kV grids available in the vicinity of this project. The location of Artistic Solar PP can be seen in Sketch-2 attached in Appendix - B.

1.2. Objectives

The overall objective of the Study is to evolve an interconnection scheme between Artistic Solar PP and SEPCO network, for stable and reliable evacuation of 42.5 MW of electrical power generated from this plant, fulfilling the N-1 reliability criteria. The specific objectives of this report are:

- To develop scheme of interconnections at 132 kV for which right of way (ROW) and space at the terminal substations would be available.
- To determine the performance of interconnection scheme during steady state conditions of system, normal and N-1 contingency, through load-flow analysis.
- To check if the contribution of fault current from the plant unit 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 Artistic Solar PP.
- To check if the interconnection withstands dynamic stability criteria of post fault recovery with good damping.

1.3. Planning Criteria

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

Steady State:

Voltage	$\pm 5 \%$, Normal Operating Condition
	$\pm 10 \%$, Contingency Conditions
Frequency	50 Hz Nominal, continuous
	49.8 Hz to 50.2 Hz variation in steady state
	49.4 - 50.5 Hz, Min/Max Contingency Freq. Band
Power Factor	± 0.95 (as per Grid Code Addendum No.2 for Solar Power Plants)

Short Circuit:

132 kV Substation Equipment Rating of 40 kA

Dynamic/Transient:

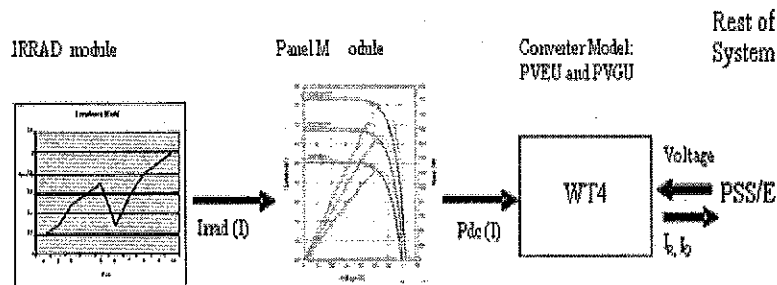
The system should revert to normal condition after transients die out with good damping, without losing synchronism. The system is tested under the following fault conditions:

- a) Permanent three-phase fault on any primary transmission element; including: transmission circuit, substation bus section, transformer or circuit breaker. It is assumed that such a fault shall be cleared by the associated circuit breaker action in 5 cycles.
- b) Failure of a circuit breaker to clear a fault ("Stuck Breaker" condition) in 9 cycles after fault initiation.

2. Assumptions of Data

2.1. Solar Power Plant Data

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



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

Steady State Data:

Maximum Net AC Output of Solar PP to Grid	= 42.5 MW
Size of a single inverter	= 2.5 MW
MVA Rating of Transformer	= 2.8 MVA
% Impedance of GSU Transformer	= 6 %

Dynamic Data:

Converter time constant for I_{Qcmd} seconds	= 0.02 s
Converter time constant for I_{Qcmd} 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 Artistic Solar Power Plant are as shown in Sketches 1 and 2 in Appendix-B. The lengths of the nearby circuits are also mentioned in the sketches.

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



3. Study Approach and Methodology

3.1. Understanding the Problem

The 42.5 MW (Net AC Output) Solar Power Plant by Artistic Solar, is going to be a photovoltaic (PV) based solar project in Sindh embedded in the 132 kV distribution network of SEPCO. 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 SEPCO grid stations are Nara C-1 and Rohri-New 132 kV substations. The addition of this source of power generation combined with the power from other solar power plant in its vicinity shall provide relief to the transformers at Rohri - New 220/132 kV and the sources feeding this area from further away. The 132 kV network of SEPCO in the electrical vicinity of Artistic Solar PP has significant load demand; therefore a considerable portion of the power from Artistic Solar PP will be utilized in meeting this load demand on substations including Nara – C1, Shah Ludhani, Kunb, Gambat etc.

The adequacy of SEPCO network of 132 kV in and around the proposed site of Artistic Solar Energy (Pvt.) Ltd. Solar Power Plant would be investigated in this study for absorbing and transmitting this power fulfilling the reliability criteria.

3.2. Approach to the Problem

The following approach has been applied to the problem:

- A base case network model has been prepared for the peak load case of Winter 2021, after COD of Solar Power Plant by Artistic Solar Energy (Pvt.) Ltd., 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 SEPCO.
- The expected COD of the project is during the month of December 2020. In view of the planned COD of Artistic Solar PP, the above proposed interconnection scheme has been tested for steady state conditions through detailed load flow studies for off-peak load conditions of Winter 2021, peak load conditions of Summer 2021 and peak load conditions of Summer 2023.
- Load flow and short circuit studies have also been performed for Summer 2023 to gauge the performance of the proposed plant in an extended term scenario.
- An interconnection scheme without any physical constraints, such as right of way or availability of space in the terminal substations, have been identified.

- Technical system studies have been conducted for peak load conditions, to confirm technical feasibility of the interconnection. The scheme will be subjected to standard analyses such as load flow, short circuit, and transient stability to gauge the strength of the machines and the proposed interconnection under disturbed conditions.
- The relevant equipment for the proposed technically feasible scheme has been determined.
- Finally, the most technically feasible interconnection scheme has been recommended.

4. Development of Interconnection Scheme

4.1. The Existing Network

The existing 132 kV network available around the proposed location of Artistic Solar PP is shown in Sketch-1 in Appendix-B.

Artistic Solar PP is located near Rohri, Sindh, embedded in the distribution network of SEPCO. The network is being fed from the 220/132 kV substation of Rohri-New. The nearest existing SEPCO interconnection facilities at the time of commissioning of the plant are Nara C-1 132 kV and Rohri-New 132 kV Substations. There is also the presence of three 50 MW PV Solar Farms in the immediate vicinity, namely Helios Power, HNDS Energy and Meridian Energy.

4.2. The Interconnection Scheme of Artistic Solar PP

Keeping in view of the above mentioned 132 kV network available in the vicinity of the site of the Artistic Solar PP, the most feasible interconnection scheme would be direct double circuit. The looping distance is 8 km and the conductor used will be Lynx. A few approximate sketches are shown in Appendix-B.

5. Detailed Load Flow Studies

The base cases have been developed for the peak conditions of Winter 2021 using the network data of NTDC and SEPCO available with PPI. The peak loads of the year 2021 for SEPCO have been modeled as per the latest PMS Demand forecast as provided by NTDC. Detailed load flow studies have been carried out for Winter 2021, Summer 2021 and future case Summer 2023.

5.1. Modeling of Solar Power Plant in the Load Flow

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

5.2. Reactive Power Requirements

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

The Grid Code Addendum No.2 requires to meet the criteria of ± 0.95 power factor at the point of interconnection with the NTDC/QESCO grid at 132 kV (point of common coupling). Therefore, Artistic Solar with its maximum AC output of 42.5 MW generating capacity is required to pump around 14 MVARs to the grid at maximum AC power output of 42.5 MW to fulfill the criteria. The VAR generating capability of the inverters will not be able to fully meet this VAR demand of the system because of VAR loss in step-up transformers, collector cables and the transformers at the Solar Plant substation.

In order to meet the Grid Code criteria, we need to install reactive power compensation equipment. For a Solar Power Plant delivering 42.5 MW Net AC output, we need to have around 14 MVAR at 132 kV bus bar after farm losses. Hence a Static VAR Compensator (20 MVAR) with contactors and PLC (Programmable Logic Controller) is proposed at 33 kV bus bar of the Solar PP.

5.3. Base Case Peak Winter 2021, Without Solar Power Plant

A base case has been developed for the peak load of Winter 2021, using the network data of SEPCO and NTDC.

The results of load flow for this base case are plotted in Exhibit 0.0 of Appendix-C. The system plotted in this Exhibit shows 132 kV network in the vicinity of Artistic Solar (Pvt.) Ltd. Solar PP including the substations of Rohri, Nara-C1, Shah Ludhani, Kunb, Gambat and other substations.

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

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

Exhibit-0.1	HNDS Energy to Rohri-NW 132 kV Single Circuit Out
Exhibit-0.2	Nara C-1 to Rohri-NW 132 kV Single Circuit Out
Exhibit-0.3	Rohri-NW to Gambat 132 kV Single Circuit Out
Exhibit-0.4	Rohri-NW to Kunb 132 kV Single Circuit Out
Exhibit-0.5	Kunb to Gambat 132 kV Single Circuit Out
Exhibit-0.6	Rohri-NW to Shah Ludhani 132 kV Single Circuit Out
Exhibit-0.7	Shah Ludhani to Khairpur-1 132 kV Single Circuit Out
Exhibit-0.8	Rohri-NW to Shkpr220 220 kV Single Circuit Out
Exhibit-0.9	Engro Energy to Rohri-NW 220 kV Single Circuit Out
Exhibit-0.10	Guddu to Shkpr220 220 kV Single Circuit Out
Exhibit-0.11	Guddu 500/220 kV Single Transformer Out
Exhibit-0.12	Shkpr500 to Guddu 500 kV Single Circuit

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 Artistic Solar PP for its connectivity under normal conditions and the N-1 contingency conditions considered.

5.4. Base Case Peak Winter 2021, With Solar Power Plant

The results of load flow with Helios Power Pvt. Ltd. Solar Power Plant interconnected as per proposed scheme are shown for each case. The power flows on the circuits under normal

conditions are seen well within the rated capacities. Also the voltages on the bus bars are within the permissible operating range of $\pm 5\%$ 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 – C as follows:

Exhibit-1.1	Artistic Solar 132/33 kV Single Transformer Out
Exhibit-1.2	HNDS Energy to Rohri-NW 132 kV Single Circuit Out
Exhibit-1.3	Helios Power to Nara C-1 132 kV Single Circuit Out
Exhibit-1.4	Artstc Solar to Nara C-1 132 kV Single Circuit Out
Exhibit-1.5	Nara C-1 to Rohri-NW 132 kV Single Circuit Out
Exhibit-1.6	Rohri-NW to Gambat 132 kV Single Circuit Out
Exhibit-1.7	Rohri-NW to Kunb 132 kV Single Circuit Out
Exhibit-1.8	Kunb to Gambat 132 kV Single Circuit Out
Exhibit-1.9	Rohri-NW to Shah Ludhani 132 kV Single Circuit Out
Exhibit-1.10	Shah Ludhani to Khairpur-1 132 kV Single Circuit Out
Exhibit-1.11	Rohri-NW to Shkpr220 220 kV Single Circuit Out
Exhibit-1.12	Engro Energy to Rohri-NW 220 kV Single Circuit Out
Exhibit-1.13	Guddu to Shkpr220 220 kV Single Circuit Out
Exhibit-1.14	Guddu 500/220 kV Single Transformer Out
Exhibit-1.15	Shkpr500 to Guddu 500 kV Single Circuit

We find that power flows on the circuits are seen well within the rated capacities and the voltages on the bus bars are also within the permissible operating range of $\pm 10\%$ off the nominal for contingency conditions' criteria. We find no capacity constraints on 132 kV circuits under normal and contingency conditions.

5.5. Off-Peak Load Case Winter 2021

We have considered the off-peak scenario of Winter 2021 so that we can judge the impact of the project on the system when the load of the system is at its minimum.

The power flows on the circuits 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 132 kV circuits under normal conditions i.e. without any outages of circuits.

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

Exhibit-2.1	Artistic Solar 132/33 kV Single Transformer Out
Exhibit-2.2	HNDS Energy to Rohri-NW 132 kV Single Circuit Out
Exhibit-2.3	Helios Power to Nara C-1 132 kV Single Circuit Out
Exhibit-2.4	Artstc Solar to Nara C-1 132 kV Single Circuit Out
Exhibit-2.5	Nara C-1 to Rohri-NW 132 kV Single Circuit Out
Exhibit-2.6	Rohri-NW to Gambat 132 kV Single Circuit Out
Exhibit-2.7	Rohri-NW to Kunb 132 kV Single Circuit Out
Exhibit-2.8	Kunb to Gambat 132 kV Single Circuit Out
Exhibit-2.9	Rohri-NW to Shah Ludhani 132 kV Single Circuit Out
Exhibit-2.10	Shah Ludhani to Khairpur-1 132 kV Single Circuit Out
Exhibit-2.11	Rohri-NW to Shkpr220 220 kV Single Circuit Out
Exhibit-2.12	Engro Energy to Rohri-NW 220 kV Single Circuit Out
Exhibit-2.13	Guddu to Shkpr220 220 kV Single Circuit Out
Exhibit-2.14	Guddu 500/220 kV Single Transformer Out
Exhibit-2.15	Shkpr500 to Guddu 500 kV Single Circuit

We find that power flows on the circuits are seen well within the rated capacities and the voltages on the bus bars are also within the permissible operating range of $\pm 10\%$ off the nominal for contingency conditions' criteria. We find no capacity constraints on 132 kV circuits under normal and contingency conditions.

5.6. Peak Load Case Summer 2021

We have considered the scenario of June 2018 so that we can judge the maximum impact of the project on the system when the load of the system would be at its maximum.

The results of this scenario are plotted in Exhibit 3.0. We find no capacity constraints on 132 kV circuits under normal conditions i.e. without any outages of circuits.



The power flows on the circuits 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 132 kV circuits under normal conditions i.e. without any outages of circuits.

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

Exhibit-3.1	Artistic Solar 132/33 kV Single Transformer Out
Exhibit-3.2	HNDS Energy to Rohri-NW 132 kV Single Circuit Out
Exhibit-3.3	Helios Power to Nara C-1 132 kV Single Circuit Out
Exhibit-3.4	Artstc Solar to Nara C-1 132 kV Single Circuit Out
Exhibit-3.5	Nara C-1 to Rohri-NW 132 kV Single Circuit Out
Exhibit-3.6	Rohri-NW to Gambat 132 kV Single Circuit Out
Exhibit-3.7	Rohri-NW to Kunb 132 kV Single Circuit Out
Exhibit-3.8	Kunb to Gambat 132 kV Single Circuit Out
Exhibit-3.9	Rohri-NW to Shah Ludhani 132 kV Single Circuit Out
Exhibit-3.10	Shah Ludhani to Khairpur-1 132 kV Single Circuit Out
Exhibit-3.11	Rohri-NW to Shkpr220 220 kV Single Circuit Out
Exhibit-3.12	Engro Energy to Rohri-NW 220 kV Single Circuit Out
Exhibit-3.13	Guddu to Shkpr220 220 kV Single Circuit Out
Exhibit-3.14	Guddu 500/220 kV Single Transformer Out
Exhibit-3.15	Shkrpr500 to Guddu 500 kV Single Circuit

We find that power flows on the circuits are seen well within the rated capacities and the voltages on the bus bars are also within the permissible operating range of $\pm 10\%$ off the nominal for contingency conditions' criteria. We find no capacity constraints on 132 kV circuits under normal and contingency conditions.

5.7. Peak Load Case Summer 2023: Extended Term Scenario

We have also studied the future scenario of Summer 2023 to assess the impact of the plant in the extended term of its installation as per NTDC requirement.



The power flows on the circuits 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 132 kV circuits under normal conditions i.e. without any outages of circuits.

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

Exhibit-4.1	Artistic Solar 132/33 kV Single Transformer Out
Exhibit-4.2	HNDS Energy to Rohri-NW 132 kV Single Circuit Out
Exhibit-4.3	Helios Power to Nara C-1 132 kV Single Circuit Out
Exhibit-4.4	Artstc Solar to Nara C-1 132 kV Single Circuit Out
Exhibit-4.5	Nara C-1 to Rohri-NW 132 kV Single Circuit Out
Exhibit-4.6	Rohri-NW to Gambat 132 kV Single Circuit Out
Exhibit-4.7	Rohri-NW to Kunb 132 kV Single Circuit Out
Exhibit-4.8	Kunb to Gambat 132 kV Single Circuit Out
Exhibit-4.9	Rohri-NW to Shah Ludhani 132 kV Single Circuit Out
Exhibit-4.10	Shah Ludhani to Khairpur-1 132 kV Single Circuit Out
Exhibit-4.11	Rohri-NW to Shkpr220 220 kV Single Circuit Out
Exhibit-4.12	Engro Energy to Rohri-NW 220 kV Single Circuit Out
Exhibit-4.13	Guddu to Shkpr220 220 kV Single Circuit Out
Exhibit-4.14	Guddu 500/220 kV Single Transformer Out
Exhibit-4.15	Shkpr500 to Guddu 500 kV Single Circuit

The power flows on the circuits are seen well within the rated capacities and the voltages on bus bars are also within the permissible operating range of $\pm 10\%$ off the nominal for contingency conditions' criteria.

We find that there are no capacity constraints in the proposed connectivity scheme even in the upcoming years i.e. 2023.

5.8. Conclusion of Load Flow Analysis

From the analysis discussed above, we conclude that the proposed interconnection scheme of connecting Artistic Solar Energy (Pvt.) Ltd. by looping in-out of 132 kV single circuit between

HNDS Energy Pvt. Ltd. and Rohri-New 132 kV Grid Station ensures reliability and availability under all events of contingencies, i.e. planned or forced outages studied in this report for the base year 2021 as well as for the future scenario of 2023. The bus bar voltages remain well within the permissible limits in all the contingency events.

6. Short Circuit Analysis

6.1. Methodology and Assumptions

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

The 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

For maximum short circuit levels, the desired voltage magnitude at bus bars was set equal to 1.10 P.U. i.e. 10 % higher than nominal, which is the maximum permissible voltage under contingency condition. For calculations of minimum short circuit levels, the bus voltage has been set equal to 0.9 P.U. i.e. 10% below the nominal.

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 years 2021 and 2023 i.e. all the generating units have been assumed on-bar in fault calculation's simulations.

For minimum short circuit levels, we have considered conditions of 2021 to simulate the minimum short circuit strength of the grid. Artistic Solar PP's output has been set at 25% of its capacity for minimum short circuit calculations.

The assumptions about the generator and the transformers data are the same as mentioned in Chapter.2 of this report.

6.2. Fault Current Calculations without Artistic Solar PP Year 2021

In order to assess the short circuit strength of the 132 kV network without Artistic Solar PP, three-phase and single-phase fault currents have been calculated for SEPCO in the vicinity of the site of the Plant near Rohri, for the year 2021. These levels will give us the idea of the fault levels without Artistic Solar PP which we can use to determine the impact of the addition of the Plant later on. The results are attached in Appendix – D.

The short circuit levels have been calculated and plotted on the bus bars of 132 kV of substations lying in the electrical vicinity of our area of interest and are shown plotted in the Exhibit 5.0 attached in Appendix-D. Both 3-phase and 1-phase fault currents are indicated in

the Exhibit 5.0 which are given in polar coordinates i.e. the magnitude and the angle of the current. The total fault currents are shown below the bus bar.

The tabular output of the short circuit calculations is also attached in Appendix-D for the 132 kV and 11 kV bus bars of our interest. 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 for older substations and 40 kA for new substations.

Table-6.1
Maximum Short Circuit Levels without Artistic Solar PP

Substation	3-Phase fault current, kA	1-Phase fault current, kA
HNDS Energy 132 kV	6.08	6.39
Meridian Energy 132 kV	6.08	6.40
Helios Power 132 kV	6.08	6.40
Nara-C1 132 kV	6.08	6.00
Rohri-NW 132 kV	17.71	15.90
Kunb 132 kV	8.18	5.95
Gambat 132 kV	10.56	8.92
Shah Ludhani 132 kV	8.00	5.90
Khairpur 132 kV	6.33	4.60
Pirjogoth 132 kV	4.31	3.01
Rohri-NW 220 kV	16.85	12.86
Shikarpur 220 kV	28.18	20.85
Guddu 500 kV	23.28	20.11
Shikarpur 500 kV	17.68	10.52
D. G. Khan 500 kV	13.67	7.40

6.3. Fault Current Calculations with Artistic Solar PP Year 2021

6.3.1. Maximum Short Circuit Levels

Maximum fault currents have been calculated for the electrical interconnection of proposed scheme. Fault types applied are three phase and single-phase at the 132 kV bus bar of Artistic Solar PP itself and other bus bars of the 132 kV and 11 kV substations in the electrical vicinity of Artistic Solar PP. The graphic results are shown in Exhibit 5.1.

The tabulated results of short circuit analysis showing all the fault current contributions with short circuit impedances on 132 kV bus bars of the network in the electrical vicinity of Artistic Solar PP and the 132 kV bus bars of Artistic Solar PP itself are placed in Appendix-D. Brief summary of fault currents at significant bus bars of our interest are tabulated in Table 6.2.

Table-6.2
Maximum Short Circuit Levels with Artistic Solar PP

Substation	3-Phase fault current, kA	1-Phase fault current, kA
Artistic Solar MV 33 kV	10.2	12.06
Artistic Solar 132 kV	5.58	5.92
HNDS Energy 132 kV	6.21	7.04
Meridian Energy 132 kV	6.21	7.05
Helios Power 132 kV	6.21	7.05
Nara-C1 132 kV	6.20	6.75
Rohri-NW 132 kV	18.12	16.57
Kunb 132 kV	8.24	5.97
Gambat 132 kV	10.70	8.98
Shah Ludhani 132 kV	8.07	5.94
Khairpur2 132 kV	6.38	4.59
Khairpur 1 132 kV	6.38	4.89
Pirjogoth 132 kV	4.31	2.98
Rohri-NW 220 kV	17.31	13.38
Shikarpur 220 kV	29.15	21.65

Guddu 500 kV	23.57	20.85
Engro Energy 220kV	11.49	11.06
Foundation-P 220kV	8.07	7.72
DM.J-220kV	14.47	14.12
Guddu 220 kV	34.56	37.42
Shikarpur 500 kV	18.27	11.17
Guddu-New 550 kV	23.15	20.66
D.G.Khan 500kV	13.98	7.67

6.3.2. Minimum Short Circuit Levels

The minimum fault levels have been calculated for minimum dispatch of power in the grid system. The plotted results of short circuit analysis are attached as Exhibit 5.2. 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 faulted bus bar.

The tabular output of the short circuit calculations is also attached in Appendix-D for the 132 kV bus bars of our interest. The total minimum fault currents for 3-phase and 1-phase short circuit at these substations are summarized in Table 6.3.

Table-6.3
Minimum Short Circuit Levels with Artistic Solar PP

Substation	3-Phase fault current, kA	1-Phase fault current, kA
Artistic Solar MV 33 kV	7.99	8.29
Artistic Solar 132 kV	4.33	3.89
HNDS Energy 132 kV	4.80	4.52
Meridian Energy 132 kV	4.80	4.52
Helios Power 132 kV	4.80	4.52
Nara-C1 132 kV	4.80	4.41

Rohri-NW 132 kV	13.20	11.70
Kunb 132 kV	6.51	4.75
Gambat 132 kV	8.38	7.08
Shah Ludhani 132 kV	6.34	4.67
Khairpur2 132 kV	5.10	3.68
Khairpur 1 132 kV	5.10	3.68
Pirjogoth 132 kV	3.49	2.42
Rohri-NW 220 kV	11.11	8.33
Shikarpur 220 kV	19.04	14.63
Guddu 500 kV	14.05	10.90
Engro Energy 220kV	6.08	3.84
Foundation-P 220kV	4.33	2.65
DM.J-220kV	8.31	7.91
Guddu 220 kV	19.89	18.19
Shikarpur 500 kV	12.06	7.69
Guddu-New 500 kV	13.82	10.67
D.G.Khan 500kV	9.91	5.99

6.4. Fault Current Calculations with Artistic Solar PP Year 2023

Fault currents have been evaluated for the case of 2023 in order to observe the maximum fault current on Artistic Solar PP and the bus bars in its vicinity considering the future additions in the system. Fault types applied are three phase and single-phase at 132 kV bus bars of Artistic Solar PP itself and other bus bars of the 132 kV and 11 kV substations in the electrical vicinity of Artistic Solar PP. The graphic results showing maximum 3-phase and 1-phase fault levels are indicated in Exhibit 5.3. Both 3-phase and 1-phase fault currents are indicated in the Exhibit 5.3 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 tabulated results of short circuit analysis showing all the fault current contributions with short circuit impedances on 132 kV bus bars of the network in the electrical vicinity of Artistic Solar PP are placed in Appendix-D. Brief summary of fault currents at significant bus bars of our interest are tabulated in Table 6.4.

Table-6.4
Maximum Short Circuit Levels with Artistic PP

Substation	3-Phase fault current, kA	1-Phase fault current, kA
Artistic Solar MV 33 kV	10.48	12.89
Artistic Solar 132 kV	5.80	6.10
HNDS Energy 132 kV	6.48	7.29
Meridian Energy 132 kV	6.48	7.29
Helios Power 132 kV	6.48	7.29
Nara-C1 132 kV	6.47	6.94
Rohri-NW 132 kV	20.11	16.70
Kunb 132 kV	8.97	6.07
Gambat 132 kV	12.37	9.01
Shah Ludhani 132 kV	8.57	4.72
Khairpur2 132 kV	6.81	3.63
Khairpur 1 132 kV	6.81	3.63
Pirjogoth 132 kV	4.52	2.27
Rohri-NW 220 kV	18.51	13.59
Shikarpur 220 kV	29.15	21.65
Guddu 500 kV	23.57	20.85
Engro Energy 220kV	11.49	11.06
Foundation-P 220kV	8.07	7.72
DM.J-220kV	14.47	14.12
Guddu 220 kV	34.56	37.42

Shikarpur 500 kV	18.27	11.17
Guddu-New 550 kV	23.15	20.66
D.G.Khan 500kV	13.98	7.67

Comparison of Tables 6.1, 6.2 and 6.3 shows an increase in short circuit levels for three-phase and single-phase faults due to connection of Artistic Solar PP on the 132 kV bus bars in its vicinity. We find that even after some increase, these fault levels are much below the rated short circuit values of the equipment installed on these substations.

6.5. Conclusion of Short Circuit Analysis

The short circuit analysis results show that for the proposed scheme of interconnection of Artistic Solar PP with HNDS Energy and Rohri-New 132 kV Grid Station, we don't find any violations of short circuit ratings of the already installed equipment on the 132 kV bus bars in the vicinity of the plant due to fault current contributions from Artistic Solar PP. The short circuit levels of the Artistic Solar PP 132 kV are 5.58 kA and 5.92 kA for 3-phase and 1-phase faults, respectively, in the year 2021. Therefore industry standard switchgear of the short circuit rating of 40 kA would serve the purpose as per NTDC requirement taking care of any future generation additions and system reinforcements in its electrical vicinity.

7. Dynamic Stability Analysis

7.1. Assumptions & Methodology

7.1.1. Dynamic Models

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

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

Generator	PVGU1
Electrical Model	PVEU1
Solar Panel Model	PANEL1

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

7.1.2. System Conditions

The month of Winter 2021 has been selected for the study because it represents the load scenario immediately after the COD of Artistic Solar PP, allowing us to judge the impact of the plant during low water season.

The proposed Artistic Solar PP has been modeled in the dynamic simulation as per data provided by client. All the power plants of WAPDA/NTDC from Tarbela to Hub have been dynamically represented in the simulation model.

7.1.3. Presentation of Results

The plotted results of the simulations runs are placed in Appendix-E. Each simulation is run for its first one second for the steady state conditions of the system prior to fault or disturbance. This is to establish the pre fault/disturbance conditions of the network under study were smooth and steady. Post fault recovery has been monitored for nineteen seconds. Usually all the transients due to non-linearity die out within a few 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 Artistic Solar PP i.e. right at the 132 kV bus bar of Artistic Solar PP substation, cleared in 5 cycles, as normal clearing time for 132 kV i.e.

100 ms, followed by a permanent trip of a 132 kV single circuit from Artistic Solar PP to Rohri-New. Also to fulfil the Grid Code criteria case of stuck breaker (breaker failure) single phase fault has also been studied where the fault clearing time is assumed 9 cycles i.e. 180 ms.

7.2. Dynamic Stability Simulations' Results - Winter 2021

7.2.1. Fault at 33 kV Artistic Solar PP (Stuck Breaker)

We applied single-phase fault on Artistic Solar PP 33 kV bus bar, cleared fault in 9 cycles (100 ms) followed by trip of a 132/33 kV Artistic Solar single transformer. We monitored different quantities for one second pre-fault and nine seconds after clearance of fault (post-fault) conditions and plotted the results attached in Appendix – E and discussed as follows:

Fig. 1.1 Bus Voltages

The bus voltages of 33 kV bus bar of Artistic MV and 132 kV bus bars of Artistic Solar PP, Nara-C1, Helios Power and 132kV and 220kV bus bar of Rohri-NW 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 Generators of Artistic Solar PP

The MW/MVAR output of Artistic Solar PP gets back to the pre-fault output quickly after fast damping of the oscillations in its output.

Fig. 1.4 Power Flow on Artistic Solar 132/33 kV Single Transformer

Followed by clearing of fault, the tripping of the 132/33 kV Artistic Solar single transformer causes this entire power to flow on the intact second transformer. This causes significant loading on this transformer. We plotted the flows of MW and MVAR on this intact transformer and see that the power flow attains a steady state level with power swings damping down fast.

Fig. 1.5 Voltage Sensor for LVACR

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

Fig. 1.6 MW/MVAR Output of Generators of HNDS Energy Solar Power Plant

The MW/MVAR output of the nearby HNDS Energy Solar PP gets back to the pre-fault output quickly after fast damping of the oscillations in its output.

Fig. 1.7 Angles Rotor

The rotor angles of the generators of Liberty, JDW-III-GSM, Alliance-P1, Alliance-P2 and Guddu are plotted relative to machines at KAPCO 220 kV. The results show that the rotor angles swing very little after the fault and damp fast after clearing of fault. The system is strongly stable and very strong in damping the post fault oscillations.

7.2.2. Fault at 132 kV Artistic Solar PP

We applied three-phase fault on Artistic Solar PP 132 kV bus bar, cleared the fault in 5 cycles (100 ms), followed by trip of a 132 kV single circuit from Artistic Solar PP to Rohri-New. We monitored different quantities for one second pre-fault and nine seconds after clearance of fault (post-fault) conditions and plotted the results attached in Appendix – E and discussed as follows:

Fig. 2.1 Bus Voltages

The bus voltages of 33 kV bus bar of Artistic MV and 132 kV bus bars of Artistic Solar PP, Nara-C1, Helios Power and 132kV and 220kV bus bar of Rohri-NW 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 Generators of Artistic Solar PP

The MW/MVAR output of Artistic Solar PP gets back to the pre-fault output quickly after fast damping of the oscillations in its output.

Fig. 2.4 Power Flow on Artistic Solar to Nara-C1 132 kV Single Circuit

Followed by clearing of fault, the tripping of the 132 kV single circuit from Artistic Solar to Nara-C1 causes this entire power to flow on the 132 kV intact circuit from Artistic Solar to Nara-C1. This causes significant loading on the circuit. We plotted the flows of MW and MVAR on this intact circuit and see that the power flow attains a steady state level with power swings damping down fast.

Fig. 2.5 Voltage Sensor for LVACR

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

Fig. 2.6 MW/MVAR Output of Generators of HNDS Energy Solar Power Plant

The MW/MVAR output of the nearby HNDS Energy Solar PP gets back to the pre-fault output quickly after fast damping of the oscillations in its output.

Fig. 2.7 Angles Rotor

The rotor angles of the generators of Liberty, JDW-III-GSM, Alliance-P1, Alliance-P2 and Guddu are plotted relative to machines at KAPCO 220 kV. The results show that the rotor angles swing very little after the fault and damp fast after clearing of fault. The system is strongly stable and very strong in damping the post fault oscillations.

7.2.3. Fault at 132 kV Rohri-New

We applied three-phase fault on Rohri-NW 132 kV bus bar, cleared the fault in 5 cycles (100 ms), followed by tripping of a 220/132 kV Rohri-New single transformer. We monitored different quantities for one second pre-fault and nine seconds after clearance of fault (post-fault) conditions and plotted the results attached in Appendix – E and discussed as follows:

Fig. 3.1 Bus Voltages

The bus voltages of 33 kV bus bar of Artistic MV and 132 kV bus bars of Artistic Solar PP, Nara-C1, Helios Power and 132kV and 220kV bus bar of Rohri-NW 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 Generators of Artistic Solar PP

The MW/MVAR output of Artistic Solar PP gets back to the pre-fault output quickly after fast damping of the oscillations in its output.

Fig. 3.4 Power Flow on Rohri-New 220/132 kV Single Transformer

Followed by clearing of fault, the tripping of the Rohri-New 220/132 kV single transformer causes this entire power to flow on the intact second transformer. This causes significant loading on the transformer. We plotted the flows of MW and MVAR on this intact transformer and see that the power flow attains a steady state level with power swings damping down fast.

Fig. 3.5 Voltage Sensor for LVACR

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

Fig. 3.6 MW/MVAR Output of Generators of HNDS Energy Solar Power Plant

The MW/MVAR output of the nearby HNDS Energy Solar PP gets back to the pre-fault output quickly after fast damping of the oscillations in its output.



Fig. 3.7 Angles Rotor

The rotor angles of the generators of Liberty, JDW-III-GSM, Alliance-P1, Alliance-P2 and Guddu are plotted relative to machines at KAPCO 220 kV. The results show that the rotor angles swing very little after the fault and damp fast after clearing of fault. The system is strongly stable and very strong in damping the post fault oscillations.

7.3. Conclusion of Dynamic Stability Analysis

The results of dynamic stability carried out for Winter 2021 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 from Artistic Solar PP under all events of disturbances. Therefore there is no problem of dynamic stability for interconnection of Artistic Solar PP; it fulfills all the criteria of dynamic stability.

8. Power Quality

The issues of power quality are of particular importance to PV solar power plants that may cause flicker and distortions in the power supply due to harmonics and unbalance. These issues are more significant for weak systems of low short circuit strength. Therefore we have investigated these issues for the case of minimum short circuit for the proposed scheme of interconnection. The same case has been re-evaluated with per unit MVA values and plotted for 3-phase faults in Appendix-D.

8.1. Flicker

We have used IEC61400-21 for the calculations of flicker levels for steady-state continuous operation and for switching conditions.

8.1.1. Continuous Operation

The probability of 99th percentile flicker emission from a single inverter during continuous operation for short time $P_{st\Sigma}$ and longer time flicker levels $P_{lt\Sigma}$ are assumed same and calculated by the following formula

$$P_{st\Sigma} = P_{lt\Sigma} = \frac{1}{S_k} \cdot \sqrt{\sum_{i=1}^{N_{wt}} (c_i(\psi_k, v_a) \cdot S_{n,i})^2}$$

Where,

$c(\psi_k, v_a)$ has a maximum value of 1

S_n is the r

ated apparent power of one inverter

S_k is the short circuit apparent power at the PCC

N_{wt} is the number of inverters connected to the PCC

PCC is the point of common coupling of inverters that is MV bus of Artistic Solar Power substation. For minimum short circuit case we have assumed that the output of Artistic Solar Power Plant is reduced as low as 20% of its rated capacity. Therefore for two inverter group we have calculated as follows;

$$S_n = 2.77 \text{ MVA}$$

$$N_{WT} = 4$$

$$S_k \text{ for MV bus} = 460 \text{ MVA}$$

The value of $c(\psi_k)$ at 10 minute average speed (v_a) is supplied by the manufacturer after filed measurements of $P_{st, fic}$ for different operating conditions using the following formula.

$$c(\psi_k) = P_{st, fic} \cdot \frac{S_{k, fic}}{S_n}$$

Where,

S_n is the rated apparent power of one inverter

$S_{k, fic}$ is the short circuit apparent power of the fictitious grid

The value of $c(\psi_k)$ may not be greater than 1, therefore for the present analysis we may assume it as 1 for the worst case.

Putting this data in the above Equation, we find

$$P_{st\Sigma} = P_{lt\Sigma} = 0.012043 = 1.2043\%$$

Whereas the maximum acceptable value is 4%. Therefore the value is much less than the maximum permissible level and the inverters at Artistic Solar PP would not cause any flicker problem during steady state operation even in the weakest system conditions of minimum short circuit level.

The values evaluated above are less than the values recommended in the references of above standards.

8.2. Voltage Unbalance

8.2.1. Voltage Step-Change

The voltage step change would occur when an inverter will be energized, assuming just one inverter in the collector for the minimum No. of units in the collector being energized.

The limit on the voltage change is based on the impedance of the circuit between the point of connection and the MV transformer bus bar together with the apparent power of the inverters. The following equation needs to be satisfied [2];

$$\Delta V = \sum S_{WKA} [(1/S_{KE}) - (1/S_{KSS})] \leq 1/33 \text{ or } 3 \%$$

Where

S_{WKA} = MVA rating of the inverter

S_{KE} = Short circuit MVA at connection point

S_{KSS} = Short circuit MVA at MV bus of the solar plant substation

For the minimum short circuit case, we have calculated minimum fault levels in MVA as shown in Exhibit 5.2.2

S_{WKA} = 2.77 MVA for the equivalent inverter of a collector group for the minimum case

S_{KE} for one inverter in collector group = 380 MVA (Exhibit 5.2.2)

$S_{KSS} = 450 \text{ MVA}$ (Exhibit 5.2.2)

Substituting these values we get

$$\Delta V = 0.00113 = 0.113\%$$

Which is much less than the limit of 3%

8.2.2. Voltage Variation

The operation of a Solar PV unit is acceptable if it is verified that the system complies with the standards IEC 61000-3-3 or IEC 61000-3-11. If this proof is not available, the variations of voltage caused by hooking up and turning off are acceptable, if the values in the following table are not exceeded at the PCC.

Voltage	Max. Voltage Variation	Max. Frequency: once in
Low Voltage	3%	5 Minutes
Medium Voltage	2%	1.5 Minutes

If there are only few operating cycles, for example one per day, the DNO may allow a higher variation of voltage. The voltage variation can be estimated via:

$$\Delta u_a = k_{i_{\max}} \cdot \frac{S_{rE}}{S_{kV}}$$

$k_{i_{\max}}$ - Maximum inrush current in relation to the nominal current

S_{kV} - Short-circuit power at the PCC

S_{rE} - Nominal apparent power of the Solar PV unit that is to be connected

This calculation gives an upper assessment and is basically a safe margin.

For Solar Power plants $k_{i_{\max}}$ can be assumed to be 1. With this

$$S_{kV} = 450 \text{ MVA}$$

$$S_{rE} = 2.5 \text{ MVA}$$

$$\Delta u_a = 0.006578 = 0.6578\%$$

Which is much less than the maximum value of 3%.

9. Conclusions

- ❖ The Draft Report of 50 MW Solar Power Plant by Artistic Solar Energy (Pvt.) Ltd. at Rohri, Sindh, referred to as Artistic Solar PP, is submitted herewith. The maximum net AC output of this plant would be 42.5 MW.
- ❖ The latest generation, transmission plan and load forecast of NTDC has been used for the study, attached in Appendix – A.
- ❖ The study objective, approach and methodology have been described and the plant's data received from the Client validated.
- ❖ The nearest grid facilities are the 132 kV substations of Nara-C1 and Rohri. Narac-C1 is 8km from the site of Artistic Solar PP.
- ❖ Due to the location of Artistic Solar PP, the most feasible interconnection scheme would be direct double circuit from Nara-C1. The looping distance is 8 km and Lynx conductor will be used. The upcoming chapters discuss in detail the location and interconnection of the Artistic Solar PP. A few approximate sketches are shown in Appendix-B.
- ❖ In view of planned COD of Artistic Solar PP in December 2020, the above proposed interconnection scheme has been assessed for steady state conditions through detailed load flow studies, short circuit analysis and stability criterion for Winter 2021 for maximum thermal power dispatches in the grid.
- ❖ Detailed load flow studies have also been carried out for peak and off-peak load conditions of Summer 2021, and for future scenario of Summer 2023 for the proposed scheme under normal and N-1 contingency conditions to meet the reliability criteria.
- ❖ Steady state analysis by load flow for all the scenarios described above reveals that the proposed scheme is adequate to evacuate the maximum power of 42.5 MW of the plant under normal and contingency conditions.
- ❖ The short circuit levels of the Artistic Solar PP 132 kV are 5.58 kA and 5.92 kA for 3-phase and 1-phase faults, respectively, in the year 2021. Therefore, industry standard switchgear of a short circuit rating of 40 kA would be sufficient for installation at 132 kV switchyard of Artistic Solar PP, as the maximum short circuit levels for the year 2023 were also found to be within this range, taking care of any future generation additions and system reinforcements in its electrical vicinity and also fulfilling the NEPRA Grid Code requirements specified for 132 kV switchgears. There are no violations of the power rating of the equipment in the vicinity of Artistic Solar PP in the event of fault conditions.

- ❖ The dynamic stability analysis of proposed scheme of interconnection has been carried out. The stability has been tested for the worst cases, i.e. three phase fault right on the 132 kV bus bar of Artistic Solar PP substation followed by trip of a 132 kV single circuit from Artistic Solar PP to Rohri-New has been performed for fault clearing of 5 cycles (100 ms), as understood to be the normal fault clearing time of 132 kV protection system. Also the extreme worst case of stuck breaker (breaker failure) has been studied where the fault clearing time is assumed 9 cycles i.e. 180 ms for single phase fault. The stability of the system for far end fault of 3-phase occurring at Rohri-New 132 kV bus bar has also been checked. The system is stable for all the tested fault conditions.

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ASEPL/OUT/GOS/010-2019

Date: 23rd May, 2019

The Secretary,
Energy Department,
Government of Sindh,
3rd Floor, State Life Building,
Opp. CM House,
Dr. Ziauddin Ahmed Road,
Karachi.

Subject: Submission of Feasibility Study Report for "Construction & Operation of 50 MW Solar PV Power Project, Artistic Solar Energy Pvt. Limited, Located at Saleh Pat, District-Sukkur, Sindh.

Dear Sir,

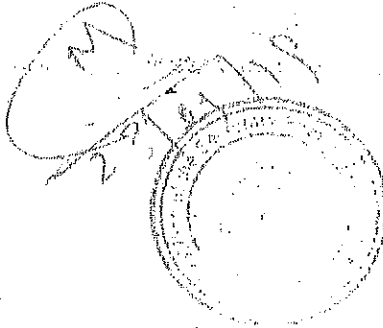
This is with reference to the LOI no. DAE/solar/93/2015/67 dated 13th April, 2016 to set up 50 MW solar power generation project in Sukkur district. As required under LOI we are pleased to submit herewith feasibility study along with all the required annexures.

We hereby request you to kindly process the enclosed feasibility study document. In case you have any comments with regards to study, kindly apprise us so that resolution is made timely.

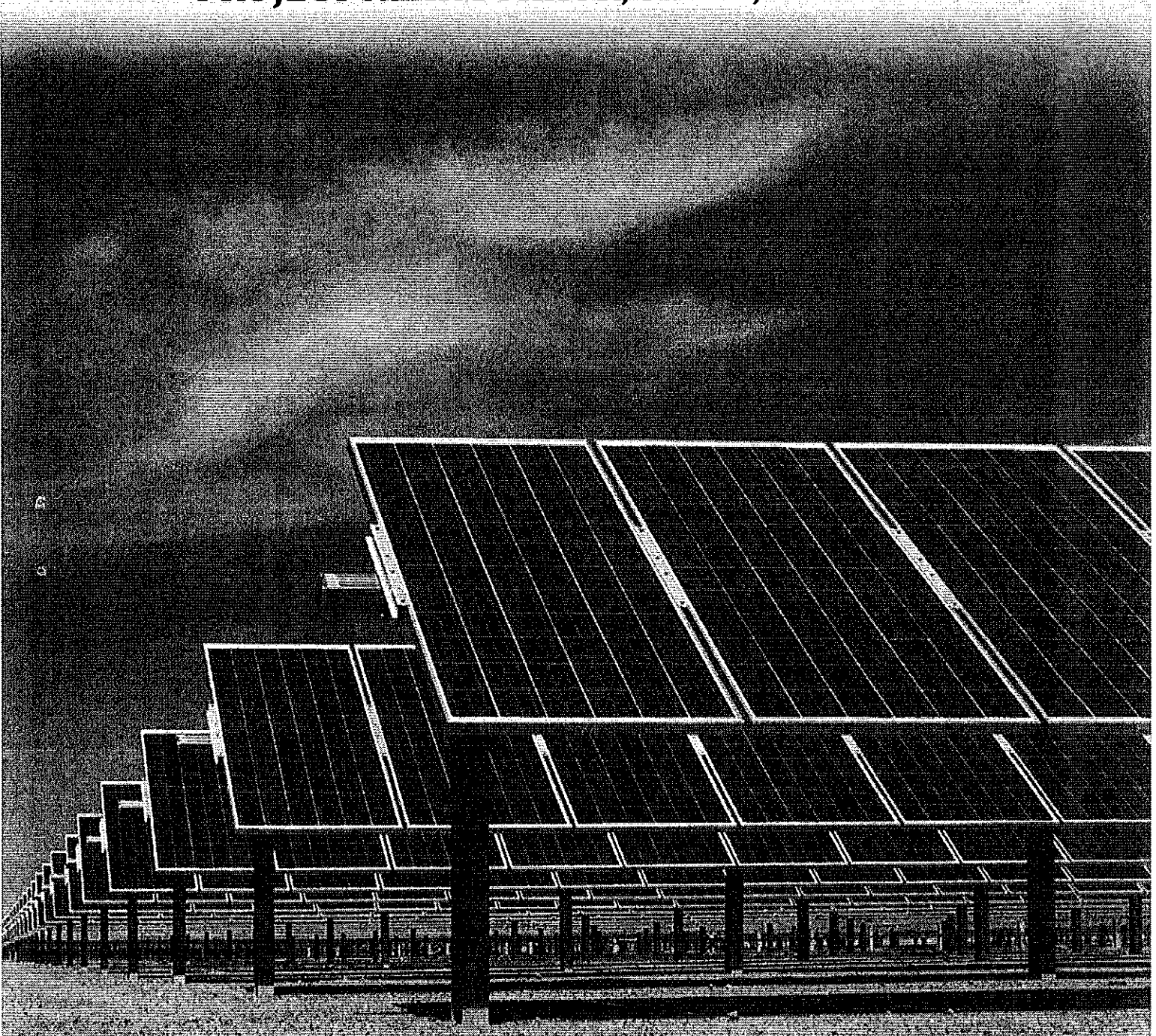
Yours Sincerely,
For & On Behalf of
Artistic Solar Energy (Pvt.) Limited



.....
Rafique Khanani
CFO/ Company Secretary



FEASIBILITY STUDY REPORT OF 50 MW SOLAR PV POWER PROJECT NEAR SUKKUR, SINDH, PAKISTAN



Project Company

Artistic Solar Energy Private Limited

Project Consultants

Renewable Resources Private Limited

APPROVAL SHEET

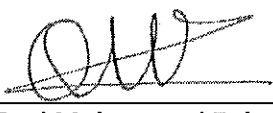
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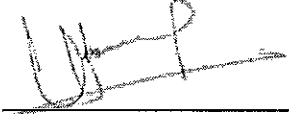
CLASSIFICATION : **CONTROLLED**

SYNOPSIS

This document is a feasibility study report of the 50MW Solar PV Power Project being developed by Artistic Solar Energy Pvt Ltd. It contains the hardware specifications, energy yield estimates, electrical interface, civil works design and the project cost. It also includes the initial environmental examination and other site-specific information. This report has been prepared by Renewable Resources (Pvt.) Ltd.

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Project near Sukkur, Sindh, Pakistan

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LIST OF ABBREVIATIONS

AEDB	Alternative Energy Development Board
ADB	Asian Development Bank
AREs	Alternative and Renewable Energies
C.R	Core Recovery
CDM	Clean Development Mechanism
CERs	Certified Emission Reductions
CFCs	Chlorofluoro Carbons
CH ₄	Methane
CO ₂	Carbon dioxide
COD	Commercial Operation Date
CoP	Conference of the Parties
CPPA-GL	Central Power Purchasing Agency Guarantee Limited
CT	Continuous Transmission
CVT	Continuously Variable Transmission
DAE GoS	Directorate of Alternative Energy, Government of Sindh
DC	Direct Current
DISCOs	Distribution Companies
EE	Energy Efficiency
EMP	Environment Management Plan
EPA	Energy Purchase Agreement
EPC	Engineering Procurement Construction
EU	European Union
GoP	Government of Pakistan
GSU	General Step Up (transformers)
GRM	Grievance Redress Mechanism
GW	Giga Watt
HESCO	Hyderabad Electric Supply Corporation
HFCs	Hydro fluorocarbons
HV	High Voltage
IEE	Initial Environmental Examination
IPPs	Independent Power Producers
IRR	Internal Rate of Return
JI	Joint Implementation

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KESC	Karachi Electric Supply Company
km	Kilometer
kV	Kilovolt
KIBOR	Karachi Inter Bank Offer Rate
LIBOR	London Inter Bank Offer Rate
LOI	Letter of Intent
LOS	Letter of Support
MVA	Mega Volt-Ampere
MV	Medium Voltage
MW	Megawatt
N ₂ O	Nitrous Oxide
NEPRA	National Electricity Power Regulatory Authority
NPMV	Non Project Missed Volume
NREL	National Renewable Energy Laboratories
NTDC	National Transmission and Despatch Company
O & M	Operation & Management
OECD	Organization for Economic Cooperation and Development
OHL	Overhead Lines
OJT	On Job Trainings
PPI	Power Planners International
POE	Panel of Experts
PFCs	Per fluorocarbons
RE	Renewable Energy
RE2	Renewable Resources (Pvt.) Ltd
RQD	Rock Quality Designation
RMU	Ring Main Units
SF ₆	Sulfur Hexafluoride
SPT	Standard Penetration Test
VT	Voltage Transformer
WAPDA	Water And Power Development Authority

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ACKNOWLEDGEMENTS

The management of Artistic Solar Energy Pvt Ltd (ASEPL) is thankful to the Ministry of Energy and the dedicated team of Energy Department Government of Sindh (EDGoS) for their generous support at all stages of project development and looks forward to their continued support in the future.

The management of ASEPL also looks forward to the cooperation of Government of Sindh and other Government departments (NEPRA, NTDC, DISCOs) which they have 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 an informed decision regarding the implementation and execution of this project.

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1 EXECUTIVE SUMMARY

Located on the western stretch of the South Asian Continent, The Islamic Republic of Pakistan is largely under the influence of a tropical desert climate. The relative shortage of conventional energy resources in Pakistan and the hiking of fuel prices worldwide spurred the Pakistan Government to find alternative sources, including wind power and 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 at the state level called the Directorate of Alternative Energy, Sindh (DAE, Sindh) has been established to facilitate the implementation of renewable energy projects.

Artistic Solar Energy Pvt Ltd is a 50MW solar power project to be located near Sukkur and is being developed by Artistic Milliners. The group already has a wind power project installed in Jhimpir, 50 MW Artistic Energy Pvt Ltd, and is concurrently developing other power projects. The sponsor plans to install a Solar PV Power Project 50 MW capacity near Sukkur. In this regard, the sponsor has an LOI from EDGoS.

In this regard, the sponsor has been allocated land near Sukkur; having an area of approximately 250 acres and the site assessment of this area has been carried out.

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1.1 PROJECT OVERVIEW AND SITE

The Project is to be near Sukkur, Sindh which has been identified as a potential area for the development of the solar power project. The overview of the project site is shown in below figure. Sukkur is towards North East of Karachi, Pakistan's commercial hub and main coastal/port city. The National Highways (N5) and (N55) and Motorway (M9) are the major connecting roads to the Project site, having total road distance of approximately 500 km from Port Qasim.



Figure 1-1: Project Site overview

The Project Site has a relatively flat terrain with sparse vegetation, consisting of small shrubby bushes. A closer view of the Project site is shown in Figure 1-2 below.

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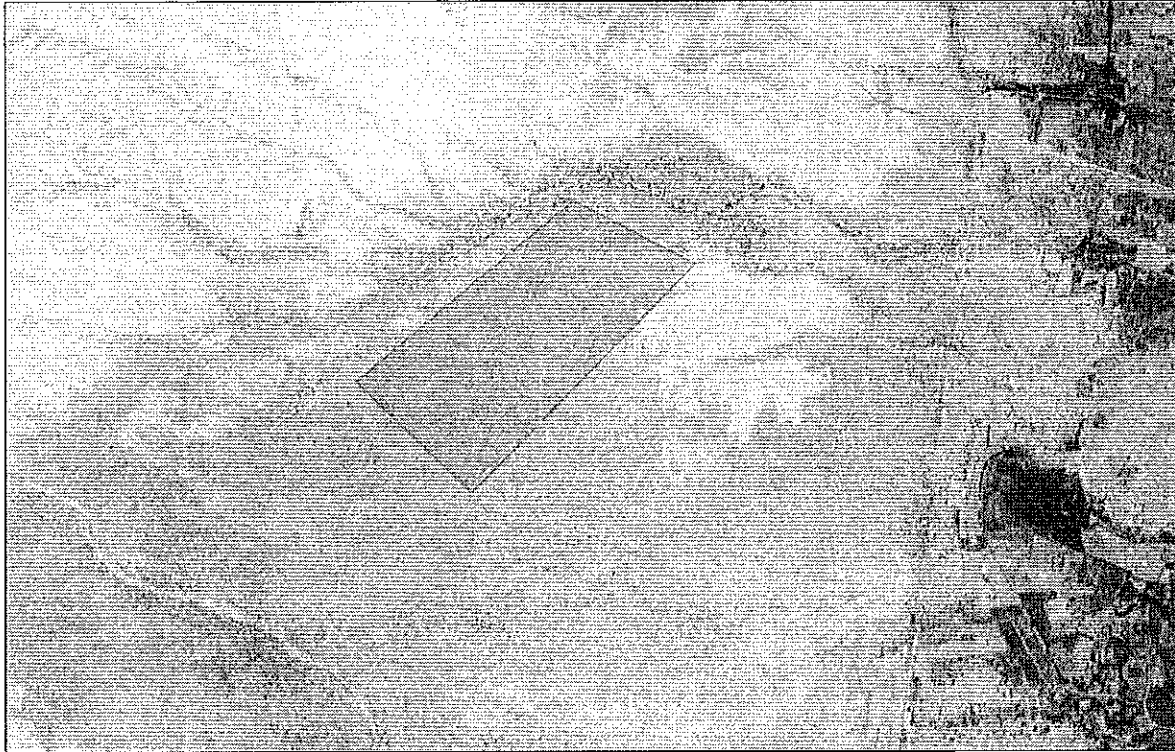


Figure 1-2: Satellite map of Project site (depicted in red)

Further details of Site are given in Section 07 and the Site Transportation and Access Study are attached as Annex II.

1.1.1 Project Size

The Project site consists of 250 acres of land and the Project shall have an installed capacity of 50MW.

1.1.2 Project Status and Calendar

From here onwards, the Sponsors shall pursue the approval of feasibility and other project development tasks from the concerned stakeholders. In parallel, the Sponsors shall also pursue the determination of tariff and signing of EPA/IA. The project calendar is given on the next page:

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Table 1-1: Project Planned Milestones

Activity / Milestone	2018				2019				2020			
	3 rd QTR	4 th QTR	1 st QTR	2 nd QTR	3 rd QTR	4 th QTR	1 st QTR	2 nd QTR	3 rd QTR	4 th QTR	1 st QTR	2 nd QTR
Preparation of Feasibility												
Submission of Feasibility Study												
Approval of Feasibility Study												
Generation License												
Tariff Application												
Signing of EPA												
Signing of IA												
Financial Close												
Project Construction												
Start of Operations												

The project construction shall take approximately 10 months from the date of planning till the COD.

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Table 1-2: Project Construction Scheduling

Activity / Month	1	2	3	4	5	6	7	8	9	10
Engineering and Mobilization										
Construction of Temporary Establishment										
Mech/Civil Works of PV panels and Substation										
Construction of Substation										
Supply of PV Panels										
Cables and Interconnection										
Testing and Commissioning of EBOP										
Testing and Commissioning of PV Panels										
EPA Tests and Reliability Run Test										

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1.1.3 Geological Conditions

The Project area has a wide range of soil types due to its diverse land forms, which include sandy, deltaic, alluvial, gravel, coastal, and mountainous.

The information related to geological conditions is given in Section 11. The detailed Geotechnical Investigation Report is attached as an annex to this report.

1.1.4 Summary of Equipment

The details of the equipment used for the sake of resource assessments consist of various PV panels *inter alia* Yingli Solar, Jinko, Trina, Sunpower and inverters by SMA, Sungrow and TBEA Xian. However, the final choice of equipment and manufacturer will be defined with the final execution design.

1.1.5 Electrical Grid Interconnection

Pakistan has a vast transmission and distribution system ranging from Northern areas to the southern most regions of Balochistan and Sindh. National Transmission and Dispatch Company (NTDC) is the main authority which manages all the transmission facilities and the National Grid for voltages above 220 kV.

The Project shall evacuate at voltage level of 132kV or 220kV. The nearest grid stations are Nara grid station and Rorhi Grid Station operated by NTDC. Grid interconnection assessment shall specify the interconnection mechanism in detail. More details on electrical configuration can be found in Section 11.

1.1.6 Design of Mechanical Works

For the mechanical works, the project will take use of the most advanced technological approach available for optimized design. The mechanical design shall consider site specific conditions and information including but not limited to corrosion, wind loads and gusts. The sub-structures will be procured through suppliers with prequalified technology and design.

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1.1.7 Design of Civil Works

The civil works will include but not be limited to:

- Cleaning and preparations of the site including cutting of trees.
- Erecting and installing the laydown area according to requirements in the Design Basis. The area must be cleared, leveled, compacted/surfaced and fenced.
- Installation of water supply line to the control building using the borehole as the preferred source. Provision should also be made for storage of drinking water.
- Construction / pre-fabrication of the control building including foundations, electricity supply, air-conditioning, water and sewage tank.
- Make provision for (preferably borehole) water supply during construction as well as operations.
- Excavating and backfilling of trenches as per specification, relevant drawings, norms and regulations.
- Foundations of the containerized inverter/transformer solution.
- Internal roads according to the preliminary design drawings and specifications.
- Access road according to preliminary design drawings.
- Preparing the ground for works.
- Surveying of the area including: fencing, significant points of the substructure, internal roads, and trenches.
- Installing drainage and storm water management systems as per design.

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

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1.1.8 Construction Management

Information related to the construction management is given in Section 14.

1.1.9 Environmental Management

Information related to the environmental management works is given in Section 15.

A separate environment study has been carried out; The Initial Environmental Examination (IEE) report is attached as an annex to this report.

There are no significant hazards. The minor adjustments required during construction phase have been addressed and mitigation plan provided.

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1.1.10 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 safety and health supervision department will be established on the project, 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. There will be safety personnel in the production section, and a part-time worker for the routine safety and health work.

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 provide sound meter and other appropriate inspection equipment, as well as necessary public education service for production safety.

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. The Safety Regulation of the project will also be carefully observed to minimize accidents.

1.1.11 CDM Aspect

The Project is a power generation project with renewable resource and zero emission. When put into operation, the project can provide power supply to the southern 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. It can deliver substantial environmental and social benefits. It is also consistent with the spirit of the Kyoto Protocol and qualifies for the application of CDM projects.

The Project Company intends to develop a CDM project according to the provisions of the prevailing Policy.

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1.2 LIST OF ANNEXURES

ANNEX – I: Pakistan Energy Profile and Industry Stats
ANNEX – II: Transportation and Access Study Report
ANNEX – III: Energy Yield Estimation
ANNEX – IV: Geo Technical Investigation Report
ANNEX – V: Topographic Study
ANNEX – VI: Initial Environmental Examination (IEE) Report
ANNEX – VII: Grid Interconnection Study

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1.3 PROJECT TEAM

1.3.1 Project Company

Artistic Milliners, the main sponsor of the Project, is an established developer in the energy market. The Sponsor has already setup a wind power project in to operation, Artistic Energy Pvt Ltd and is developing other power projects simultaneously.

A special purpose company has been incorporated by the Sponsor; Artistic Solar Energy Pvt Ltd in accordance with the laws and policies of Pakistan for development, construction and operation & maintenance of the Project as an independent power producer.

1.3.2 Renewable Resources (Pvt.) Ltd – Project Consultant

Renewable Resources (RE2) is the professional technical advisor for the Project. RE2 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.

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.

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2 COUNTRY AND INDUSTRY OVERVIEW

The detailed stats and situation of energy in Pakistan, specific information and prospects of wind, solar and trends in power sector are given in Annex I.

Pakistan's energy requirements are met through Oil, Gas, Hydro Power, Nuclear Power and Coal. While Hydro and Nuclear are used only for electricity generation with reference to energy, Oil and Gas are used to supply other areas also. The share of each source in primary energy supplies for 2016-17 was: oil: 34.4%, gas: 37.9%, LNG import: 5.6%, LPG: 1.3%, coal: 8.1%, hydro-electricity: 9.7%, nuclear electricity: 2.1%, renewable electricity: 0.8% and imported electricity: 0.1%. While the annual growth rate of final energy consumption was increased considerably by 7.59% during 2016-17.

Oil production increased from 86,481 barrels per day in 2015-16 to 88,409 barrels per day in 2015-16 (1.95%) while natural gas production moved down slightly from 4,048 MMCFD in 2015-16 to 4,032 MMCFD in 2016-17. Decreased activity was seen in the upstream sector where 48 exploratory and 40 development/appraisal wells were drilled.

Import of petroleum products was increased in 2016-2017. The import of the various petroleum products from HOBC to motor spirit etc. increased from 13,549,740 tonnes to 15,145,270 tonnes, mainly catering the needs of transport and power sectors; the overall import of petroleum products was increased by 11.78% as compared to the last year. The refining capacity increased slightly from 18.79 million tons/annum in 2015-16 to 19.37 million tons/annum in 2016-17. The total oil import bill increased significantly from US\$ 7.41 billion in 2015-16 to US\$ 9.08 billion in 2016-17.

During 2016-17, coal production stood at 0.56% while import of coal being much higher was at 43.71% which resulted in overall increase in coal consumption by 23.92% over the last year.

In the power sector, hydel generation contributed to 26.1% of the generation mix. This year 2,668 GWh of electricity was generated from renewable sources (solar, wind and bagasse).

During 2016-17, 123,118 GWh electricity was generated as against 111,300 GWh in 2015-16, which included 66.0% thermal, 26.1% hydel, 5.7% nuclear and 2.2% renewables. However, the consumption increased and reached 95,530 GWh from 90,431 GWh last year. Major increase in consumption was in other government sector (218.1%) followed by domestic (9.5%), commercial sector (9.4%), agriculture (8.2%), bulk supplies (7.5%) and street lights (5.4%) during 2016-17. As of 30th June 2017, the total installed capacity was increased to 29,994 MW from 25,889 MW in 2015-16.

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3 REGULATORY REGIME

Power sector Pakistan 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:

- ❖ Ministry of Energy
- ❖ National Electric Power Regulatory Authority (NEPRA)
- ❖ National Transmission and Despatch Company (NTDC)
- ❖ Central Power Purchasing Agency Guarantee Ltd. (CPPA-GL)
- ❖ Directorate of Alternative Energy, Sindh (DAE-GoS)
- ❖ Alternative Energy Development Board (AEDB)

3.1 MINISTRY OF ENERGY

The Federal Ministry of Energy is the GoPs 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.

3.3 NATIONAL TRANSMISSION AND DESPATCH COMPANY (NTDC)

National Transmission & Despatch Company (NTDC) Limited was incorporated on 3rd 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). NTDC operates and maintains fourteen 500 KV and thirty-eight 220 KV Grid Stations, 5110.48 km of 500 KV transmission line and 9686.32 km of 220 KV transmission line in Pakistan. Main functions of the company include:

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- (i) **System Operator:** For secure, safe and reliable operation, control and dispatch of generation facilities.
- (ii) **Transmission Network Operator:** For Operation & Maintenance, Planning, Design and expansion of the 500 kV and 220 kV transmission network.
- (iii) **Contract Registrar and Power Exchange Administrator (CRPEA):** As CRPEA, to record and monitor contracts relating to bilateral trading system.

3.4 SUKKUR ELECTRIC POWER COMPANY

Among the DISCOs that fall under NTDC, the Project falls under the jurisdiction of Sukkur Electric Power Company (SEPCO).

The distribution company SEPCO (Sukkur Electric Power Company) has been formed by bifurcating HESCO (modified) so that the areas of operation that were entirely under the jurisdiction of HESCO have now been divided between the two DISCOs. SEPCO is a newly created company and started functioning with effect from August 2010. HESCO has surrendered its historical limits which now fall under the jurisdiction of SEPCO. The new company has been incorporated under the companies' ordinance with the S.E.C.P.

The areas that are now under the distribution system of the SEPCO consist of three operation circles namely:

i) SUKKUR ii) LARKANA iii) DADU

The new distribution system of the HESCO (modified) also retains three operation circles, namely:

i) HYDERABAD –I ii) HYDERABAD –II iii) NAWABSHAH

3.5 CENTRAL POWER PURCHASING AGENCY GUARANTEE LIMITED (CPPA-GL)

CPPA-GL is an agency to purchase power from IPPs. Since June 2015, CPPA has assumed the business of National Transmission and Dispatch Company (the "NTDC") pertaining to the market operations and presently functioning as the Market Operator in accordance with Rule-5 of the NEPRA Market Operator (Registration, Standards and Procedure) Rules, 2015 (the "Market Rules").

3.6 DEPARTMENT OF ALTERNATE ENERGY GOVT. OF SINDH (DAE GoS)

Energy Department, Government of Sindh is to solve matters relating to development and generation of power plants that are put up in Sindh. It also determines of rates of supply to

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consumers in bulk and otherwise and may prescribe tariffs within the province except where entrusted to WAPDA.

3.7 ALTERNATIVE ENERGY DEVELOPMENT BOARD (AEDB)

Alternative Energy Development Board (AEDB) is the sole representing agency of the Federal Government that was established in May 2003 with the main objective to facilitate, promote and encourage development of Renewable Energy in Pakistan and with a mission to introduce Alternative and Renewable Energies (AREs) at an accelerated rate as to achieve sustainable economic growth. The administrative control of AEDB was transferred to the then called Ministry of Water and Power (now Ministry of Energy) in 2006. The Government of Pakistan has inter alia mandated AEDB to implement policies, programs and projects through private sector in the field of ARE and Undertake ARE projects on commercial scale (AEDB Act 2010). The Federal Government established AEDB as a statutory organization by announcing and promulgating the AEDB Act in May 2010.

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4 CARBON CREDITS

Kyoto Protocol, in full Kyoto Protocol to the United Nations Framework Convention on Climate Change, international treaty, named for the Japanese city in which it was adopted in December 1997, that aimed to reduce the emission of gases that contribute to global warming. In force since 2005, the protocol called for reducing the emission of six greenhouse gases in 41 countries plus the European Union to 5.2 percent below 1990 levels during the “commitment period” 2008–12. It was widely hailed as the most significant environmental treaty ever negotiated, though some critics questioned its effectiveness.

Backgrounds and Provisions

The Kyoto Protocol was adopted as the first addition to the United Nations Framework Convention on Climate Change (UNFCCC), an international treaty that committed its signatories to develop national programs to reduce their emissions of greenhouse gases. Greenhouse gases, such as carbon dioxide (CO₂), methane (CH₄), nitrous oxide (N₂O), perfluorocarbons (PFCs), hydrofluorocarbons (HFCs), and sulfur hexafluoride (SF₆), affect the energy balance of the global atmosphere in ways expected to lead to an overall increase in global average temperature, known as global warming (see also greenhouse effect). According to the Intergovernmental Panel on Climate Change, established by the United Nations Environment Programme and the World Meteorological Organization in 1988, the long-term effects of global warming would include a general rise in sea level around the world, resulting in the inundation of low-lying coastal areas and the possible disappearance of some island states; the melting of glaciers, sea ice, and Arctic permafrost; an increase in the number of extreme climate-related events, such as floods and droughts, and changes in their distribution; and an increased risk of extinction for 20 to 30 percent of all plant and animal species. The Kyoto Protocol committed most of the Annex I signatories to the UNFCCC (consisting of members of the Organization for Economic Co-operation and Development and several countries with “economies in transition”) to mandatory emission-reduction targets, which varied depending on the unique circumstances of each country. Other signatories to the UNFCCC and the protocol, consisting mostly of developing countries, were not required to restrict their emissions. The protocol entered into force in February 2005, 90 days after being ratified by at least 55 Annex I signatories that together accounted for at least 55 percent of total carbon dioxide emissions in 1990.

The protocol provided several means for countries to reach their targets. One approach was to make use of natural processes, called “sinks,” that remove greenhouse gases from the atmosphere. The planting of trees, which take up carbon dioxide from the air, would be an example. Another approach was the international program called the Clean Development Mechanism (CDM), which encouraged developed countries to invest in technology and infrastructure in less-developed countries, where there were often significant opportunities to reduce emissions. Under the CDM, the investing country could claim the effective reduction in

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emissions as a credit toward meeting its obligations under the protocol. An example would be an investment in a clean-burning natural gas power plant to replace a proposed coal-fired plant. A third approach was emissions trading, which allowed participating countries to buy and sell emissions rights and thereby placed an economic value on greenhouse gas emissions. European countries initiated an emissions-trading market as a mechanism to work toward meeting their commitments under the Kyoto Protocol. Countries that failed to meet their emissions targets would be required to make up the difference between their targeted and actual emissions, plus a penalty amount of 30 percent, in the subsequent commitment period, beginning in 2012; they would also be prevented from engaging in emissions trading until they were judged to be in compliance with the protocol. The emission targets for commitment periods after 2012 were to be established in future protocols.

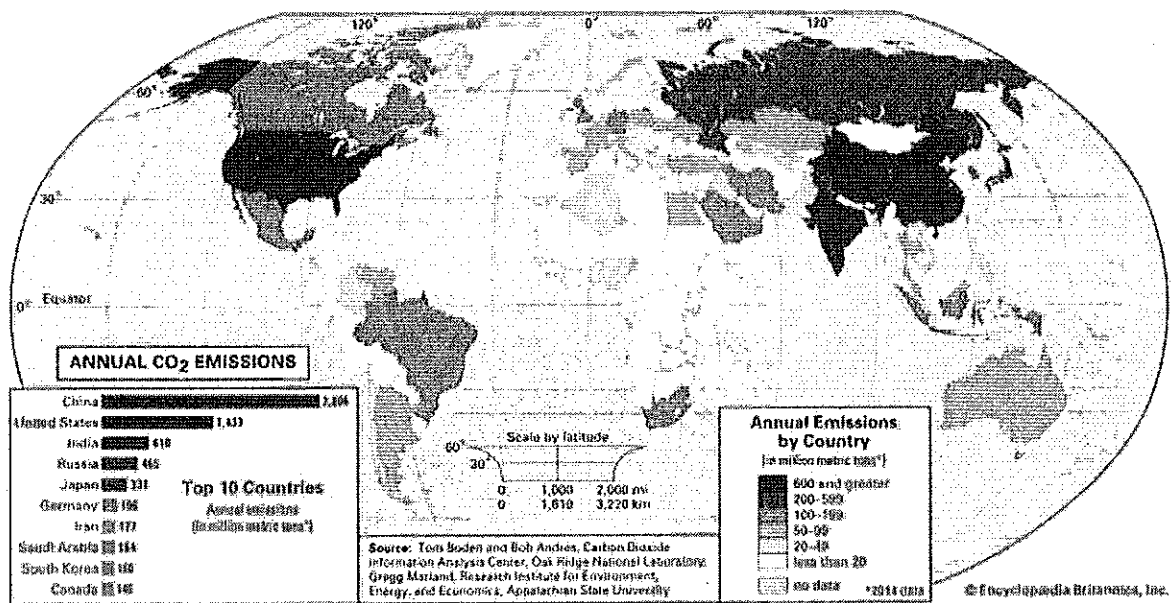


Figure 4-1: Map of annual carbon carbon dioxide emissions by country in 2014 (Encyclopædia Britannica, Inc)

Challenges

Although the Kyoto Protocol represented a landmark diplomatic accomplishment, its success was far from assured. Indeed, reports issued in the first two years after the treaty took effect indicated that most participants would fail to meet their emission targets. Even if the targets were met, however, the ultimate benefit to the environment would not be significant, according to some critics, since China, the world's leading emitter of greenhouse gases, and the United States, the world's second largest emitter, were not bound by the protocol (China because of its status as a developing country and the United States because it had not ratified the protocol). Other critics claimed that the emission reductions called for in the protocol were too modest to

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make a detectable difference in global temperatures in the subsequent several decades, even if fully achieved with U.S. participation. Meanwhile, some developing countries argued that improving adaptation to climate variability and change was just as important as reducing greenhouse gas emissions.

Treaty Extension and Replacement

The Kyoto Protocol, 2nd commitment period (2013-2020) bridges the gap between the end of the 1st Kyoto period and start of the new global agreement (Paris Agreement) in 2020. In this period, the EU, some other European countries and Australia have agreed to make further emissions cuts. For their part, the EU countries (together with Iceland) have agreed to meet – jointly – a 20% reduction target compared to 1990 (in line with the EU's own target of 20% by 2020). They are on track to do so.

At the 18th Conference of the Parties (COP18), held in Doha, Qatar, in 2012, delegates agreed to extend the Kyoto Protocol until 2020. They also reaffirmed their pledge from COP17, which had been held in Durban, South Africa, in 2011, to create a new, comprehensive, legally binding climate treaty by 2015 that would require greenhouse-gas-producing countries—including major carbon emitters not abiding by the Kyoto Protocol (such as China, India, and the United States)—to limit and reduce their emissions of carbon dioxide and other greenhouse gases. The new treaty, planned for implementation in 2020, would fully replace the Kyoto Protocol.

After a series of conferences mired in disagreements, delegates at the COP21, held in Paris, France, in 2015, signed a global but nonbinding agreement to limit the increase of the world's average temperature to no more than 2 °C (3.6 °F) above preindustrial levels while at the same time striving to keep this increase to 1.5 °C (2.7 °F) above preindustrial levels. The landmark accord, signed by all 196 signatories of the UNFCCC, effectively replaced the Kyoto Protocol. It also mandated a progress review every five years and the development of a fund containing \$100 billion by 2020—which would be replenished annually—to help developing countries adopt non-greenhouse-gas-producing technologies.

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.

4.1.1 Emissions Trading

Emission trading or 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 ok to trade in emissions, but that it should not

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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.

4.1.2 Clean Development Mechanism (CDM)

Clean Development Mechanism (CDM) allows richer countries to offset their CO₂ emission against the emissions prevented when technology that cuts down on greenhouse gas emissions is deployed in poor countries.

4.1.3 Joint Implementation (JI)

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.

4.2 ROLE OF CDM IN THE PROJECT

The Project is a power generation project with renewable resource and zero emission. When put into operation, the project can provide power supply to the southern 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. It can deliver significant environmental and social benefits. 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 favorable 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.

There are mainly three steps which proponents need to undertake to develop and submit the project which has CDM component. First of all Project Idea Note (PIN) is prepared which provides the brief summary of overall project activities and its CDM component. This PIN is submitted to CDM Cell/ Designated National Authority (DNA), Ministry of Climate Change, along with the request for Letter of Intent. CDM experts conduct the preliminary evaluation of the PIN to check whether the recommended project is viable and in line with environmental criteria or not. After examining the document department decides to issue the LOI to the concerned party and ask for submission of complete Project Design Document (PDD). Once the PDD is submitted, it goes through the detailed evaluation by experts. And for every project, experts submit the evaluation report which explains the project strengths, weaknesses and assessment of claims made by proponents to the Designated National Authority (DNA) focal person. DNA focal person who also chair the session for approval of the projects, decides about the fate of the projects on the basis of experts' evaluation and overall merit.

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In next step DNA focal person gives the directive to CDM staff to call the projects for their oral presentations. For this purpose, a Host Country Approval (HCA) meeting is called in which decision about the projects is announced. A panel of field experts is also invited for on spot evaluation which submits their expert opinions regarding each project. In the light of CDM Cell internal evaluation and comments of HCA meeting panel DNA focal person decide to give the approval to projects. The approved projects received the HCA Letter after meeting. Those proponents which cannot qualify the criteria are advised to revise their projects. This is the first step of project registration for CDM and carbon trading. After this is the second stage in which projects are submitted to Designated Operational Entity (DOE) for technical evaluation. DOE is a committee which verifies claims of emission reduction production of a given CDM project.

At third stage CDM project is submitted to UNFCCC for registration and issuance of CERs. After assessing the basic documents and requirements for a project, it is decided that CERs should be granted to the proponent.

In Pakistan, alternative and renewable energy (ARE) projects have definite prospects for development as carbon offsetting initiatives. Being clean source of energy, ARE projects are best suited for CDM and can earn CERs. The Government of Pakistan (GoP) has taken up a broad spectrum of initiatives for the development of AREs in the country and seeks projects to address the CDM pertaining to sustainable development and should apply to CDM Executive Board as per the guidelines of United Nations Framework Convention on Climate Change (UNFCCC) for get CERs and earn carbon revenues.

To accelerate and streamline activities related to the REs, the Government of Pakistan has authorized Alternative Energy Development Board (AEDB) to act as a focal body of the federal government with mandate of one window facility for ARE development in the country. The GoP approved Policy for Development of Renewable Energy for Power Generation, 2006, in which it specified constitution of Joint Management Committee (JMC) for sale and management of CERs earn through renewable energy projects. The JMC comprise of power purchaser, power producer and AEDB.

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5 SOLAR & WIND INDUSTRY IN PAKISTAN

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 and using the spare land available at existing wind farms will increase the production/area ratio, as well.

The development of renewable 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 wind energy sector of Pakistan matured in the past few years and some quick pace was observed in development and construction of wind power plants between 2009 till now. Abundant wind data is available in both Jhimpir and Gharo regions. Though the construction of projects is still rapidly underway, the development process of wind power plants is moving around inconclusive circles since 2016 due to some unclear and inconsistent policy decisions being taken one after the other by the Federal Government.

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.

Moreover, the tariff of both solar and wind has become very affordable in Pakistan over the past years.

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6 PROJECT IN TERMS OF POLICY FRAMEWORK

6.1 LETTER OF INTENT (LOI)

The project is being developed under the Government of Pakistan's Policy for Development of Renewable Energy for Power Generation, 2006.

The LOI was issued by EDGoS on 13-Apr-2016. This letter entitled the Project Company to start working on the hybrid power project at official level and get support from pertinent government departments in the preparation of feasibility study for the Project. and the feasibility study was triggered right away. All pre-requisites and requirements of the feasibility study are complete as per the requirements of the LOI. In parallel, an NOC from SEPA for the Project is also being pursued by the Project company.

6.2 ACQUISITION OF LAND

The land has been allocated to the Project for the development of this power project by the Sindh Government.

6.3 FEASIBILITY STUDY

The feasibility study of the Project is being finalized in this document.

6.4 GENERATION LICENSE

Rights to produce and sell electricity in Pakistan are granted by NEPRA through "Generation License" (GL). Project Company may file for a Generation License after approval of this Feasibility study.

6.5 TARIFF

There is no upfront tariff available to solar projects at the moment. It is expected a cost-plus tariff will be applicable on the Project. For the purposes of the feasibility study, a cost-plus tariff has been assumed.

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7 PROJECT SITE

7.1 Potential of Solar PV

Solar energy has excellent potential in areas of Pakistan that receive high levels of solar radiation throughout the year. Every day 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. It has an annual mean sunshine duration of 8 to 8.5 hours (6-7hrs in cold and 10-12 hours in hot season) and these values are among the highest in the world.

An overview for the potential of solar energy in Pakistan can be obtained from the map of solar energy resource released by World Bank Group from 1999 to 2016.

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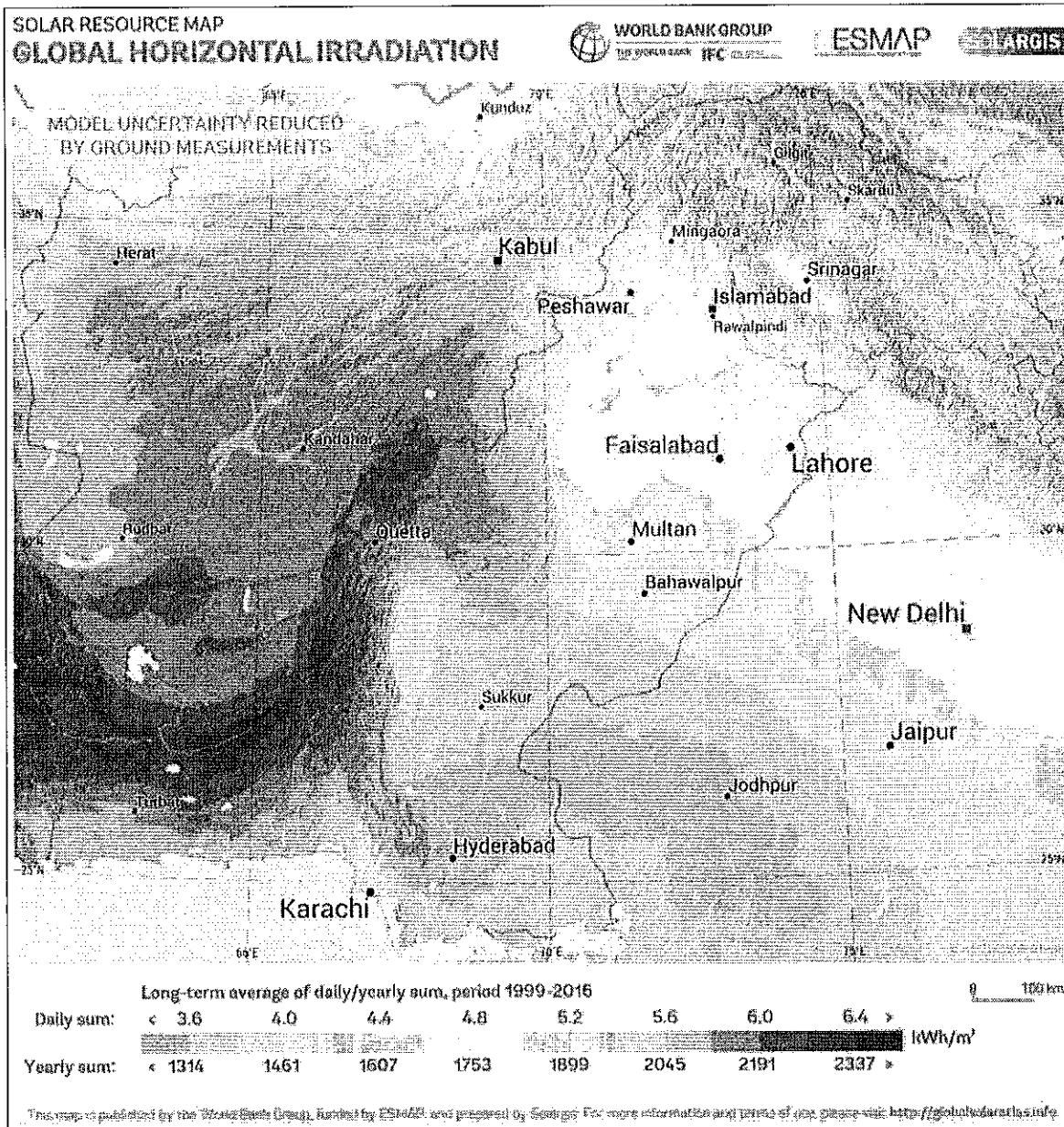


Figure 7-1 : Solar Resource Map for Pakistan

Pakistan receives about 15.5×10^{14} kWh of solar irradiance each year with most regions receiving approximately 8 to 10 sunlight hours per day. The total power generation capacity of solar

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photovoltaic power is estimated to be 1600GW per year, a figure approximately 40 times that of current power demand in the country.

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

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7.2 SITE DETAILS

The site is located in Jhimpir, Sindh which is towards the North East of Karachi as shown in **Figure 7-3** and the coordinates are listed below.

An overview of Project site allocated in is shown in **Figure 7-2**:

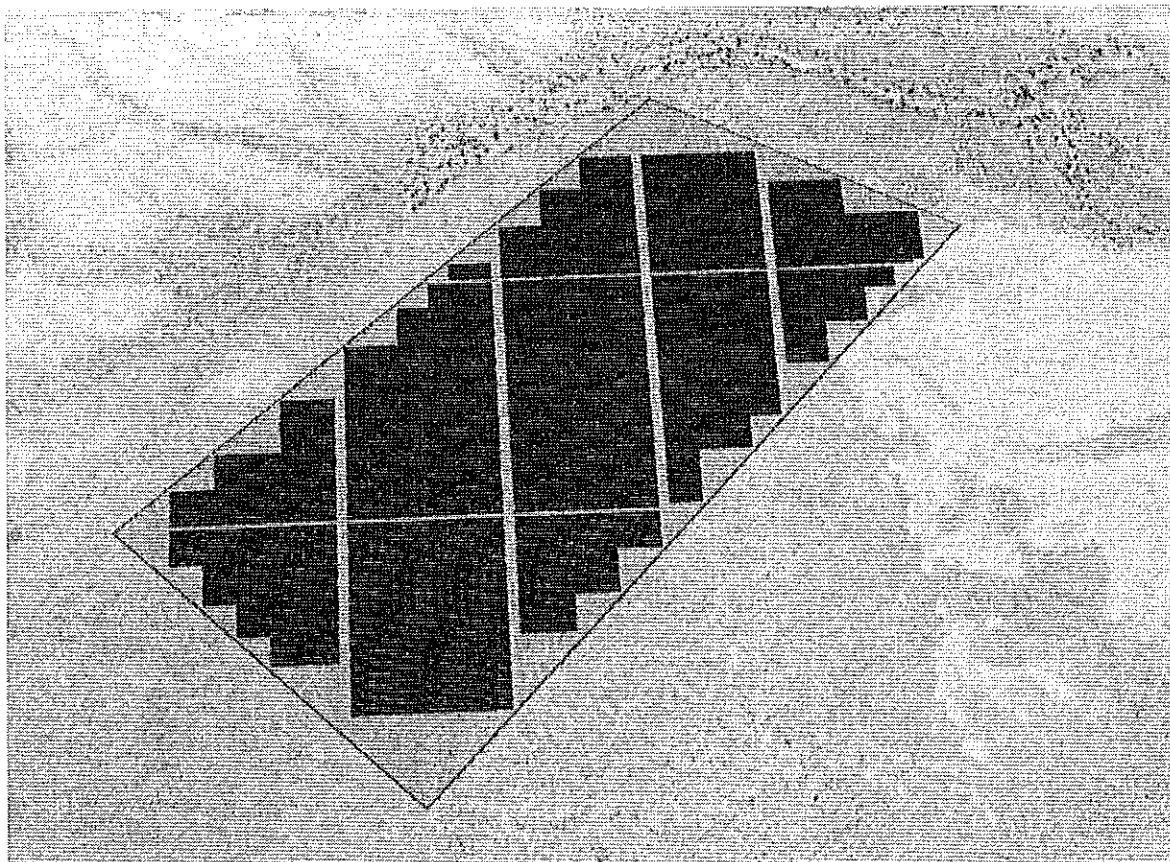


Figure 7-2: Overview of Project site

Coordinates of the land opted for the solar project;

Latitude (°N)	Longitude (°E)
27.391769	68.963281
27.381827	68.952427
27.386644	68.946786
27.394571	68.957380

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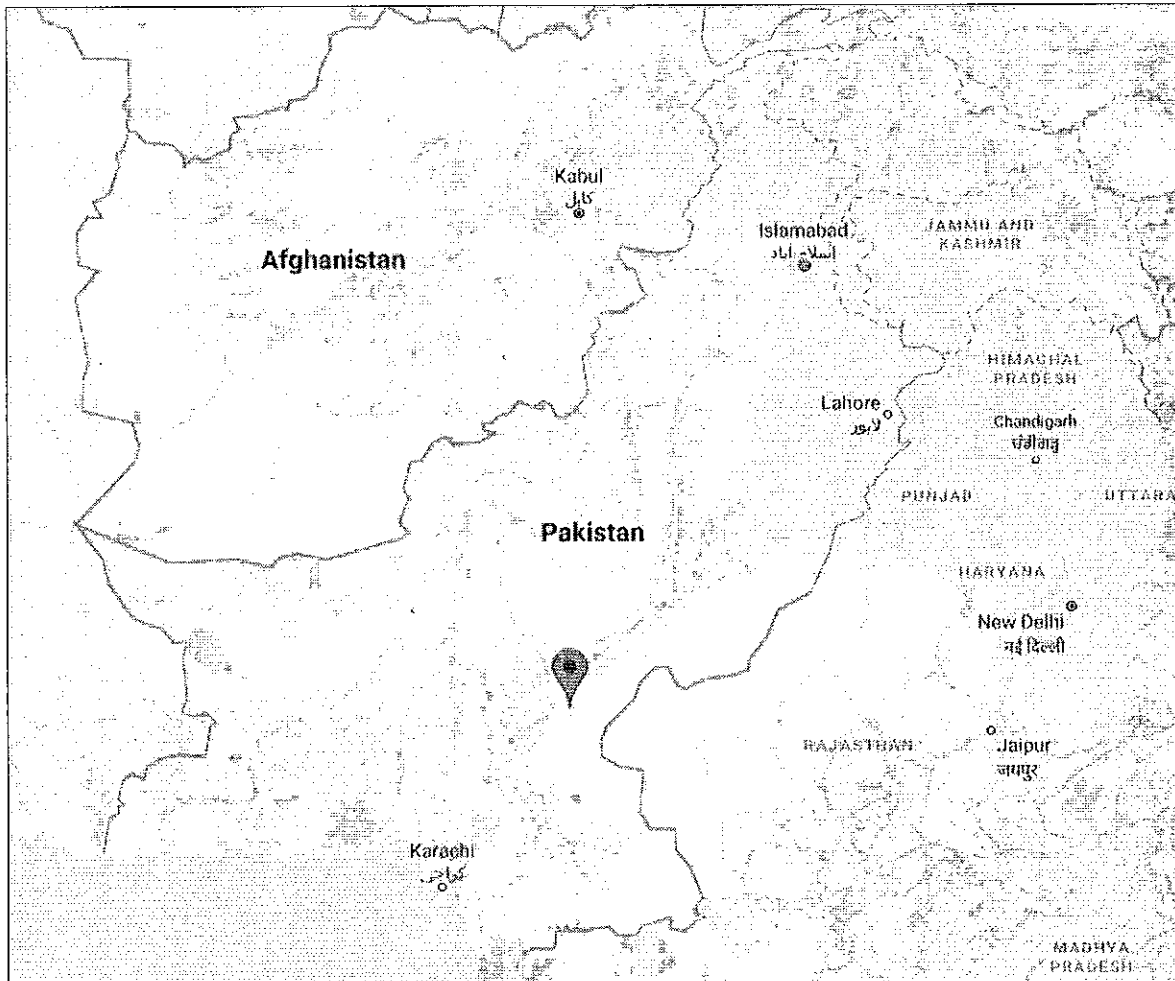


Figure 7-3: Project Location in Pakistan

The electrical network within the vicinity of Project comprises of HV (132 kV and 220 kV) lines. The distance of nearest grids station from the Project site ranges from 4 to 30 kilometers approximately. The site is relatively flat with the surroundings having same characteristics.

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7.3 TRANSPORTATION AND ACCESS NETWORK

A Transportation and Access Study has been carried out and is attached as Annex II.

The major section of track from Karachi to the site is via the National and Super high-way. The track is a multi-lane road. It has a flat terrain, and long and heavy vehicles can easily navigate through this road. The total distance from Karachi to the site is approximately 500 km.

The overview of the track from Bin Qasim Port to the Project site through the National and Super Highway is shown in **Figure 7-4**.

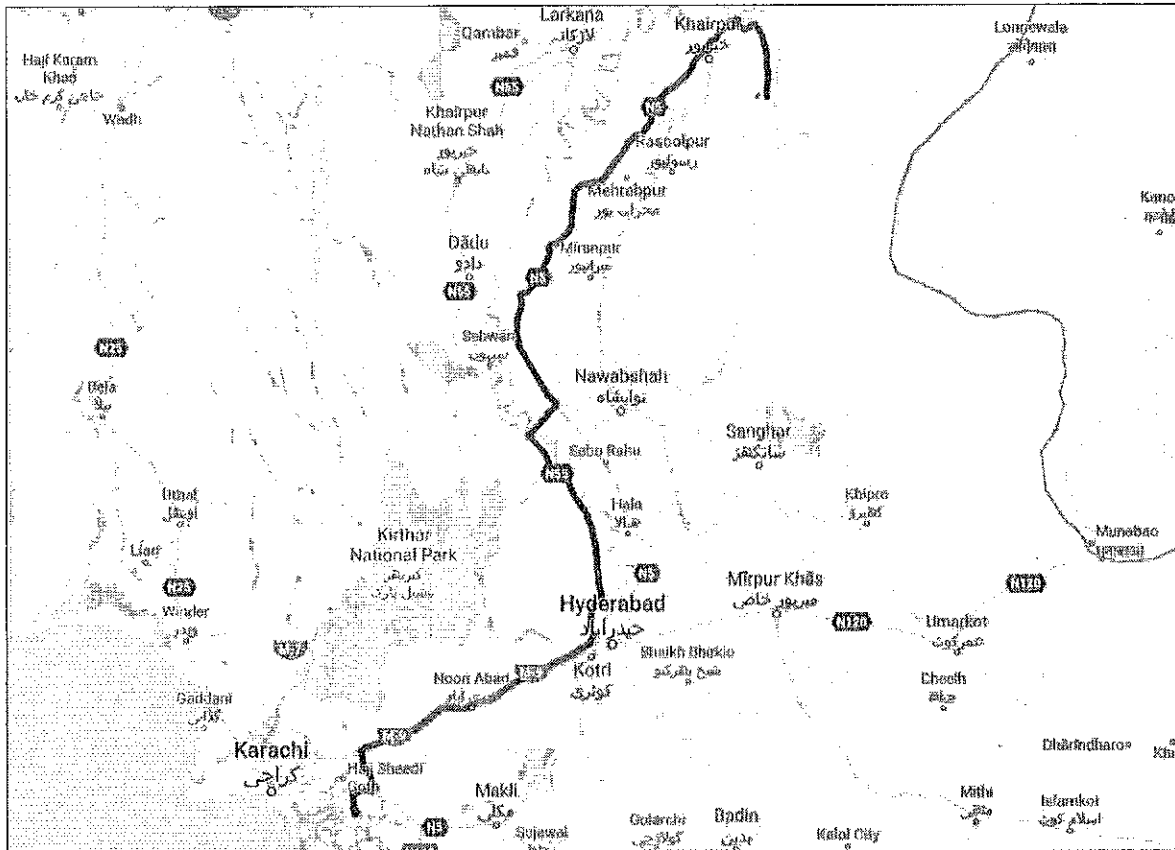


Figure 7-4: Access to the site

Sukkur city, is located towards North-West of the site as shown in **Figure 7-5**, having an aerial distance of approximately 40 km.

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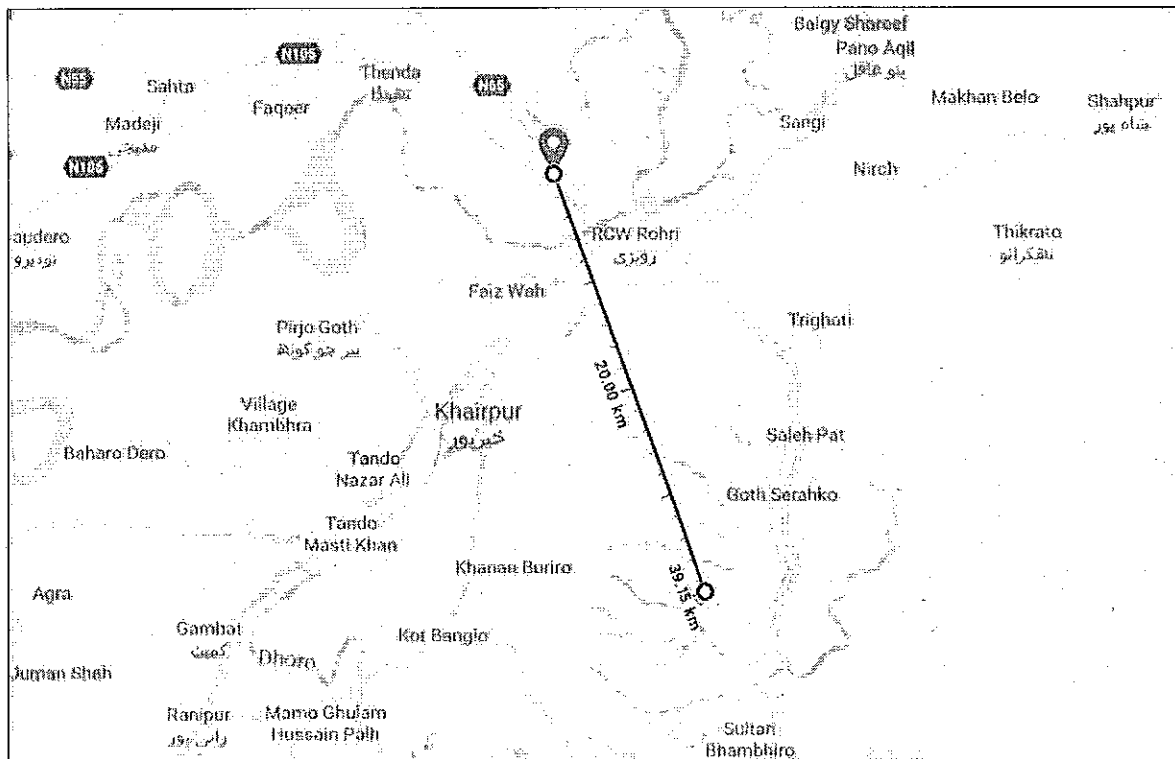


Figure 7-5: Orientation of Sukkur from Site 1 (Aerial View)

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7.4 CLIMATIC CONDITIONS

The climate of the southern parts of Sindh is characterized by fluctuating temperatures and sparse rainfall. The summers are hot and humid with average temperature ranging between 33°C to 40°C. The temperature in summers may reach up to 50°C. The winters are pleasant with average temperature in the range of 15°C to 25°C. Climate information of Pakistan is depicted in figures below:

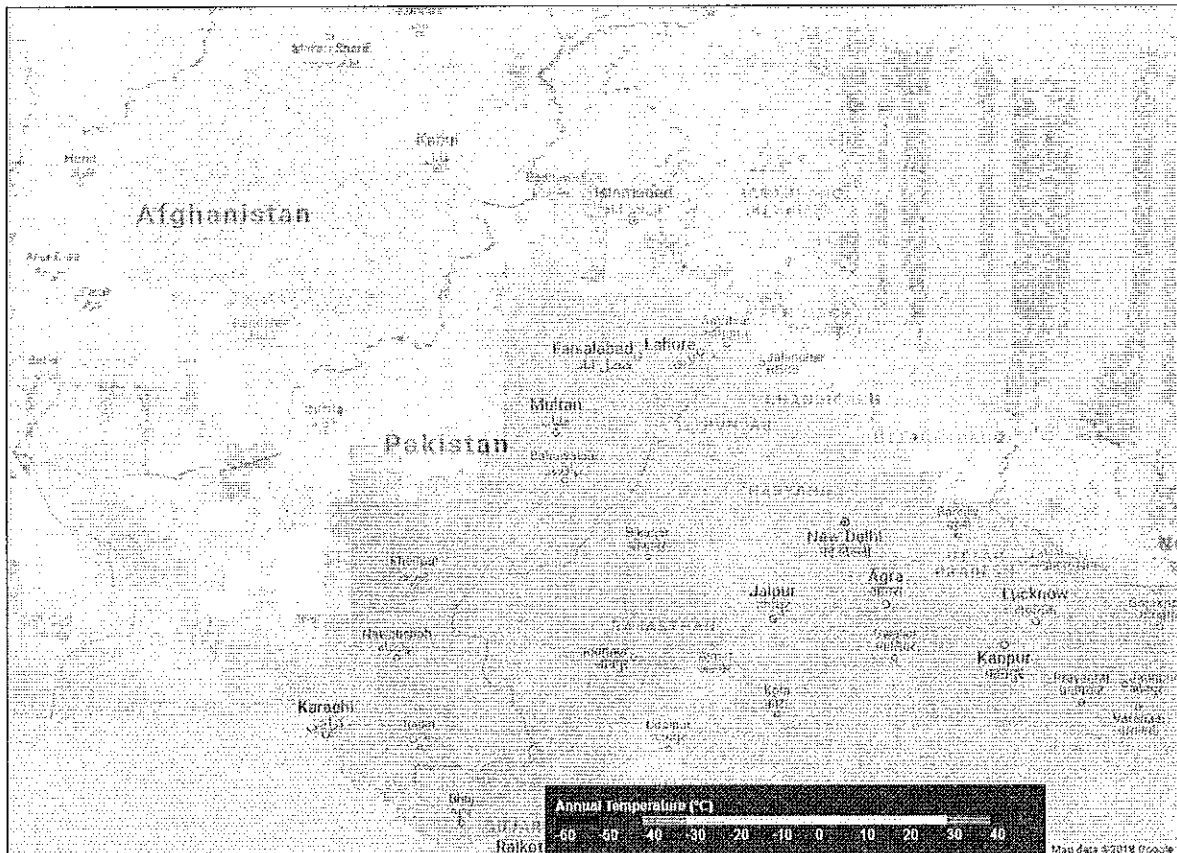


Figure 7-6: Annual Temperature Map

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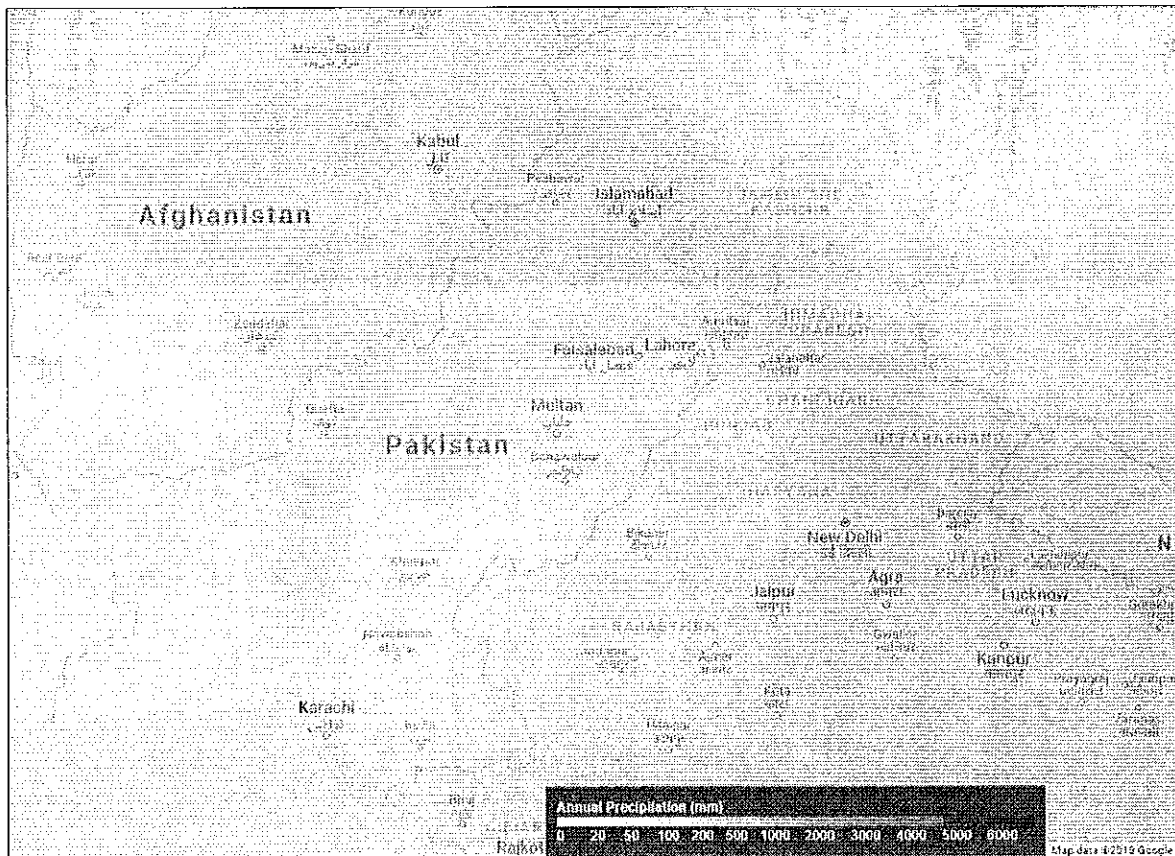


Figure 7-7: Annual Precipitation Map

7.5 TELECOMMUNICATION

PTCL telephone service is not available but mobile carriers have partial coverage on the site area.

7.6 EARTHQUAKES

According to the seismic zoning map of Pakistan, the project region falls in ZONE II-B with moderate to severe damage area probability. This has been separately covered in the Geo Technical Study and the Initial Environmental Examination.

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8 SOLAR RESOURCE ASSESSMENT

A separate study has been carried out for the complete resource assessment of the solar resource at site. The assessment study takes in account the potential to simultaneously generate solar power round the year. The solar assessment was carried out for 50MW installed capacity using the equipment specifications mentioned earlier. Based on the findings from site assessment, the site is considered feasible for installation of solar PV project. The Project site in general has no shading due to terrain or natural objects.

As per the preference of GOP and accordingly contemplated in the LOI, the Project will be a standalone Solar PV. The solar resource assessment is based on the reliable dataset of long-term Solar GIS and simulations of industry proven software called PVSyst and the detailed Energy Yield Assessment Report can be found under Annex 3.

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9 SELECTION OF EPC CONTRACTOR

Project company will base its selection of suppliers and EPC Contractors on the following items.

Turnkey EPC proposals will be invited through a bidding process as per NEPRA (Selection of Engineering, Procurement and Construction Contractor by Independent Power Producers) Guidelines 2017, which will be evaluated on merit and then initial meetings shall take place with all the bidders. Following this, detailed negotiations will be done with the best offer to make a final selection.

The main aspects to select the EPC Contractor are as follows:

- The quality of Modules and Type Certification according to site suitability.
- The quality and certifications of EBOP equipment.
- The ultimate energy yield potential at P90 for the Project.
- Technical guarantees, warranties and obligations
- Time for Completion
- The commercial and legal terms of the EPC package

Project company plans to make a final selection of EPC Contractor before the time for stage of Generation License and Tariff of the Project.

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10 GEOLOGICAL CONDITIONS

In order to collect detailed regional geological information, Geotechnical Investigation & study was carried out and is attached as an annexure to this report.

Boreholes were drilled as part of the field investigation along with relevant in-situ tests. Soil/rock samples were also collected during the field investigation. Laboratory testing of these samples has been carried out in the laboratory.

The ground conditions observed at the site indicate the presence of following subsurface deposits:

- Very dense fine to coarse Sand with gravels
- Clayey sandy silt / clayey silty sand
- Rock (Weak to medium strong Limestone)
- Rock (Extremely weak shale)

Keeping these conditions under consideration allowable bearing pressures for shallow footings have been given. Seismic soil profile has been taken as 'SB' in accordance with UBC-97. Tests on soil samples obtained from the borehole indicate negligible chloride and sulfate exposure. In continuation with the findings listed in the detailed report, type of cement recommended for these conditions is 'Ordinary Portland Cement'. The corrosiveness of the ground up to 5 meters below existing ground has been determined through insitu electrical resistivity tests and medium to high resistivity values indicate mildly to low corrosiveness of the subsurface deposits. The tectonic map of Pakistan, Geological and Sub Surface details of the Project region are shown in **Figure 10-1 & Figure 10-2**.

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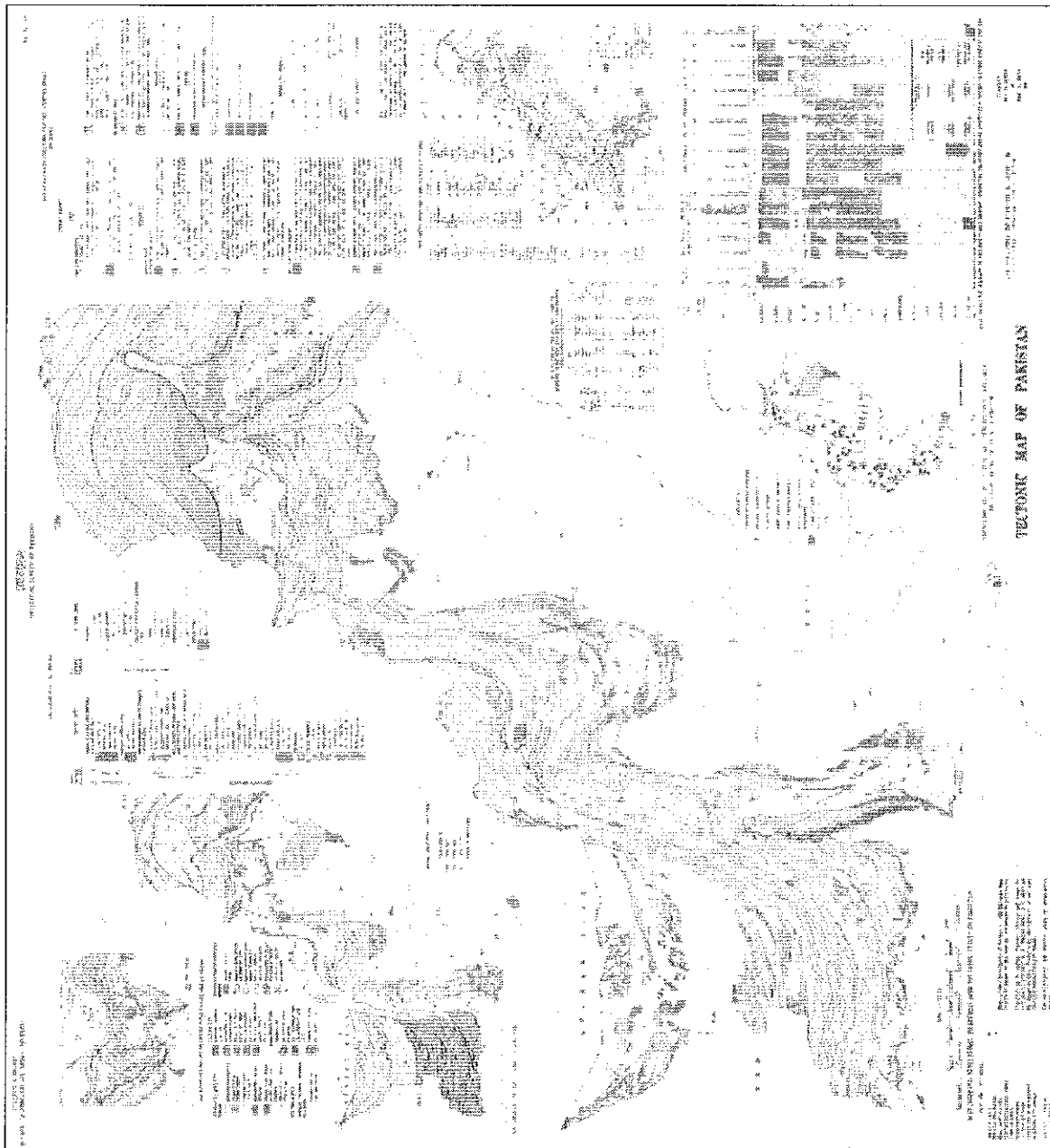


Figure 10-1: Tectonic Map of Pakistan

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10.1 FIELD WORK

10.1.1 Borehole Drilling

The drilling and sampling work has been performed using the standards, procedures and equipment's recommended for engineering site investigation. All borings were advanced through soil between sampling intervals by rotary wash methods, using rotary drilling machines of hydraulic feed. These machines are most suitable to the site conditions with all accessories for extending the bore to required depths, taking samples and performing the necessary on-site tests. Minimum drilling fluid consisting of water bentonite slurry was used for flushing out the cutting to provide a positive head and to maintain stability of the drilled hole. The boreholes were also stabilized using casing with a nominal diameter of 130mm. A drag bit was used to advance the boring. Observations during drilling such as change of strata, texture, color and drilling difficulties were noted.

The soil layers encountered in the borehole were visually classified and were later upgraded as per laboratory test results. Few samples were obtained from split spoon sampler after performing standard penetration test (SPT). A number of core samples were preserved. The samples were cleaned, labeled and put in especially made core-boxes for onward transmission to the laboratory for testing. Special care was taken during handling and transportation of samples.

10.1.2 Rock Core Drilling

Rock core drilling relates to the procedure in which underlying rock is investigated by coring so as to obtain samples for classification, to determine the quality of rock, and to check for possible detrimental properties such as cracks, fissures and weathering or other deterioration that could affect the strength of the formation. To obtain rock core samples, NX diameter core barrels with special bits were used. Under rotary action, the core bit advances into the rock. A circulating supply of water was provided in the cutting edge to help flush rock cuttings and dissipate heat. "Core Runs" were made to drill the hole in segments. At the completion of a core run, the barrel and rock sample were brought to the surface, the depth of recovery was properly recorded for further evaluation in the laboratory. Based on the length of the rock core recovered from each run, core recovery (C.R.) and rock quality designation (RQD) were calculated for a general evaluation of rock quality encountered. Suitable core samples were preserved for shear strength characteristics.

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11 ELECTRICAL WORKS

11.1 GRID INTERCONNECTION STUDY

The detailed report on Electrical and Grid Interconnection Studies for the power project has been conducted by the Sponsor separately. Accordingly, the NOC from NTDC is being pursued by the Sponsor directly. The detailed report can be found as Annexure VII to the feasibility study package.

11.2 PV PLANT ELECTRICAL OVERVIEW

The detailed design activity of the electrical works shall be carried out by the EPC contractor prior to start of construction. This sequence is in accordance with industrial practices. The following sub-sections provide an overview of the solar PV power plant.

The key electrical components of the plant shall include the PV panels, cabling, inverters, step up transformers 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.

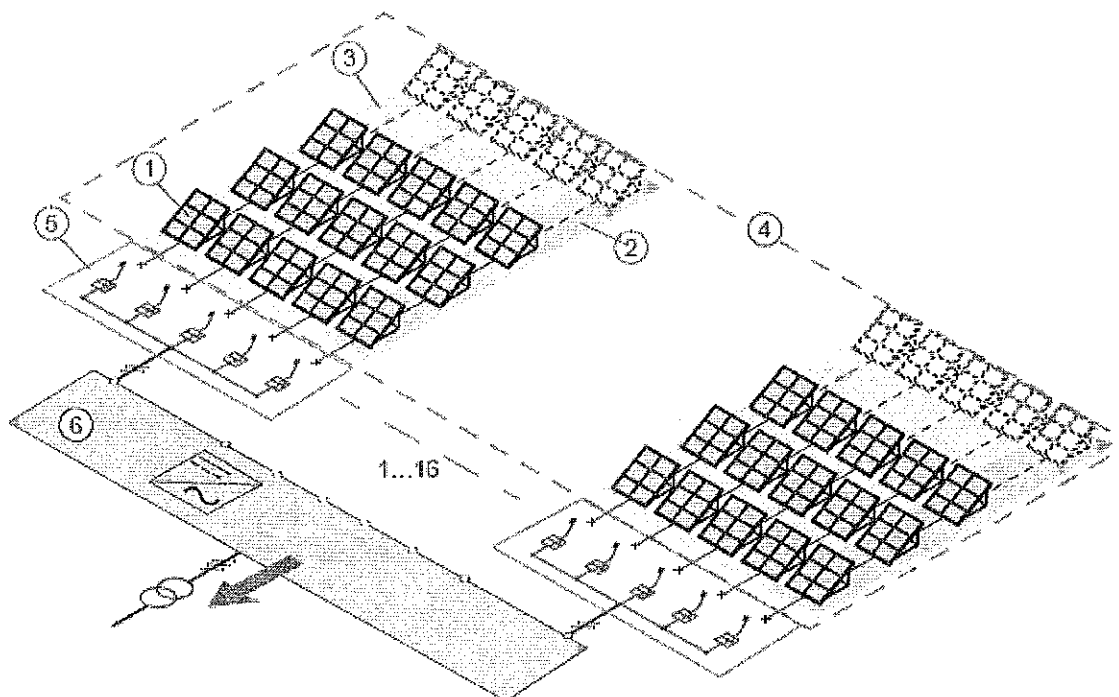
The DC electricity from the panels shall be converted into 50 Hz AC via the inverters. There may be some support apparatus such as junction boxes between the inverter and the panels.

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. 22 kV or 33 kV. This shall be achieved using step up transformers.

Once stepped up to 22 kV or 33 kV through a transformer, the power shall be transmitted to the sub-station where it will be stepped up to the NTDC's grid voltage (i.e. 132 kV or 220kV). The sub-station will serve as the inter-connection point to the utility transmission grid system.

A pictorial representation of the plant is given below:

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- | | | | | | |
|---|------------------------------------|---|-----------------|---|--------------------------|
| 1 | Solar module (photovoltaic module) | 3 | Solar array | 5 | Solar array junction box |
| 2 | Solar string | 4 | Solar generator | 6 | Inverter |

Figure 11-1: Block Diagram of Single PV Group

11.3 INTERCONNECTION OF PV MODULES AND FORMATION OF ARRAYS

The interconnection of PV modules and formation of arrays shall be designed by the EPC contractor. The overall layout shall consist of PV arrays, inverters, control room/building and substation. Factors influencing the design include:

- ❖ PV module rating and dimensions
- ❖ Inverter rating and dimensions
- ❖ Principle direction of sunlight
- ❖ Topography and shape of land
- ❖ Type of sub-structure
- ❖ Geotechnical conditions
- ❖ Shading objects

Document Title:	Consultant Name: Renewable Resources (Pvt.) Ltd	Document No RE2-141-233-001	Approval Date Dec 2018
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- ❖ Weather and other environmental conditions
- ❖ Existing infrastructure
- ❖ Local regulation and legislation
- ❖ Utility requirements

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12 CONSTRUCTION MANAGEMENT

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

Project shall ensure the Plant is designed, its components manufactured, erected and configured in such a way that it will achieve high availability and reliability with minimum power production costs, and it shall be designed to optimize the use of the solar resource for generating electricity. All plant equipment and systems will be built to appropriate internationally recognized standards and shall comply with all the applicable national codes and statutory codes.

The PV system will be built sequentially in blocks or zones making partial connections of the facility possible if desired/feasible; a detailed execution plan will be drafted once the relevant arrangement under the EPA and the other relevant agreements are made public, so as to make an optimized schedule for the execution of the plant within the legal boundaries.

The imported equipment (including but not limited to inverter solutions, modules, trackers, interconnection and monitoring solutions and HV equipment) will come via Karachi Sea Port. The civil work materials will be arranged from the nearest local markets / dealers. Certain items (steel accessories, local cables, electrical accessories will be delivered from appropriate cities including Islamabad, Karachi and Lahore.

The project will create more than 100 jobs that can be taken up by the local people. Training will be provided to unskilled labor.

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The project construction shall take approximately 10 months from the date of planning till the COD. The activity structure and timelines are given in table below:

Table 12-1: Project Construction Scheduling

Activity / Month	1	2	3	4	5	6	7	8	9	10
Engineering and Mobilization										
Construction of Temporary Establishment										
Mech/Civil Works of PV panels and Substation										
Construction of Substation										
Supply of PV Panels										
Cables and Interconnection										
Testing and Commissioning of EBOP										
Testing and Commissioning of PV Panels										
EPA Tests and Reliability Run Test										

Document Title: Feasibility Study of 50 MW PV Solar Power Project near Sukkur, Sindh, Pakistan	Consultant Name: Renewable Resources (Pvt.) Ltd	Document No RE2-141-233-001	Approval Date Dec 2018
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13 Initial Environment Examination (IEE)

The Initial Environment Examination (IEE) has been carried out as per the Pakistan Environmental Protection Act, 1997, according to the requirements of Environmental Protection Agency, Government of Sindh and has already been submitted.

A data collection survey, which included geology, meteorology, hydrology, ambient air quality, water quality, soil characteristics, noise levels, shadow forecasting, flora and fauna, land use pattern and socioeconomic conditions, was undertaken based on the available secondary information or through data collected in the field. The primary data was collected to establish baseline conditions for the soil, water (surface and ground) quality, flora and fauna, and noise. The secondary data was collected for land, ecology, climate, and socioeconomic factors.

According to the study conducted, the prime benefit of the Project will be the replacement of conventional power generation with renewable energy and efficient utilization of the grid system. Added energy will help counteract fossil fuel powered generation, and therefore reduce suspended particulate matter and greenhouse gas emissions into the atmosphere.

The 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 and 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 of any significant vegetation for the construction of the power Project.

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

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

Proper GRM will have to be implemented by the Project to overcome the 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 by Project 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 Project, no major adverse impacts are expected. There is no adverse impact of migration on the habitat, any natural existing land resources and there is no effect on the regular life of people.

The environment and social impact associated with the 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. Most of the impacts are expected to occur during the construction phase and are considered to be of a temporary nature. The transmission corridor will be 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.

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From this perspective, the project is expected to have a lesser "environmental footprint". No endangered or protected species of flora or fauna are reported near the project sites.

The stakeholder from the Government and Non-Government sector has also appreciated the project activities, raised concerns related to the social and environment areas which shall be addressed through effective planning and management.

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. Mitigation measures related to 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 impacts, which can be mitigated following the EMP & shall be pollution free Renewable source of Power generation with low Environmental foot prints.

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 that the project is classified as a category "B", in accordance with ADB's Safeguards Policy Statement 2009. The Project is not considered highly sensitive or complex. The mitigation measures related to 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 and shall be a pollution free renewable source of power generation with small environmental foot prints.

In view of the aforementioned details, it is concluded that development of the power project by the Client will have no adverse environmental impact and the project can be regarded as an Environment Friendly Green Project.

Document Title: Feasibility Study of 50 MW PV Solar Power Project near Sukkur, Sindh, Pakistan	Consultant Name: Renewable Resources (Pvt.) Ltd	Document No RE2-141-233-001	Approval Date Dec 2018
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14 CONCLUSIONS OF FEASIBILITY STUDY

The detailed feasibility of the project has been conducted which covers all aspects required for developing the Project.

The solar climate observed on the site indicates attractive energy production. The Project IRR as currently being assessed is suitable.

The site is feasible for the Project with suitable access for the transportation of equipment. The climatic conditions at the project site are moderate and the telecommunication and transportation facilities are adequate.

The Project shall not have negative environmental impact during its life cycle. Instead, the project will bring positive development and improve the socio-economic conditions of the area through generation of employment opportunities and contribute in environmental sustainability of the area.

The negotiations of the EPC contract and price shall play a vital role in the final selection. The project site is conveniently located close to the NTDC's grid station.

The Project seeks an approval of the POE enabling it to move into the next stages of development. The next steps after approval of feasibility study would be to apply for the Generation License based on finalized tariff regime for this Project, and to begin negotiations for EPA and IA. The Project may also enter discussions with lenders at some stage.

It is expected that the Project will achieve financial close in due course of time. It is anticipated that the Project would be a valuable addition to the National Grid for generating electricity and contribute to overcome the energy crisis of the Pakistan.

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Environmental Protection Agency

Government of Sindh, Regional Office Sukkur

Opposite Govt. College of Physical Education Sukkur, Near New Bus Terminal, Post office Arain, Sukkur

Reference No. EPA (ROS)/Tech/32/2019/212

Dated: 17/05/2019

✓
General Manager/Owner/C.E.O
Artistac Solar Energy Private Limited
Plot No 3A, M.A.C.H.S
Main Shahrah-e-Faisal, Karachi-75350 Pakistan.

SUBJECT: PRESENTATION REGARDING INITIAL ENVIRONMENTAL EXAMINATION REPORT FOR CONSTRUCTION AND OPERATION OF 50 MW SOLAR PV POWER PLANT BY ARTISTAC SOLAR ENERGY PVT LIMITED LOCATED AT DISTRICT SUKKUR.

Sindh Environmental Protection Agency, Government of Sindh has a mandate to implement Sindh Environmental Protection Act-2014 and rules and regulations made there under. This Act is to provide the protection, conservation, rehabilitation and improvement of the environment, prevention and control of pollution and promotion sustainable development.

Through this letter it is advised/directed to appear in the office of SEPA Regional Office, Sukkur for presentation before Review Committee regarding the Initial Environmental Examination IEE for the Constructional, Installation and Operational mechanism activities of 50MW Solar PV Power Plant By Artistac Solar Energy Pvt Limited on 23-05-2019 at 01:00pm sharp .

ASSISTANT DIRECTOR

C.c to;

1. Regional Incharge Deputy Director EPA ROS
2. Office Record.

ARTISTIC SOLAR ENERGY (PVT) LTD.

Postal office : Plot 3A, M.A.C.H.S. Main Shahrab-e-Faisal, Karachi-75350 Pakistan
Phone : 92-21-38709711, Fax : 92-21-34321940, Email : energy@artisticmilliners.com

Date: 18th, January 2019

Director General,
Environmental Protection Agency,
Government of Sindh,
Karachi,

Subject: Submission of Initial Environmental Examination Report for "Construction & Operation of 50 MW Solar PV Power Project By Artistic Solar Energy Pvt. Limited Located at Gagrawara, District-Sukkur, Sindh.

Dear Sir,

Please find attached the Initial Environmental Examination Report (IEE) along with Schedule-V for our project of "Construction & Operation of Solar PV Power Project of Artistic Solar Energy Pvt. Limited (ASEPL) of 50 MW" located at Gagrawara, District Sukkur, Sindh.

This report is being submitted to your office in compliance with the requirements of Section-12 of the Pakistan Environmental Protection Act 1997, and Sindh Environment Protection Act 2014 section 17 the Rules and Regulations made there under.

Please also find attached a Pay Order of Rs. 100,000 (Pak rupees One Hundred thousand only) in favor of 'Sindh Sustainable Development Fund' as a review fees for the IEE report.

Yours Sincerely,
For & On Behalf of
Artistic Solar Energy (Pvt.) Limited

Rafique Khanani
CFO/ Company Secretary



AYZ 23/1/19



Ph: 021-99206449

NO. DAE/Gen/116/2015 /101
GOVERNMENT OF SINDH
Directorate of Alternative Energy
ENERGY DEPARTMENT
Karachi, dated 09th November, 2018

SAY NO TO CORRUPTION

To,

Assistant Commissioner,
Taluka Salehpat, District Sukkur.

Deputy Director (Civil/hydro),
Power Development Sindh
Energy Department, Govt. of Sindh

✓ Technocrat/consultant (Mr. Salman Ahmed)
Pakistan Alternative Energy Services.

Subject: MINUTES OF THE COMMITTEE OF EXPERT MEETING REGARDING
SCRUTINY/EXAMINE/SURVEY THE REQUIREMENT OF LAND FOR WIND/SOLAR
POWER PROJECTS IN SINDH.

I am directed to enclose herewith minutes of the Committee of Expert meeting held on 12th October, 2018 under chairmanship of Director Alternative Energy, Energy Department on the subject noted above, for kind consideration please.

Enclosed: As above.


(SHANZAIB BASHIR)
Assistant Director-III

Copy for information:

- Secretary, Land Utilization Department, Government of Sindh.
- PS to Minister of Energy Department Govt. of Sindh
- PS to Secretary, Energy Department Govt. of Sindh

GOVERNMENT OF SINDH
DIRECTORATE OF ALTERNATIVE ENERGY
ENERGY DEPARTMENT

MINUTES OF THE MEETING

Subject: MINUTES OF THE MEETING OF COMMITTEE OF EXPERT REGARDING
SCRUTINY/ EXAMINE/ SURVEY THE REQUIREMENT OF LAND FOR WIND
/SOLAR POWER PROJECTS IN SINDH.

The meeting of the Committee of Expert (CoE) to examine the proposals for the requirement of land for the development of wind /solar energy projects was held under the Chairmanship of Director Alternative Energy, Energy Department on October 12, 2018 in the Committee room of Energy Department, 3rd floor state life building No.3 opposite CM house Karachi. The list of participants are as under:

1. Engr. Mehfooz Ahmed Qazi	Director, Alternative Energy	Chair
2. Mr. Mustafa Ahamed Jatoti	Assistant Commissioner Salehpat	Member
3. Mr. Salman Ahmed	Technocrat	Member
4. Mr. Niaz Ahmed Janjhi	Deputy Director (Solar On-Grid)	Member
5. Mr. Shahzaib bashir	Assistant Director	Member

2. The chair welcomes the participants and enquires about absence of representative of DC Thatta office. The secretary of committee informed that the DC Thatta office informed that the A.C Thatta post is vacant.
3. Detail deliberation held on the meeting agendas

**AGENDA ITEM-I: ALLOTMENT OF 250 ACRES OF LAND FOR THE DEVELOPMENT OF 50
MW SOLAR PROJECT BY M/S ARTISTIC SOLAR ENERGY PVT. LTD IN
DEH LOOLI, TALUKA SALEHPAT, DISTRICT SUKKUR.**

4. The Committee was informed that M/s Artistic Solar Energy Pvt. Ltd. has obtained LOI for development of 50MW Solar Power Project in Sukkur. The LOI has been issued by Energy Department on dated 12th April 2018. The company has requested for land allotment of 250 Acres in Deh Looli, Taluka Salehpat, District Sukkur.
5. The Assistant Commissioner Salehpat informed that the availability of the proposed land in Deh Looli, Taluka Salehpat, District Sukkur has already been conveyed to Land Utilization Department, GOS.
7. The Coordinates of the proposed land which states that vide letter no. RB38/5/2018 on dated 25th May, 2018 are as under:



C-1	250 ACRE	27.391769°	68.963281 °
C-2		27.381827°	68.952427°
C-3		27.386644°	68.946786°
C-4		27.394571°	68.957380°

8. The Mukhtlarkar Estate Head Quarters Sukkur has also recommended that, the proposed land is a state land and lying vacant on site and is available for the proposed project.

Recommendations:

6. The CoE recommended that the request of the sponsor for allotment of 250 acres land for which availability has been given by DC Sukkur may be considered for development of 50 MW solar power project as per policy, so that the project sponsor may conduct feasibility study for project development.



**INITIAL ENVIRONMENTAL EXAMINATION (IEE) OF
50 MW SOLAR POWER PROJECT BY ARTISTIC SOLAR ENERGY
PVT. LTD IN SALEH PAT SUKKUR SINDH-PAKISTAN**



PROJECT SPONSORS:



ARTISTIC MILLINERS PVT. LTD
Plot No. 4 & 8, Sector 25, Korangi Industrial Area, Karachi

PROJECT CONSULTANTS:



RENEWABLE RESOURCES (PVT) LTD.
1002, 10th Floor Green Tower, Jinnah Avenue, Blue Area,
Islamabad, Pakistan.

Disclaimer Notice

This report has been prepared for the benefit of Artistic Milliners Private Limited (AMPL) (the "Client") and may not be relied upon or disclosed to any other person for any purpose, other than as stated below, without the Client's prior written consent in each specific case. The information contained in this report is intended for purposes of seeking an approval from the Environment Protection Agency in accordance with the requirements of the Pakistan Environment Protection Act, 1997, and may be used by the Client for such other purpose as may be necessary for the development and implementation of the Project.

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Prepared in November, 2018

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Document Title: Initial Environmental Examination (IEE) 50 MW Solar Power Project for Artistic Solar Energy Private Limited in Sukkur, Sindh Pakistan	Consultant Name: Renewable Resources (Pvt.) Ltd	Document No RE2-131-233-001	Date of Approval, November, 2018
	Project Sponsor: Artistic Milliners Private Limited.	Document Issue 01	Page Number 2

APPROVAL SHEET

TITLE : Initial Environmental Examination (IEE) of 50 MW Solar Power Project at Artistic Solar Energy Private Limited in Sukkur, Sindh-Pakistan.

DOCUMENT NUMBER : RE2-131-233-001 Issue: 01

CLASSIFICATION : **UN CLASSIFIED**

SYNOPSIS : This document is a report on Initial Environmental Examination (IEE) of 50 MW Solar Power Project at Artistic Solar Energy Private Limited in Sukkur Sindh-Pakistan. Project is owned by Artistic Milliners Pvt. Ltd. The report is prepared by Renewable Resources Pvt. Ltd.

PREPARED BY :



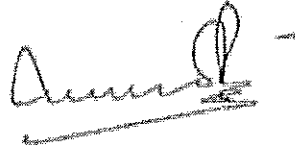
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**APPROVED BY**

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CEO
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DATE

: November, 2018

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LIST OF ABBREVIATIONS

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
EMMP	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

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LOI	Letter of Intent
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
O & M	Operation and Maintenance
PEPA	Pakistan Environment Protection Act
POPs	Persistent Organic Pollutants
Pak-EPA	Pakistan Environment Protection Agency
PM	Particulate Matter
PPB	Parts Per Billion
PV	Photo Voltaic
RE2	Renewable Resources (Pvt.) Ltd
SCR	Social Complaint Register
SHEE	Safety Health Environment and Energy
Sox	Sulphate Oxides

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UNFCC	United Nation Framework on Climate Change
WAPDA	Water and Power Development Authority
WHO	World Health Organization
WID	Women in Development
ASEPL	Artistic Solar Energy Private Limited
AMPL	Artistic Milliners Private Limited

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EXECUTIVE SUMMARY

Introduction

This document is an Initial Environmental Examination IEE of a **50 MW Solar Power Project at by Artistic Solar Energy Pvt. Limited in Sukkur, Sindh-Pakistan** (Project) being developed by Artistic Milliners Private Limited (AMPL) in District Sukkur, Sindh Pakistan.

The sponsor of the Project is **Artistic Milliners Private Limited (AMPL)**.

Artistic Solar Energy Private Limited (ASEPL) is an SPV formed for developing 50MW Solar Power Project. It is a wholly owned subsidiary of Artistic Milliners Private Limited (AMPL).

The Project of is located in Tagio Laghari, Tehsil Saleh Pat, District Sukkur Sindh. The land has been leased by the Government of Sindh by Artistic Solar Energy Private Limited (ASEPL). The National Highways (N5) and (N55) and Motorway (M9) are the major connecting roads to the Project site, having total road distance of approximately 500 km from Port Qasim. The total land area of the Project is 250 acres. The proposed site located at latitude of 27°23'21.64"N and longitude of 68°57'17.39"E with elevation of around 50 to 60 meters. (Further details about the Project and its location are given in **Section 5** of this report.)

The project land is totally barren land that will not cause any significant impact in the project area and also nearby surroundings as per conducted surveys, primary and secondary data collection, environmental monitoring and analytical references upon developed solar plants. As on experience and analytical references says that the environmental disturbance normally associated with construction activities that are minimized through an EMP implementation and proper monitoring & supervision.

Project at a glance

S. No	Particulars	Description
1	Project Site	Saleh pat, Sukkur, Province Sindh-Pakistan
2	Land Available for project	101.171 Hectares
3	Project Capacity	50MW
4	Total number of Solar PV modules to be installed	192500
6	Estimated Project Cost	50 Million dollars (0.8 to 01 million \$/ MW)

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Overview of the Project Environment

The Project site has very sparse vegetation consisting of small shrubby bushes and flat terrain. Topographically - says, it is spanned from 27.38° North latitude, 68.95° East longitude. The city of Sukkur is located at an altitude of 239 feet 70 m from sea level. The climate of the Project area can be broadly classified as arid, moderate, hot and humid. As many as 07 mammals, 14 birds, 07 reptiles and 11 plant species were recorded from the study site. The Project Area is outside the limits of any Wildlife Protected Area. The habitat is mostly arid, stony and sandy having sparse vegetation cover with common herbs and shrubs.

There are around four settlements located near to the project site. The nearest settlements are 800 meters to 04 kilometers away from project site/boundary that is located outside the project boundary. Local people of the nearby Goths have access to urban areas through link roads and public transport available. There is no health facility available in the project except one Basic Health Unit which is present is Goth Gagrawara. There is no protected area in the vicinity of project site.

Major wildlife sanctuaries or reserve areas are Takkar Wildlife and Nara Canal sanctuary. These wildlife sanctuaries are located approximately 6.5 km (Nara Canal) and 16 km (Takkar Wildlife sanctuary) away from the Project site. The ground water level of the site is around 50 meters. Ground water will not be permitted to use for commercial activities.

The texture of soils in the project area ranges from silty, and clayey in the coastal areas to gravely, mainly loamy, and clayey soils in the in-land areas.

No sources of anthropogenic sources of air pollution exist in the immediate vicinity of the site; therefore, the ambient air of the area is likely to be free from the key pollutants. The noise level recorded found under the SEQS limit.

According to Seismic Zoning map of Pakistan, Project area falls in Zone II-B (moderate to severe damage) area.

Stakeholder Consultation:

Stakeholder consultation was carried out as part of IEE study like; consultation with Wildlife department, Sukkur-EPA, 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.

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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 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

The proposed project land is leased by the GoS to the project company to develop the solar PV plan. Based on the IEE study, the project will not cause any significant impact in the project area nor to nearby surroundings. 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; Sindh Wildlife department and Sukkur EPA. 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 proposed land is located 6.5 km away from Surface water source which is the one declared wetland to be considered as sensitive and protected area, is not being influenced and impacted by project due to longer distance. Whereas care will be taken providing ESMP. The detail of IEE findings and recommendations are discussed in **Section-9** of this report.

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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: Pakistan Environmental Protection Agency Act 1997 and (Review of IEE and EIA) Regulations, 2000
- Annexure-IV: Sindh Environmental Protection Agency Act 2014 and (Review of IEE and EIA) Regulations, 2014
- Annexure-V: Pakistan National Environmental Quality Standards and Sindh Environmental Quality Standards
- Annexure-VI: OPIC Environmental Guidelines 2012 for Solar Power Project
- Annexure-VII: Laboratory Analysis Report for (Ambient Air, Water and Noise)
- Annexure-VIII: (Complete Biological Report) List of Flora and Fauna Recorded in Project Area
- Annexure-IX: Snapshots of Biological Environment
- Annexure-X: Social Survey Forms
- Annexure –XI: Snapshots of Community Consultation
- Annexure –XII: Snapshots of Stakeholders Consultation
- Annexure –XIII: Copy of LOI
- Annexure –XIV: Land Leased Documents

Statutory Requirements:

The report fulfills the following regulatory requirements:

- ❖ Pakistan Environmental Protection Agency (Review of IEE and EIA) Regulations, 2000 with reference to Pakistan Environmental Protection Act, 1997,
- ❖ Sindh Environmental Protection Agency (Review of IEE and EIA) Regulations, 2014 with reference to Sindh Environmental Protection Act, 2014
- ❖ Asian Development Bank Policies and Guidelines
- ❖ Performance Standards of IFC and World Bank group
- ❖ IFC EHS Guideline for Energy Projects
- ❖ The best practices followed at international level.

The details of the statutory requirements and compliances of this IEE report to the national and international regulations or guidelines are explained in **Section 2** of this report.

Project Consultant

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Project Sponsors

The Project Sponsors are the limited liability company incorporated under the laws of Pakistan, called Artistic Milliners Private Limited (AMPL). Contact details are as follows;

Artistic Milliners Private Limited	
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SECTION 1

INTRODUCTION AND PURPOSE OF STUDY

1 INTRODUCTION AND PURPOSE OF STUDY

1.1 PROJECT PROPONENT

The sponsor of the Project is Artistic Milliners Private Limited (AMPL).

Artistic Solar Energy is subsidiary of Artistic Milliners Private Limited (Pakistan Largest Integrated composite textile unit established in 1949).

Recently, AMPL has commissioned the first and only Green Garment Plant in Pakistan. It is certified by LEED (Leadership in Energy and Environmental Design), which is a rating system developed by USGBC (U.S. Green Building Council).

The Spinning unit is equipped with state of art machinery from Germany and Switzerland and is capable of producing high quality yarn to assure the production of premium denim fabrics. Product range includes ring spun, open end, core spun lycra and multi count and multi twist yarn. Artistic Milliners maintains ISO 9001 quality policy and operates in accordance with International and Pakistan laws and maintain strict compliance for health & safety. AMPL is also working on CSR like; Employee Wellbeing, Women Empowerment, Community Development and Environment Conservation.

The Developers or sponsors have further collaborated with professional firms that are highly qualified and committed to developing and commissioning the Project on a fast track basis. Collectively, the Sponsors along with their professional alliances (the "Development Team"), presents a vastly experienced team of power sector professionals of international repute.

Artistic Solar Energy Private Limited is an SPV formed for developing 50MW Solar Power Project. It is a wholly owned subsidiary of Artistic Milliners Private Limited (AMPL).

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Renewable Resources (Pvt.) Limited (RE2) is the consultant is engaged to develop the Project of Artistic Milliners Private Limited (AMPL).

Artistic Solar Energy Private Limited has approximately 250 Acres of land available for the development of project. Preliminary site assessment has been carried out through site visit conducted by RE2 team and also mentioned in Section 04 of the report.

1.2 THE PROFESSIONAL ADVISORS

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.

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-four (34) environmental studies of renewable energy projects, which have all been approved by the relevant Environmental Protection Agencies.

1.3 PROJECT BACKGROUND AND JUSTIFICATION

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Pakistan's energy requirements are met through Oil, Gas, Hydro Power, Nuclear Power and Coal. While Hydro and Nuclear are used only for electricity generation with reference to energy, Oil and Gas are used to supply other areas also. The share of each source in primary energy supplies for 2016-17 was: oil: 34.4%, gas: 37.9%, LNG import: 5.6%, LPG: 1.3%, coal: 8.1%, hydro-electricity: 9.7%, nuclear electricity: 2.1%, renewable electricity: 0.8% and imported electricity: 0.1%. While the annual growth rate of final energy consumption was increased considerably by 7.59% during 2016-17 is presented in **Figure 1.1**.

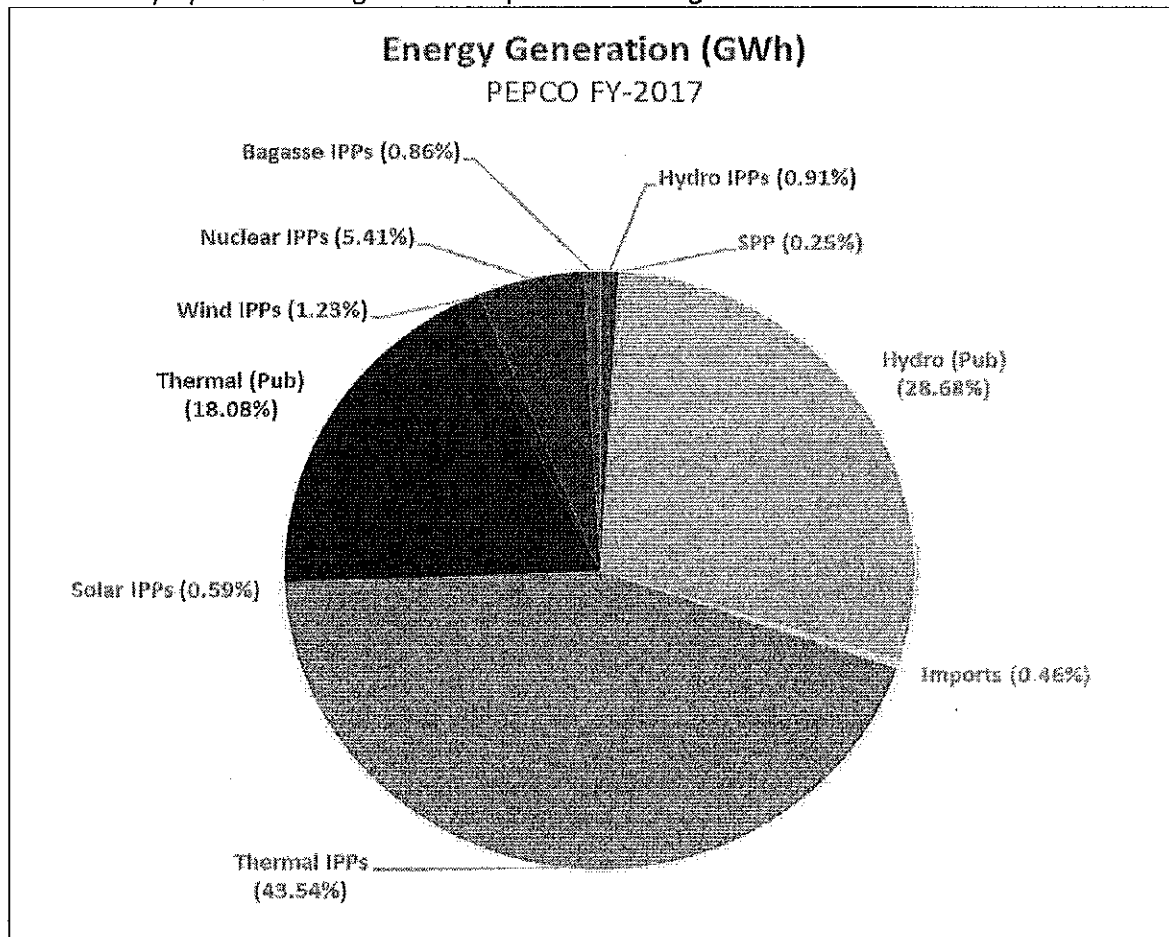


Figure 1-1: Electricity Mix of Pakistan by Source¹

Oil production increased from 86,481 barrels per day in 2015-16 to 88,409 barrels per day in 2015-16 (1.95%) while natural gas production moved down slightly from 4,048 MMCFD in 2015-

¹ PEPCO FY-2017

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16 to 4,032 MMCFD in 2016-17. Decreased activity was seen in the upstream sector where 48 exploratory and 40 development/appraisal wells were drilled.

Import of petroleum products was increased in 2016-2017. The import of the various petroleum products from HOBC to motor spirit etc. increased from 13,549,740 tons to 15,145,270 tons, mainly catering the needs of transport and power sectors; the overall import of petroleum products was increased by 11.78% as compared to the last year. The refining capacity increased slightly from 18.79 million tons/annum in 2015-16 to 19.37 million tons/annum in 2016-17. The total oil import bill increased significantly from US\$ 7.41 billion in 2015-16 to US\$ 9.08 billion in 2016-17.

During 2016-17, coal production stood at 0.56% while import of coal being much higher was at 43.71% which resulted in overall increase in coal consumption by 23.92% over the last year.

In the power sector, hydel generation contributed to 26.1% of the generation mix. This year 2,668 GWh of electricity was generated from renewable sources (solar, wind and bagasse).

During 2016-17, 123,118 GWh electricity was generated as against 111,300 GWh in 2015-16, which included 66.0% thermal, 26.1% hydel, 5.7% nuclear and 2.2% renewables. However, the consumption increased and reached 95,530 GWh from 90,431 GWh last year. Major increase in consumption was in other government sector (218.1%) followed by domestic (9.5%), commercial sector (9.4%), agriculture (8.2%), bulk supplies (7.5%) and street lights (5.4%) during 2016-17. As of 30th June 2017, the total installed capacity was increased to 29,994 MW from 25,889 MW in 2015-16.

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

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

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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 environment friendly alternative for meeting Pakistan's urgent electricity demands. In overall prospective, it may be said that the current shortfall and increased power demand in the country is also one of the major justifications of the planned solar project.

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 7 to 8 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 hour 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**.

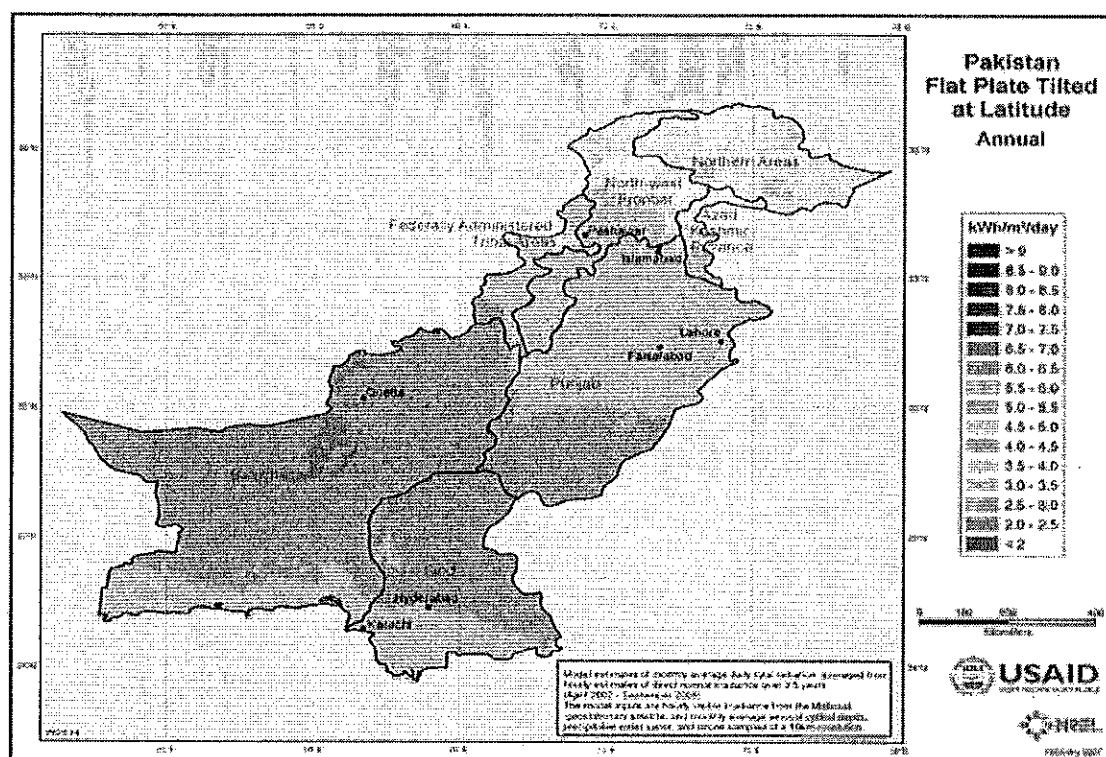


Figure 2.1: NREL Solar Map of Pakistan

2.1 PROJECT OVERVIEW AND OBJECTIVES

The Solar Power Project is located in Saleh Pat, Sukkur. The Project site consists of 250 Acres of land which has been leased by the Government of Sindh. The National Highways (N5) and (N55)

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and Motorway (M9) are the major connecting roads to the Project site, having total road distance of approximately 500 km from Port Qasim.

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 Solar PV Project is located in Sukkur, Sindh.

The brief overview of project is summarized in **Table 2.1** below;

Table 2.1: Project at a Glance

S. No	Particulars	Description
1	Project Site	Saleh Pat, Sukkur, Province Sindh-Pakistan
2	Land Available for project	101.171 Hectares
3	Project Capacity	50MW
4	Total number of Solar PV modules to be installed	192,500
6	Estimated Project Cost	50 Million dollars (0.8 to 01 million \$/ MW)

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.

2.2 NEED AND OBJECTIVES OF IEE STUDY

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

Sindh Environment Protection Agency Act 2014 (SEPA 2014)

Sindh Assembly has passed the Sindh Environmental Protection Act 2014; Environmental protection became the provincial subject; SEPA have developed Act, regulations and sectorial guidelines to develop its own Act and regulation and guidelines.

The IEE/EIA Regulations 2000 issued under PEPA 1997 IEE /EIA regulations 2014 issued under SEPA Act 2014

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 GoS, EPA,

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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.

Describe IEE Regulation 2014 under SEPA Act, 2014 These regulations are called the Sindh Environmental Protection Agency (Review of Initial Environmental Examination and Environmental Impact Assessment) Regulations, 2014. Under this regulation, the solar projects fall in Schedule I of the regulation if not fall under any sensitive areas, and then the project should conduct IEE rather than EIA.

2.3 BASIS PROJECT CATEGORIZATION OF EIA STUDY

Section 12 of Pakistan Environmental Protection Act 1997 and other regulatory documents such as Pakistan Environmental Protection Agency (Review of IEE/EIA) Regulations 2000 requires that every new development project in Pakistan has to be preceded by an Initial Environmental Examination (IEE) or Environmental Impact Assessment (EIA) depending upon the magnitude of the project and severity of impacts anticipated at the time of commissioning of the project.

Pak-EPA (Review of IEE/EIA) Regulations 2000 categorize projects into two separate schedules depending on whether a project requires an IEE (Schedule-I) or an EIA (Schedule-II). The Regulations also require that all projects located in environmentally sensitive areas need submission of an EIA.

Section 17 of Sindh Environment Protection Agency 2014 and Sindh Environmental Protection Agency (Review of IEE/EIA) Regulations 2014 requires solar project to conduct the IEE under schedule I,

Sindh Environmental Protection Agency (Review of Initial Environmental Examination and Environmental Impact Assessment) Regulation, 2014, the list of projects requiring an EIA includes solar energy projects if it falls under any sensitive, protected area. It defines "Environmental Sensitive Areas" as the area which falls under sensitive sites like protected areas, or the sites which may have crucial and growing importance. The Project Area does not fall under the said category accordingly IEE report has been prepared.

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Accordingly, an IEE Study has been conducted, and the same will be submitted to seek approval prior to project initiation.

The document has also been made to comply with the requirements of IFC PS as well as local and national standards.

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, Sind Environment Protection Act 2014 and IFC's and World Bank group performance standards.
- ❖ Highlight baseline environmental and social conditions of the project area along with identification of environmentally sensitive area and concerned stakeholders
- ❖ Relevant host country laws, regulations, applicable treaties and agreements
- ❖ Protection of human health, cultural properties and biodiversity including endangered species and sensitive ecosystems
- ❖ Major hazards; Occupational health and safety; Fire prevention and life safety
- ❖ Socio-economic impacts; Land use: Land acquisition; Involuntary resettlement
- ❖ Impacts on indigenous peoples and communities; if applicable
- ❖ Cumulative impacts of existing, proposed and anticipated future projects
- ❖ 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.

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2.4 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 as per general industrial practice.

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.

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, Sindh Environment Protection Act 2014 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;

2.4.1 Scoping

The key activities of this phase included:

Project Data Compilation: 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 on-

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ground 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.

Baseline Data Collection:

Primary Data To collect primary data, field surveys were carried out including social and biological surveys, and laboratorial testing conducted for the purpose of analyzing environmental parameters in order to quantify either they are meeting with SEQS standards. Shadow flickering and noise modeling will be carried out once the micro-siting for the turbines and PV panels need to develop, though affect could be analyzed on the sensitive receptors. A questionnaire was developed and views of local inhabitants were taken about the solar power Project attached in Annexures.

Secondary Data - Secondary data collected from some alternative resources including existing literature, internet help, existing available information, field surveys and associated departments.

Published Literature Review: 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.

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

2.4.2 Impact 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

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❖ 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 affected 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

2.4.3 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) in general and Sindh Environmental Protection agency in specific.







Chapter 1 gives the overview of project introduction and purpose of the IEE study. **Chapter 2** discusses the ADB policies and standards, as well as the regulatory, legislative and institutional setup in the country, relevant to the environmental and social assessment. **Chapter 3** provides a simplified description of the proposed project and its components. The project alternatives are discussed in **Chapter 4**. The environmental and social baseline conditions of the project area are presented in **Chapter 5**. The stakeholder consultation has been covered in **Chapter 6**. The environmental and socioeconomic impacts of the project are assessed and their respective mitigations recommended in **Chapter 7**. **Chapter 8** outlines the implementation mechanism for the mitigation measures, in the form of an environmental management plan. Finally, **Chapter 9** presents the findings and conclusion of the study.

2.5 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

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(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

	=High
	=Medium
	=Low
	=No Impact
	=Locally Favorable
	=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

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SECTION 3

LEGISLATIVE REQUIREMENTS OF IEE

3 LEGISLATIVE 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. **SEQS (Sindh environmental Quality standard, 2014).**

In exercise of the powers conferred under clause (g) of sub-section (1) of section 6 of the Sindh Environmental Protection Act, 2014, the Sindh Environmental Protection Agency, with the approval of the Sindh Environmental Protection Council, is pleased to establish the standards attached in **Annexure V**.

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

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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

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 have 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

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- Climate Change and Ozone Depletion
- Energy Efficiency and Renewable
- Agriculture and Livestock
- Multilateral Environmental Agreements
- Biodiversity Action Plan

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

Applicability on project

Since the flora and fauna survey has been conducted for the proposed area and no threatening or en-dangerous species found at this area. Meanwhile, the project does not fall into sensitive area (Protected or environmentally sensitive zone) therefore the requirement of BAP is not applicable for the proposed project.

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.

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The provincial Environment Protection Agencies (Environment Protection Department in Sindh 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. The SEQs standards are applicable at Sindh provisional Projects

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 Sukkur Sindh province, it falls under the jurisdiction of the EPA-Sindh.

3.6 SINDH ENVIRONMENTAL PROTECTION ACT, 2014

The Sindh Environmental Protection Act, 2014 (SEPA) is the basic legislative tool empowering the provincial government to frame regulations for the protection, conservation, rehabilitation and improvement of the environment. The SEPA 2014 is broadly applicable to air, water, soil, hazardous waste, marine and noise pollution. Penalties have been prescribed for those contravening the provisions of the Act. The powers of the provincial Environmental Protection

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Agencies (EPAs) were also considerably enhanced under this legislation and they have been given the power to conduct inquiries into possible breaches of environmental law either of their own accord, or upon the registration of a complaint. Sindh Environmental Protection Act, 2014 (SEPA) attached as Annexure.

- ❖ It equally lays emphasis for the preservation of the natural resources of Sindh and to adopt ways and means for restoring the balance in its eco-system by avoiding all types of environmental hazards.
- ❖ Under section 17 of SEPA, "no proponent of a project shall commence construction or operation unless he has filed with the Agency an initial environmental examination or environmental impact assessment and has obtained from Agency approval in respect thereof. "
- ❖ SEPA shall review the IEE & EIA and accord approval subject to such terms and conditions as it may prescribe or require. The agency shall communicate within sixty days its approval or otherwise from the date IEE is filed failing which the IEE shall deemed to have been approved.

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

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

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

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

- ❖ A project is categorized as requiring an IEE or EIA using the two schedules attached to the Regulations.
- ❖ An EIA or IEE is conducted as per the requirement and following the Pak-EPA guidelines.
- ❖ The EIA or IEE is submitted to the concerned EPA—provincial EPAs if the project is located in the provinces or the Pak-EPA if it is located in Islamabad.

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- ❖ 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.

Complete guidelines of Preparation of EIA/IEE along with details of other concerned laws and regulations given in Pakistan Environment Protection Act 1997 are given in Annexure-III for reference.

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3.8 SINDH ENVIRONMENT PROTECTION AGENCY REVIEW OF IEE AND EIA REGULATION, 2014

The SEPA review of IEE and EIA regulations, 2014 (the 'regulations'), prepared by the SEPA under the powers conferred by section of Sindh Environmental Protection Act, 2014 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 Clause-A6: solar energy projects if falls under any sensitive, protected area and under the Clause-J: that all projects located in environmentally sensitive areas require preparation of an EIA. SEPA (Review of IEE /EIA regulations) 2014 has been provided in the report. The Project Area does not fall under the protected area; accordingly, IEE report has been prepared. Solar power Projects, transmission lines less than 11KV and grid station falls in Schedule I - lists of projects requiring an IEE while the solar energy projects if fall under any sensitive, protected areas and transmission lines (11KV and above) and distribution projects fall in Schedule II - lists of projects require an EIA.

Complete guidelines of Preparation of EIA/IEE along with details of other concerned laws and regulations outlined in the Sindh Environment Protection Act are provided in Annexure- IV for reference

3.9 POLICY FOR DEVELOPMENT OF POWER GENERATION PROJECTS, 2006

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

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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.

3.10 PROJECT DEVELOPMENT IN TERMS OF POLICY FRAMEWORK

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

Activity / Milestone	2018		2019				2020			
	3 rd QTR	4 th QTR	1 st QTR	2 nd QTR	3 rd QTR	4 th QTR	1 st QTR	2 nd QTR	3 rd QTR	4 th QTR
Preparation of Feasibility										
Submission of Feasibility Study										
Approval of Feasibility Study										
Generation License										
Tariff Application										
Signing of EPA										
Signing of IA										
Financial Close										
Project Construction										
Start of Operations										

3.10.1 Letter of Intent (LOI)

The first step for the development of a project pursuant to the Policy is to register with the GoS or AEDB and obtain a Letter of Intent. The sponsors of the Project successfully filed their application and obtained their LOI from the Directorate of Alternative Energy Department, Government of Sindh (GoS) on 15th January, 2018 after depositing their bank guarantee. The LOI is the official mandate for the Project Company to commence working on the Project, with

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the support of the GoS 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.

3.10.2 Acquisition of Land

The land is being allocated by the Government of Sindh on the recommendation of AEDB in the Sukkur area. Land measures 250 Acres of area.

3.10.3 Submission of Feasibility Study

The Project Company is required to submit a detailed feasibility study, including Technical Feasibility, Electrical Grid Studies, and Environmental Studies, to the GoS for their approval. The feasibility study of the Project is in progress. The proponent is in process of submitting the complete set of feasibility studies to GoS.

3.10.4 Generation License

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 Government of Sindh.

3.10.5 Tariff Determination

A separate application will be submitted by the Project Company to NEPRA for approval of its power tariff. This application will be submitted simultaneously with the application of Generation License.

3.10.6 Letter of Support (LOS)

Once the tariff has been approved, the Project Company can engage with its lenders to finalize its financing terms and conditions. At this stage, GoS 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 US\$ 25,000/-. 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.

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3.10.7 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.

3.10.8 Implementation Agreement (IA)

The Implementation Agreement (IA) is an agreement between the Project Company and the Government of Pakistan (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.

3.10.9 Financial Close

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.

3.11 NATIONAL AND INTERNATIONAL ENVIRONMENTAL STANDARDS

3.11.1 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:

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- 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 Sindh Environmental Quality standards. On the basis of these standards, the results of analysis would be compared with these standards to check the compliance of these standards.

Selected NEQS for liquid effluents discharged to inland waters, gaseous emission from industrial sources, emissions from motor vehicles, noise, ambient air quality and water quality standards are provided in Annexure-V

3.11.2 Sindh Environmental Quality Standards, 2016

The Sindh Environmental Quality Standards (SEQS) were first promulgated in 2015 and were last revised in 2016. In exercise of the powers conferred under the clause (g) of sub-section (1) of section (6) of SEPA, 2014, the Sindh Environment Protection Agency, with the approval of the Sindh Environmental Protection Council is established the following standards. The SEQS specify the standards for industrial and municipal effluents, gaseous emissions from industries, ambient air requirements, vehicular emissions, noise levels and drinking water quality standards.

Applicability of SEQs

SEQs are the standard document and would be applicable to all the projects developing in Sindh Province and it can be further based on Sindh Environmental Quality standards. 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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3.11.3 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 the policy document that has certain applicability on the proposed project. The project will contribute the best for the improvement of social factors as well as minimizing the environmental impact onto sensitive receptor and surroundings. The EMP certainly prepared for the proposed solar project covers the applicability of the relevant laws, guidelines (Sectorial and cross sectorial) and their implementation as required for the solar project as per defined applicable acts and regulations.

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3.11.4 Land Acquisition Act, 1984

The Land Acquisition Act (LAA) of 1894, amended from time to time, and the amendment has been done in 24th September 1984 which 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 Sindh and the proposed land is barren land with no settlement in the project area and some of settlements are located which is outside from the project land or boundary at a distance of more than 03 kilometers. The LAA is not applicable to the acquisition of land for the proposed project.

3.11.5 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.

3.11.6 The Sindh Wildlife Protection Ordinance, 1972

The Sindh Wildlife Protection Ordinance, 1972 empowers the government to declare certain areas reserved for the protection of wildlife and control activities within these areas. It also provides protection to endangered species of wildlife.

Applicability on project

As no Project activities are planned in declared protected areas, provision of this law is not applicable to the proposed Project.

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3.11.7 The Sindh Fisheries Ordinance, 1972

The Sindh Fisheries Ordinance, 1980 regulates fishing in public waters, including the coastal areas of Sindh. It empowers the Government of Sindh to issue licenses for fishing in public waters, place restrictions on the type of equipment that can be used for fishing, restrict fishing in certain areas or of certain species of fish, regulate the onshore trade of fish catch, and regulate the fish processing industry. Article 8 of the Ordinance prohibits the discharge of wastewater to public waters without the consent of the Director Fisheries.

Applicability on the Project

As no activities are planned for this Project which can breach this Ordinance, provision of this law is not applicable to the proposed Project.

3.11.8 The Forest Act 1927

The Forest Act, 1927 empowers the government to declare certain areas as reserved forest areas. These forests are declared as a reserved forest and no activity should be done in that area like cutting of trees, shrubs, land clearing and any ecological changes in the area.

As no reserved forest exists in the vicinity of the proposed Project, the provisions of this law are not applicable to the proposed Project.

3.11.9 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.

3.11.10 The Antiquities Act, 1975& the Sindh Cultural Heritage (Preservation) Act, 1994

The Antiquities Act of 1975 ensures the protection of Pakistan's cultural resources. The Act defines "antiquities" as ancient products of human activity, historical sites, or sites of anthropological or cultural interest, national monuments, etc. The Act is designed to protect these antiquities from destruction, theft, negligence, unlawful excavation, trade, and export.

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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 archaeological significance.

Under the Act, the Project proponents are obligated to ensure that no activity is undertaken within 61m (200 ft.) of a protected antiquity, and to report to the Department of Archaeology, Government of Pakistan any archaeological discovery made during the course of the Project. The Sindh Cultural Heritage (Preservation) Act, 1994, is the provincial law for the protection of cultural heritage. Its objectives are similar to those of the Antiquity Act, 1975. No antiquity protected under these two laws was identified in the vicinity of the proposed Project.

3.11.11 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 the proposed project.

3.11.12 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 generates only packing materials, plastic pallets and cardboard materials etc.

3.11.13 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.

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3.11.14 Employment 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 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.

Artistic Solar Energy Private Limited (ASEPL) and its contractors will be bound by the ECA to disallow any child labor at the project sites or campsites.

3.11.15 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.

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- 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, 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.

3.11.16 Pakistan Penal 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.

3.11.17 National Resettlement Policy / Ordinance

The Ministry of Climate Change, 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

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policy. However, if necessary, appropriate amendments to the LAA 1894 will also be proposed to facilitate the application of the Resettlement Ordinance.

Since there has not been much progress on the enactment of the Resettlement Ordinance; hence this is not relevant for the proposed project.

3.11.18 Sindh 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. This law is applicable during the construction and operation of the project.

3.11.19 The IUCN Red List

Some animal species are already extinct in Pakistan, and many are internationally threatened. The 1996 IUCN Red List of Threatened Animals classifies 37 species and 14 sub-species of mammals that occur in Pakistan as internationally threatened or near-threatened.

The Red List is based on field data that is more than 10 to 15 years old and needs to be re-assessed. The country also provides critical habitat to 25 internationally threatened bird species and 10 internationally threatened reptiles.

According to the National Avian Research Centre in Abu Dhabi, with Houbara's birth rate of 5 per cent a year and if number of Houbara keeps decreasing at the same rate with more than 6,000 being bagged by hunting parties and more than 4000 smuggled out of country, the worst scenario is that the Houbara bustard would disappear as the species by 2015.

There are a number of organizations that were formed to protest the illegal hunting and preserve the wildlife. This includes National Council for Conservation of Wildlife (NCCW), established in 1974 and supported by the UN, which breaks into three groups: Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), Convention on Wetland of International Importance Especially as Waterfowl Habitat (RAMSAR) and Convention on the Conservation of Migratory Species of Wild Animals (CMS).

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The project area has not any extinct species and the detail of flora and fauna are discussed in section 5.

3.11.20 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.

3.11.21 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.

3.12 WORLD BANK GUIDELINES ON ENVIRONMENT

The principal World Bank publications that contain environmental guidelines are listed below.

- ❖ Environmental Assessment Operational Policy 4.01. Washington, DC, USA. World Bank 1999. Environmental Assessment Sourcebook, Volume I: Policies, Procedures, and Cross Sectorial Issues. World Bank Technical Paper Number 139, Environment Department, the World Bank, 1991, Pollution Prevention and Abatement Handbook: Towards Cleaner Production, Environment Department, the World Bank, United Nations Industrial Development Organization and the United Nations Environment Program, 1998. Environmental Health and Safety (EHS) guidelines, International Finance Corporation (IFC) World Bank Group, 2007.
- ❖ The first two publications listed here provide general guidelines for the conduct of an IEE and address the IEE practitioners themselves as well as project designers. While the

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Sourcebook in particular has been designed with Bank projects in mind and is especially relevant for the impact assessment of large-scale infrastructure projects, contains a wealth of information which is useful to environmentalists and project proponents.

- ❖ The Sourcebook identifies a number of areas of concern, which should be addressed during impact assessment. It sets out guidelines for the determination of impacts, provides a checklist of tools to identify possible biodiversity issues and suggests possible mitigation measures. Possible development project impacts on wild lands, wetlands, forests etc. are also identified and mitigation measures suggested. The Sourcebook also highlights concerns in social impact assessment and emphasizes the need to incorporate socio-economic issues in IEE exercises.

The EHS guidelines published by IFC are technical reference documents that address IFC's expectations regarding the industrial pollution management performance of its projects. They are designed to assist managers and decision makers with relevant industry background and technical information. This information supports actions aimed at avoiding, minimizing, and controlling EHS impacts during construction, operation, and decommissioning phase of project or facility.

The World Bank Guidelines for noise are provided in Table 2-1.

Table 3.1 World bank Guidelines for Noise levels			
No.	Receptor	Day (07:00-22:00)	Night (22:00-07:00)
1.	Residential & Institutional educational	55	45
2.	Industrial & Commercial	70	70
Source: Pollution Prevention and Abatement Handbook World Bank Group (1998)			
Notes: Maximum allowable log equivalent (hourly measurements) in dB(A)			

3.13 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)

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- 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.

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 project as

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 Artistic Solar Energy Private Limited (ASEPL) Solar Power Project in Category C (Low Hazard) as mentioned in Section 03.

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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 major resettlement or temporary relocation or acquisition of land is involved. This has mentioned in Section 08 of the IEE report and briefly explained this matter.

Principle 6 (Grievance Mechanism): This Principle will not apply since 'no' resettlement or temporary relocation or acquisition of land is involved. It not only restricts 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, Sindh EPA is authorized to take corrective and even coercive action.

Principle 9 (Independent Monitoring and Reporting): This Principle will be applicable to the Artistic Solar Energy Private Limited (ASEPL) for Solar Power Project since it falls in category C of projects requiring an IEE.

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Principle 10 (EPFI Reporting): The concerned EPFI may safely commit to report publicly at least annually about its Equator Principles implementation processes and experience.

3.14 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
- ❖ 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

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- ❖ Promote improved social 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 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

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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 Artistic Solar Energy Pvt. Ltd for the Solar 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.

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:

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- ❖ 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.

There is no permanent settlement or hamlet within the designated area. Project Land has been leased by the Sindh Government to AMPL.

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.

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.

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- ❖ 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.

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.

Although no site of cultural heritage is known to exist on project site as per existing surveys, however, if any unexpected finds are encountered during earthworks or excavation works the following mitigation. The cultural authority will be informed in order to seek guidance and

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specialist advice for management of the find(s) and how best to proceed, given its nature and extent _ All findings will be recorded.

3.15 OPIC GUIDELINES FOR SOLAR POWER PROJECT 2012

These guidelines address evaluation features most significant to solar photovoltaic (PV) projects, both utility scale central generating facilities and stand-alone units. PV technologies convert energy from sunlight directly into electricity, using large arrays of solar cells electrically connected and encapsulated as modules.

These guidelines present potential environmental and social issues associated with solar PV energy projects, how OPIC may consider each of these issues when screening projects, applicable guidelines and standards, recommended measures to mitigate impacts, information needed to review a project and monitoring recommendations. The solar PV project is further screened as either Category A or Category B.

- Category A solar PV projects are likely to have significant adverse environmental and social impacts that are irreversible, sensitive, diverse or unprecedented.
- Category A projects require submission of an Environmental and Social Impact Assessment (ESIA) developed in accordance with IFC P.S. 1, an on-site due-diligence visit by an OPIC environmental analyst or a third-party consultant approved by OPIC and development and implementation of an Environmental and Social Action Plan (ESAP). Within three years of the execution of the contract with OPIC, Category A projects are required to conduct a third-party audit.

Issues that require careful consideration in determining whether a project is Category A or B for solar PV projects include the following:

- Potential for significant habitat alteration or wildlife disturbance, including disruption of wildlife migration corridors.
- Potential for significant socio-cultural impacts related to land acquisition, land use, indigenous peoples, and cultural heritage
- Potential for significant environmental and social impacts from ancillary features.
- Potential for significant environmental and social impacts due to cumulative effects.

If a project originally screened as a Category A is subsequently found to result in major or unreasonable adverse environmental, social, health or safety impacts, OPIC may decide to decline support.

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Advanced planning in siting may be used to avoid or significantly reduce adverse impacts of solar PV projects. A solar PV project may be screened as Category B if significant impacts are avoided, adequately mitigated and sufficient information is provided to assess such impacts, and there is no significant opposition to the Project by local stakeholders. This section describes environmental and social evaluation features associated with solar PV projects, how each of these features may affect screening determinations, and measures to mitigate impacts as provided in applicable guidelines and standards. So, the proposed project falls under the Category B due to less or no significant impacts.

OPIC Environmental Guidelines 2012 for Solar Power Project are attached as Annexure VI.

3.16 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 Sindh Province, hence this IEE report will be sent to the Sindh-EPA for review.

3.17 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,

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- ❖ UN Convention to Combat Desertification,
- ❖ Convention for the Prevention of Pollution from Ships (MARPOL),
- ❖ UN Convention on the Law of Seas (LOS),
- ❖ Stockholm Convention on Persistent Organic Pollutants (POPs),
- ❖ 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 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.

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SECTION 4

PROJECT DESCRIPTION

4 PROJECT DESCRIPTION

4.1 LOCATION OF PROJECT

The Solar Power Project is located in Sukkur, that is located in the North of Sindh. The National Highways (N5) and (N55) and Motorway (M9) are the major connecting roads to the Project site, having total road distance of approximately 500 km from Port Qasim. The Project site - contain 250 Acres of land which has been leased by the Government of Sindh acquired by the project company. The site is located near Sukkur, Sindh that is towards the North of Karachi. The planned movement from Port Qasim to the site will be through the National and Super highways. The major section of the track from Karachi to the site is a multi-lane road, having a relatively flat terrain.

The Project site has very sparse vegetation consisting of small shrubby bushes and flat terrain area Location of the Project is shown in Figure 4.1.

The location of site can be viewed in **Figure 4.1** and **Figure 4.2**. Nearby areas of the project site is shown in **Figure 4.3**.

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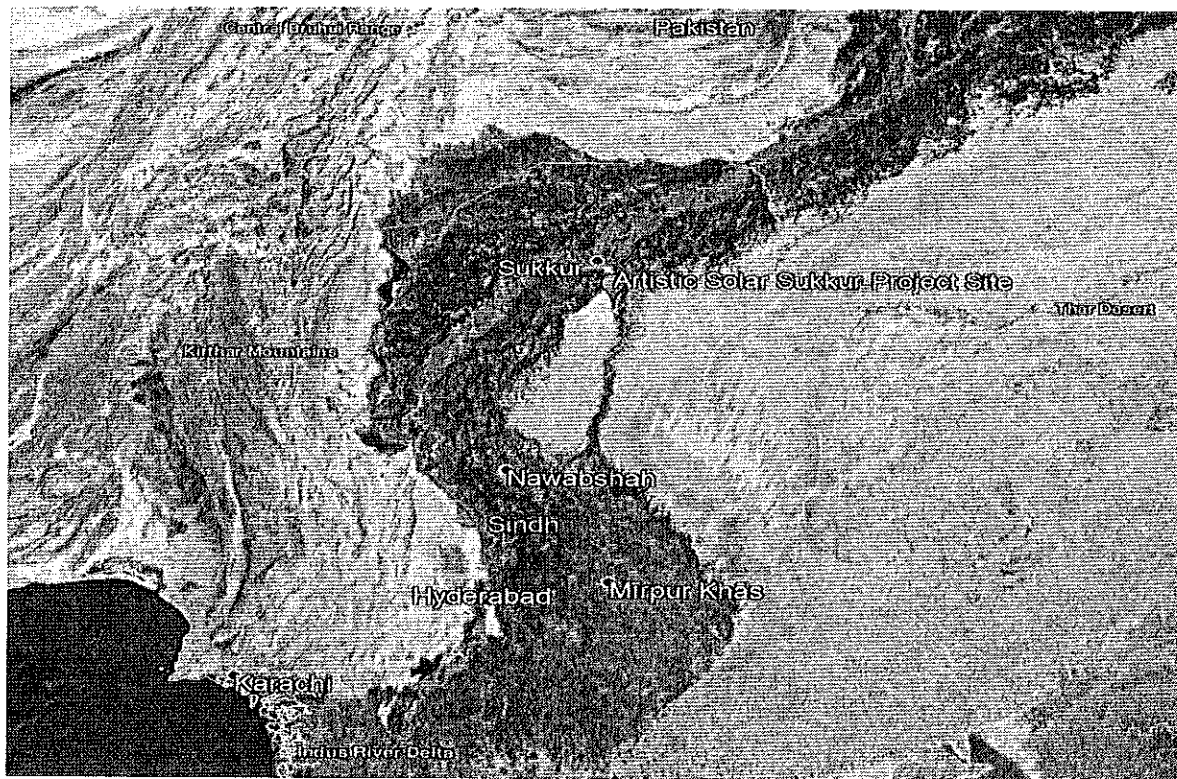


Figure 4-1: Location of Site on Pakistan Map

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Figure 4-2: Overview of the Project Site

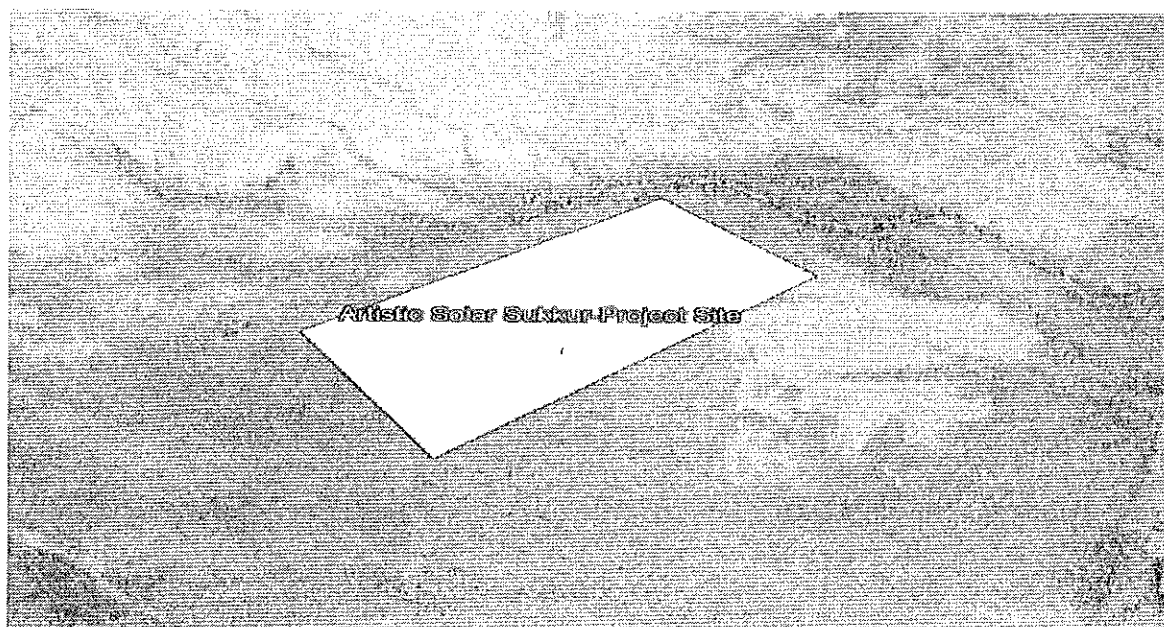


Figure 4-3: Project Site Overview

Below is the map of Sukkur district showing the towns, places and road network;

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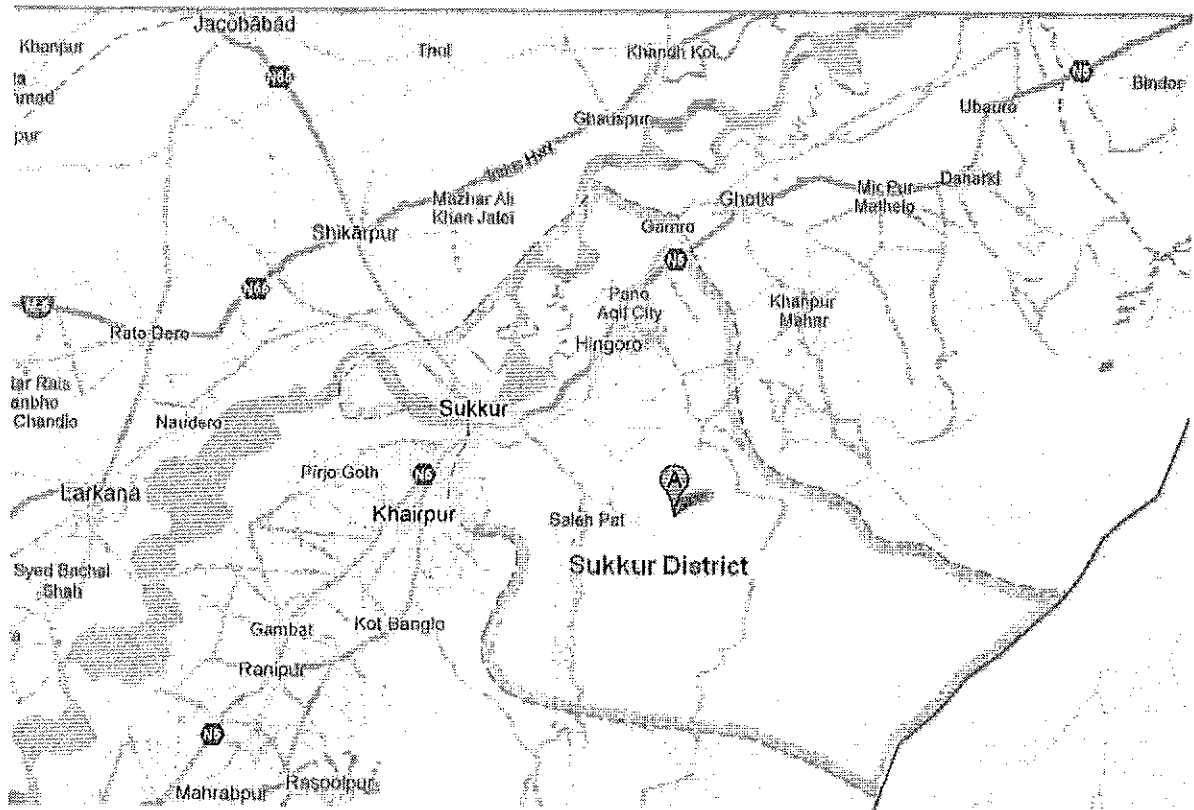


Figure 4-4: Map of Sukkur

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The coordinates of Project Site are given in **Table 4.1** and marked in **Figure 4.5**;

Table 4.1: Geographical Coordinates of Project Site

Boundary Point	Geodetic	
	Latitude	Longitude
1.	27°23'40.44"N	68°57'26.57"E
2.	27°23'30.37"N	68°57'47.80"E
3.	27°22'54.58"N	68°57'8.75"E
4.	27°23'11.92"N	68°56'48.45"E

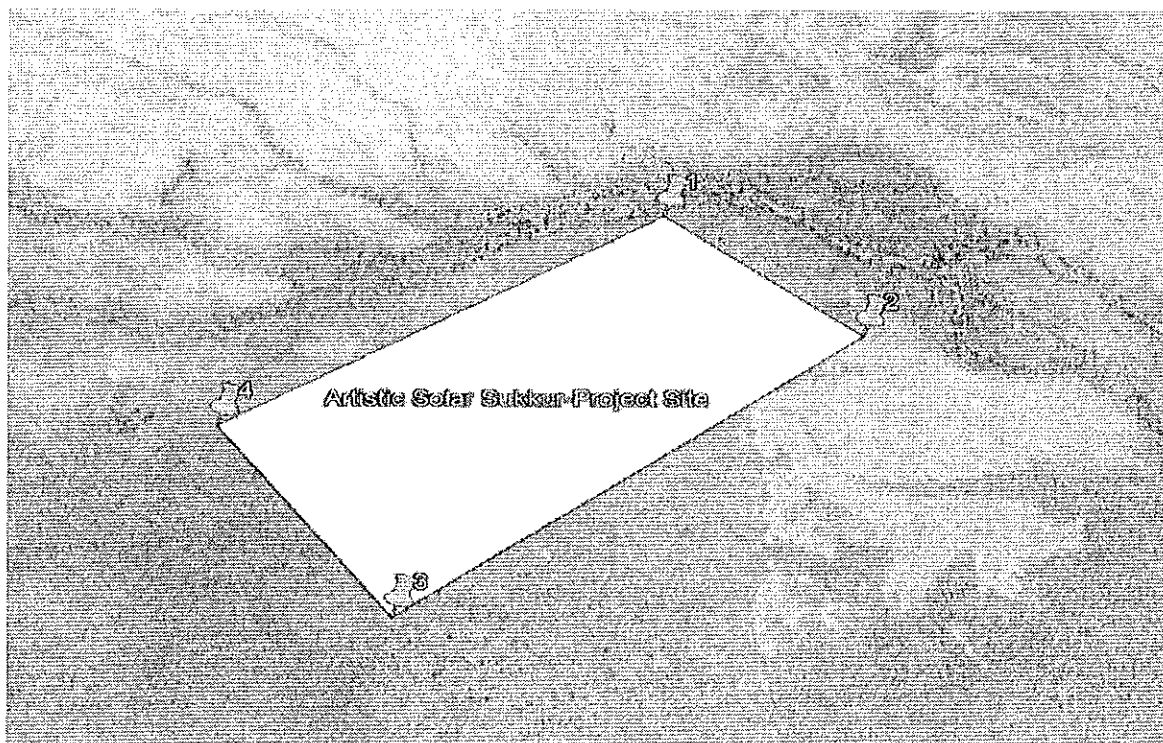


Figure 4-5: Project Site Coordinates

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The project area is open and can be seen from the images below;



Project Site (View-1)

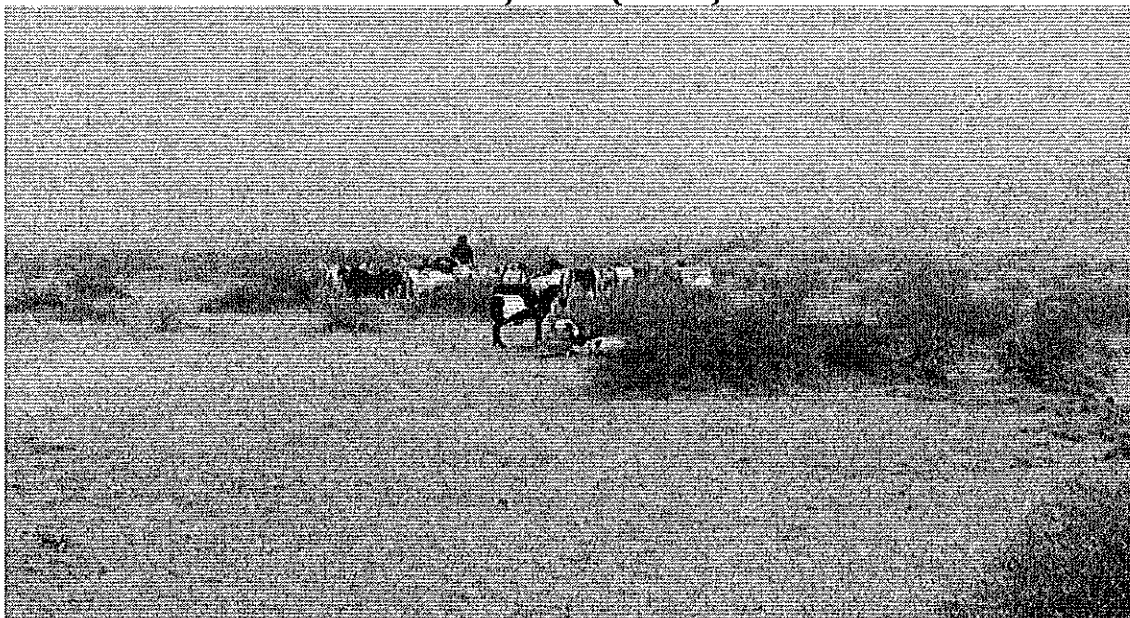


Figure 4-6: A View of Project Site

Project Site (View-2)

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4.2 ROAD ACCESS

The Project site is easily accessible throughout the year. The National Highways (N5) and (N55) and Motorway (M9) are the major connecting roads to the Project site, having total road distance of approximately 500 km from Port Qasim. The site is located near Sukkur, Sindh that is towards the North of Karachi. The planned movement from Port Qasim to the site will be through the National and Super highways. The major section of the track from Karachi to the site is a multi-lane road, having a relatively flat terrain.

The satellite overview of the track from Karachi to the Project site and the total distance from Karachi to the project site is approximately 500 km is shown in Figure 4.7.

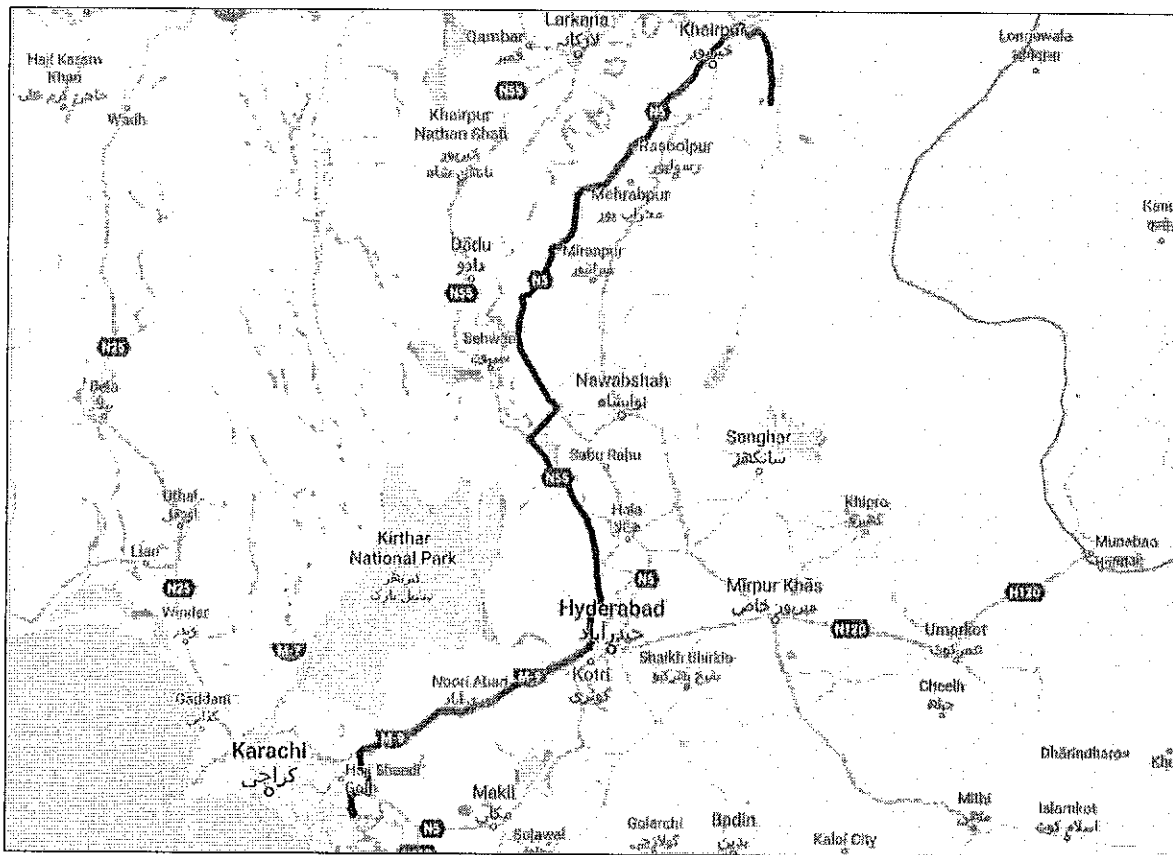


Figure 4-7: Orientation of Project Site from Karachi (Aerial View)

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The major section of track from Port Qasim to the site is via the National and Super high-way. The track is a multi-lane road, it has a flat terrain, and long and heavy vehicles can easily navigate through this road. The aerial distance of the Project site from Sukkur city is nearly 40km as shown in 4.8.

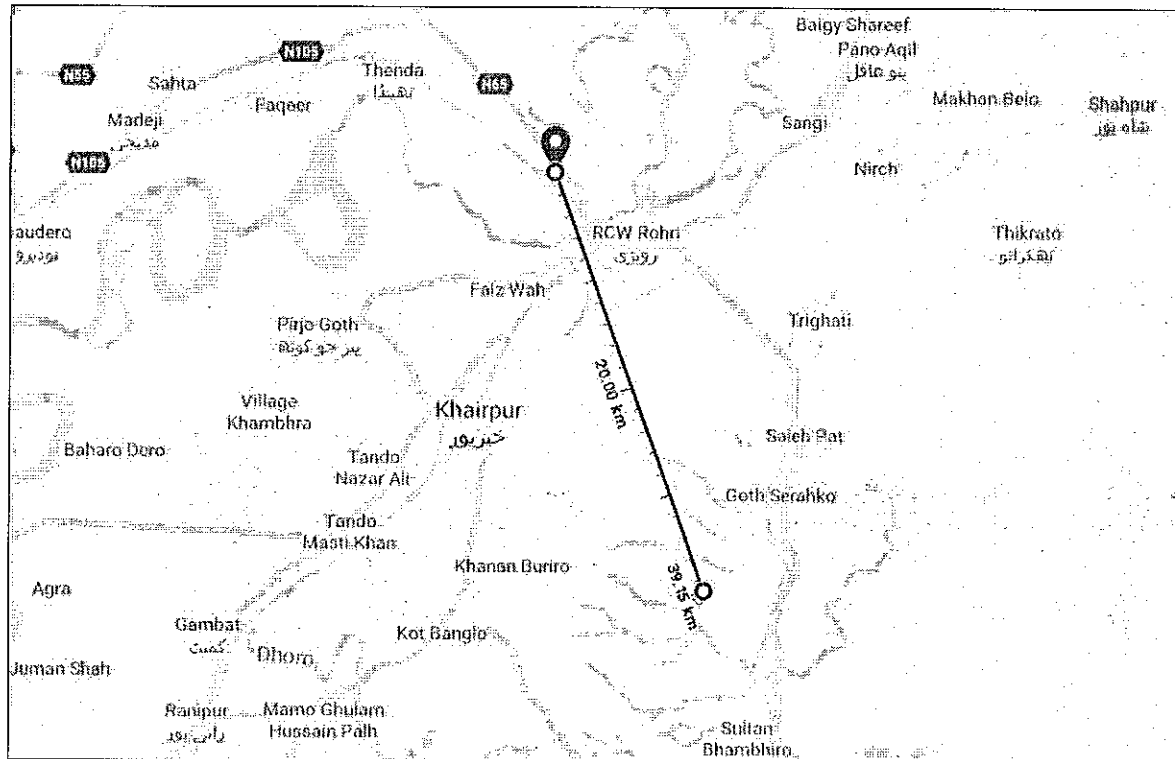


Figure 4-8: Orientation of Project site from Sukkur city (blue marker) (Aerial View)

The Project site is located towards the South of Sukkur, the aerial distance of the port from the project site is approximately 40 km. There are many bridges and fly overs on the way from Bin Qasim port to the site. The load bearing capacity of the bridges in between the Thatta and the port is considered reliable, however, the EPC Contractor will establish its own confidence and requirements for transportation of equipment to the site.

The track starts from Port Qasim, following which it joins the National Highway (N5). Passing from the link road between National highway and Motorway (M9), the track then joins the motorway, which stretches until the national highway (N55) junction near Jamshoro. From Jamshoro onwards the track continues on national highway (N55) till Aamri Town where it

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again joins the national highway (N5). The track continues from this point till Sukkur city and finally till the Project Site. Details of the track are present in the undergoing sections.

The track continues on the N5 highway for 35 km before switching to inner city roads after passing by Khairpur. Just before Sukkur, the track exits N5 national highway and follows the city roads (Naro Canal Rd and Aror Bachal Shah Rd) for approximately 7 km to Gagrawara town. The track turns off road from Gagrawara town to reach Project site. This access road is of approximately 4 km.

Description of track towards project site is shown in figure 4.9.



Figure 4-9: Depiction of track, switching from M9 to N55 at Jamshoro

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4.3 LOCATION OF GRID

The Project is planned to be built in the Sukkur region. The electrical network within the vicinity of the site of the plant comprises of LV (11 kV) and HV (132 kV and 220 kV) lines. For projects with installed capacity in excess of 10 MW, connection must be made with HV lines. The nearest 66kVA grid station Nara 1 and bidding of up gradation of grid is in process i.e, 132kVA Nara 1 Grid Station which is approximately 7.5 km away from the project site. Another 220kV grid station is located in tehsil Rohri which is approximately 30 kilometers away from project site.

A separate electrical and grid interconnection study will be conducted for the project including Power Quality, Load Flow, Short Circuit and Power Evacuation.

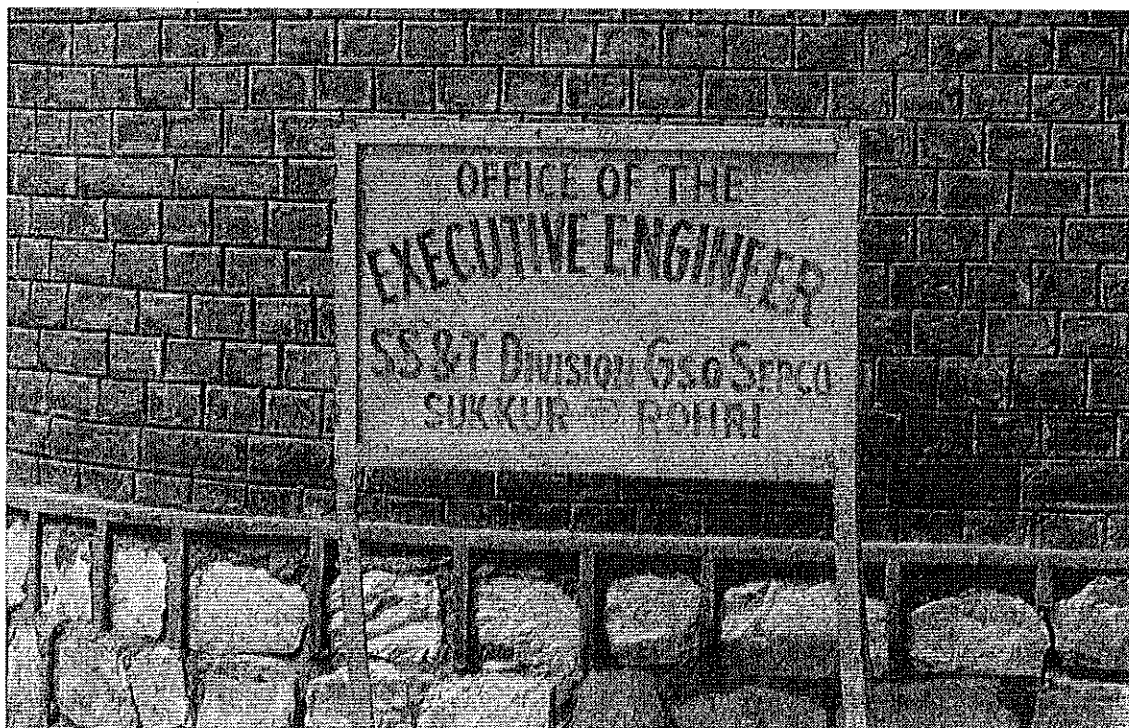


Figure 4.11: Nearest grid station

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4.4 SCOPE & LAYOUT

A 50 MW solar PV plant will be constructed and operated on the site. The "PV Layout" consists of control room and substation as well. Different solar arrays will be there in each section. The total number of panels will be around 192500 solar panels).

The electricity generated will be directly fed into the existing Grid Station located around 7.5 kilometers from the site.

Interconnection of PV modules and information of arrays is shown in **Figure 4.12** and **4.13**.

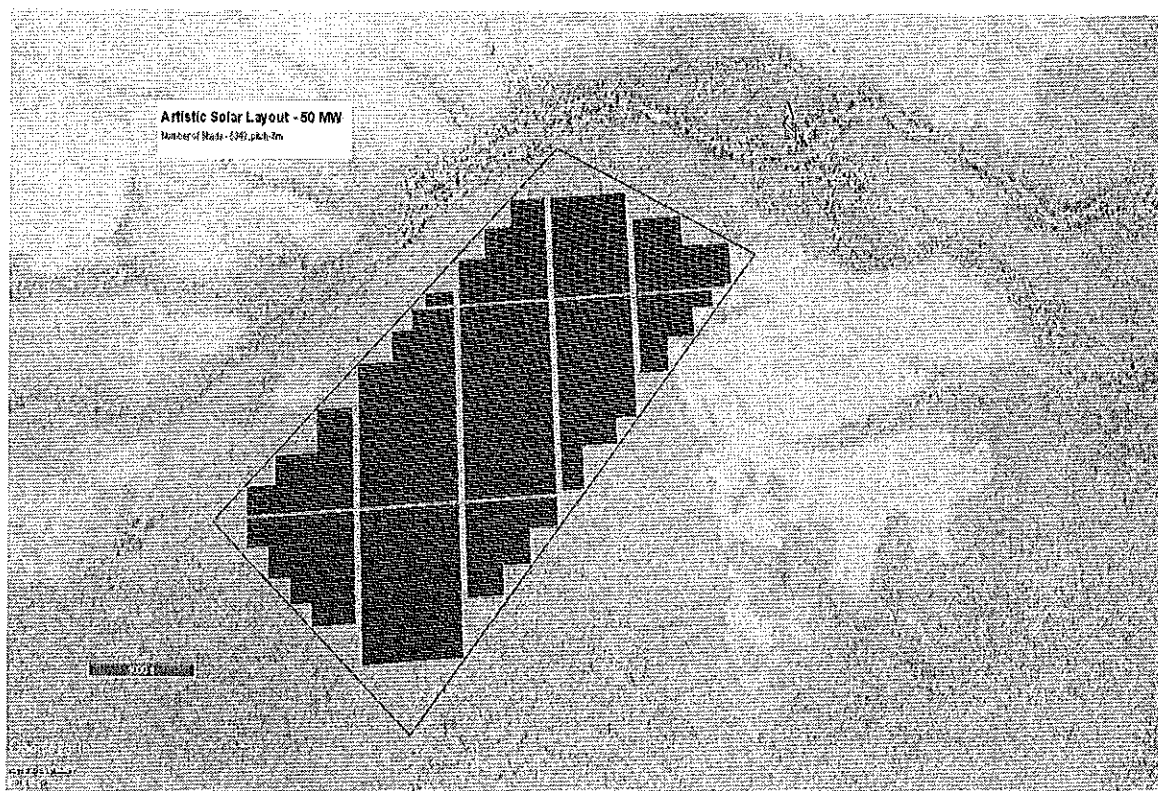


Figure 4.12: PV Layout

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SECTION 5

BASELINE ENVIRONMENTAL CONDITIONS

5 BASELINE ENVIRONMENTAL CONDITIONS

5.1 PROJECT AREA

The Solar PV Project is located in Sukkur, which is located approximately 500 km from Karachi, Pakistan's commercial hub and main coastal/port city. The project site is located around 60 Kilometers away from Sukkur city.

The total land area for the implementation of 50 MW solar PV project is about 250 Acres which has been leased by the Government of Sindh acquired by the project company. Sukkur is one of the oldest cities of Pakistan and is located at 60 km away from project site. Sukkur is the central city of Sindh province; it is located on the west bank of the river Indus.

The Project site has very sparse vegetation consisting of small shrubby bushes and flat terrain area. Location of the Project is shown in Figure 5.1.

There are around four settlements located near the project site but all of these are located away from project boundary i.e, approximately 800 meters to 04 km. As per survey, the area - around 5 Km from the project site is considered as influence zone as shown in **Figure 5.1** though the data has been collected from the influential zone. The cumulative assessment shall be under consideration at the time of operational phase.

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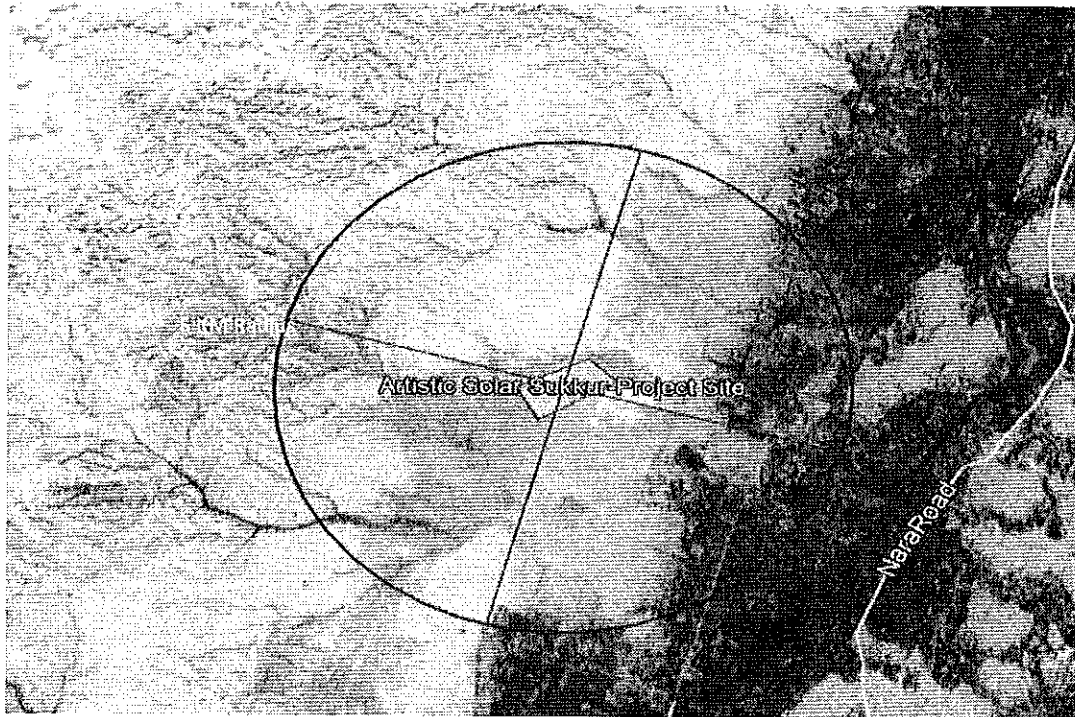


Figure 5-1: Boundary of Project Influence Zone

5.2 TOPOGRAPHY

Topographically speaking, it is spanned from 27°05' to 28°02' north latitudes and from 68°47' to 69°43' east longitudes. The city of Sukkur is located at an altitude of 220 feet 67 m from sea level, having terrestrial coordinates 68°52' east and 27°42' north. It is also the narrowest point of the lower Indus course.

Sukkur district shares its northern border with Shikarpur and the recently constituted Kashmore districts. Ghotki is located on the north eastern side while Khairpur on the south. Sukkur also shares its border with India Jaisalmer, Rajasthan. Sukkur is also connected by road and by air with all major cities of Pakistan.

The water level in this area is higher than in the upland. There is a seasonal water channel going through project site. The width of water channel is 4 Ft to 8 Ft ft and depth is 3 Ft to 4 Ft. The coordinates of Water Channel are Lat 27.5308°, Lon 69.0375°. The water channel is shown in previous section 4 of **Figure 4.2**. The soil is sandy. The upland is flat plains sloping from north-

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west to south-west. The general height of the area is from 67 to 70 meters above the sea level. Topographic map of Sukkur derived from satellite mapping is shown in **Figure 5.2**.

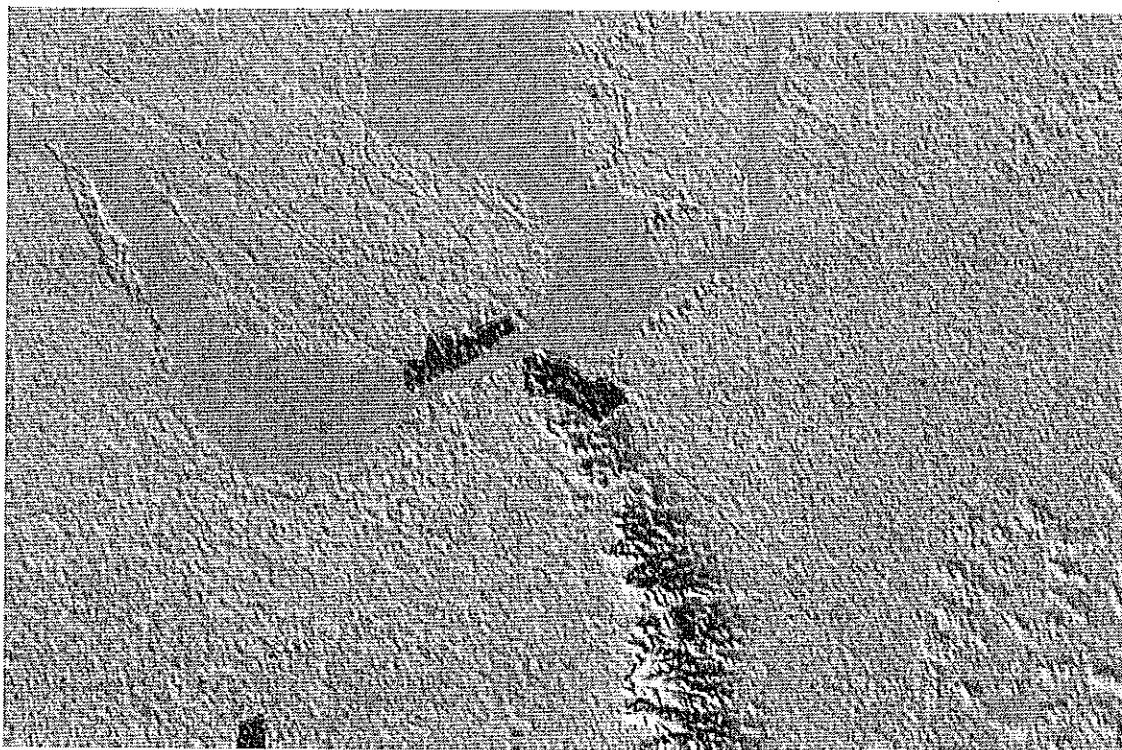


Figure 5-2: Topographic Map of Sukkur District

5.3 CLIMATOLOGY

Sukkur has extremes of climate; and the climate of Sukkur is characterized by hot and hazy weather during summer days. The summer season begins from March – April and end before October. June (month before monsoon) is the hottest month in Sukkur with its average high temperatures at 35°C and it goes from 35 to 50°C. While winter are dry and cold. The coldest month is January and temperature ranges from 10 to 20°C with an average high is 15.6°C. The average rainfall of the district is 20-30 mm, (ranges from 0.59 mm to 25.62 mm) per annum. Sukkur has 8.4 hours of sunshine daily on average.

The climate information of Sukkur is shown in Table 5.1.

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west to south-west. The general height of the area is from 67 to 70 meters above the sea level. Topographic map of Sukkur derived from satellite mapping is shown in **Figure 5.2**.



Figure 5-2: Topographic Map of Sukkur District

5.3 CLIMATOLOGY

Sukkur has extremes of climate; and the climate of Sukkur is characterized by hot and hazy weather during summer days. The summer season begins from March – April and end before October. June (month before monsoon) is the hottest month in Sukkur with its average high temperatures at 35°C and it goes from 35 to 50°C. While winter are dry and cold. The coldest month is January and temperature ranges from 10 to 20°C with an average high is 15.6°C. The average rainfall of the district is 20-30 mm, (ranges from 0.59 mm to 25.62 mm) per annum. Sukkur has 8.4 hours of sunshine daily on average.

The climate information of Sukkur is shown in Table 5.1.

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Table 5.1: Temperatures (°C) Statistics for Sukkur District

Item	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Average High Temperature (°C)	23	25	31	38	42	44	41	39	38	35	30	24
Average Low Temperature (°C)	8	11	16	22	26	28	28	27	25	20	14	10

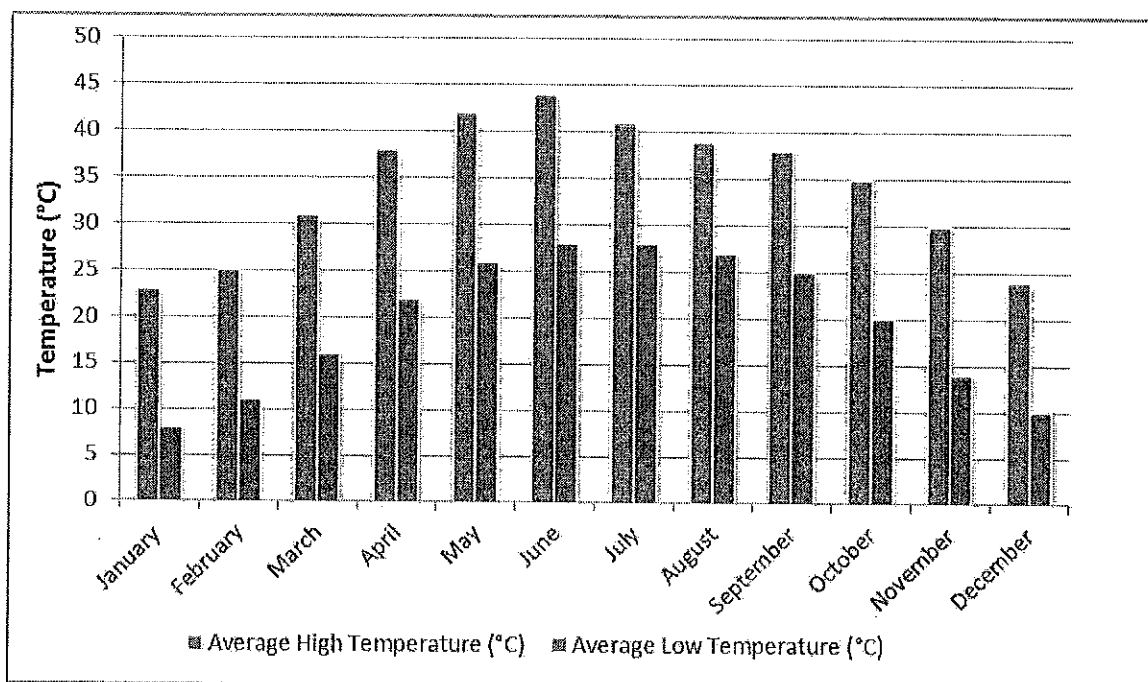


Figure 5-3: Monthly Average Temperature profile of Sukkur

Table 5.2: Average Precipitation and Rainfall Days in Sukkur Region

Item	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
------	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

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Average Precipitation (mm)	3	8	6	2	4	4	26	20	10	1	1	4
Average Rainfall Days	3	8	6	2	4	4	23	17	9	1	1	4

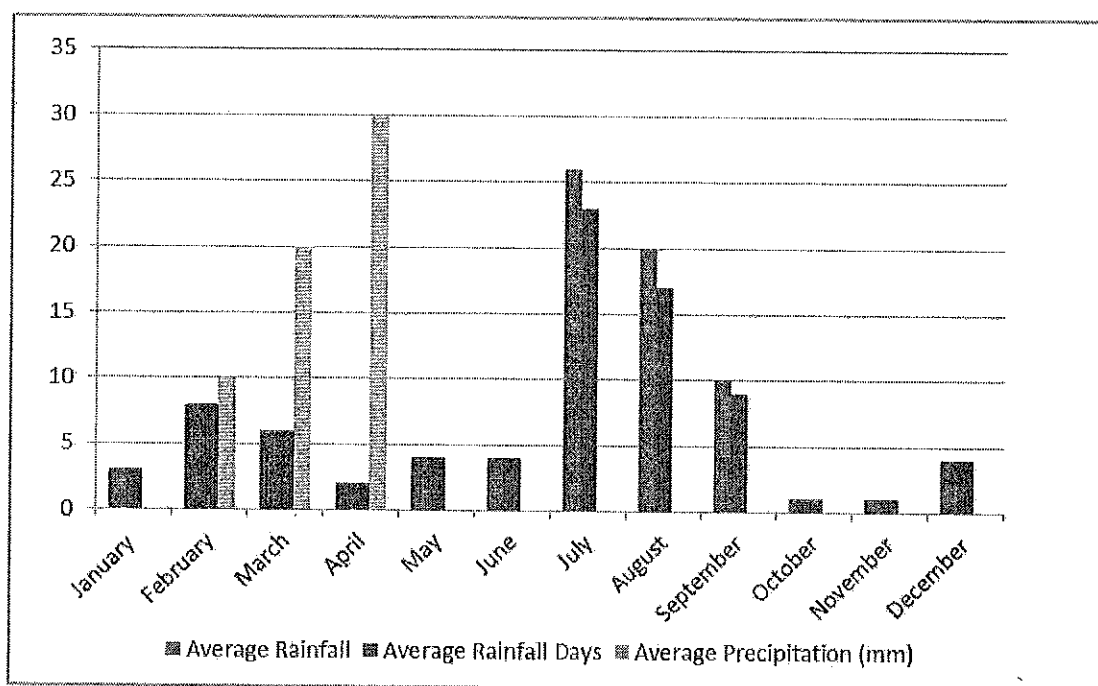


Figure 5-4: Monthly Average Rainfall Profile of Sukkur

Maximum and Minimum Temperature Regime Map of Pakistan is shown in **Figure 5.5, Figure 5.6 & Figure 5.7.**

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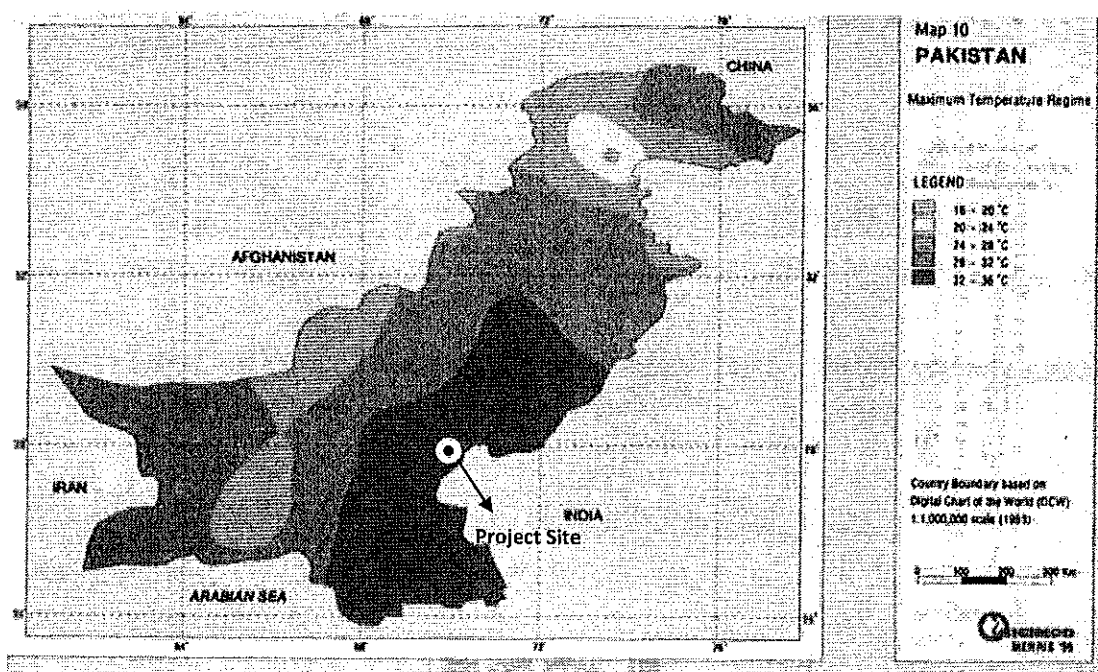


Figure 5-5: Maximum Temperature Regime Map of Pakistan

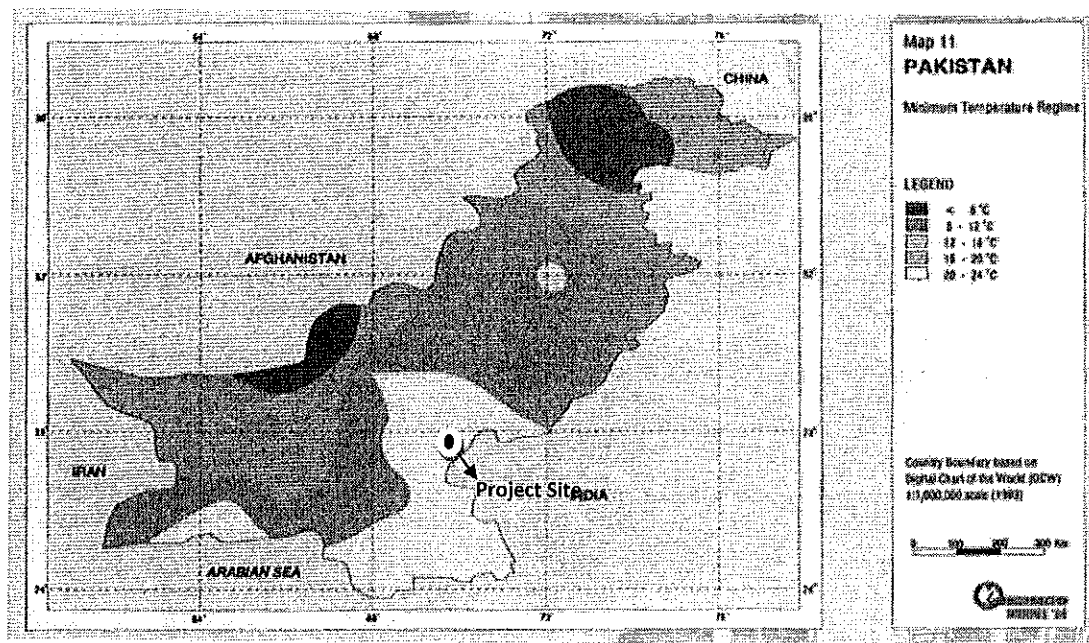


Figure 5-6: Minimum Temperature Regime Map of Pakistan

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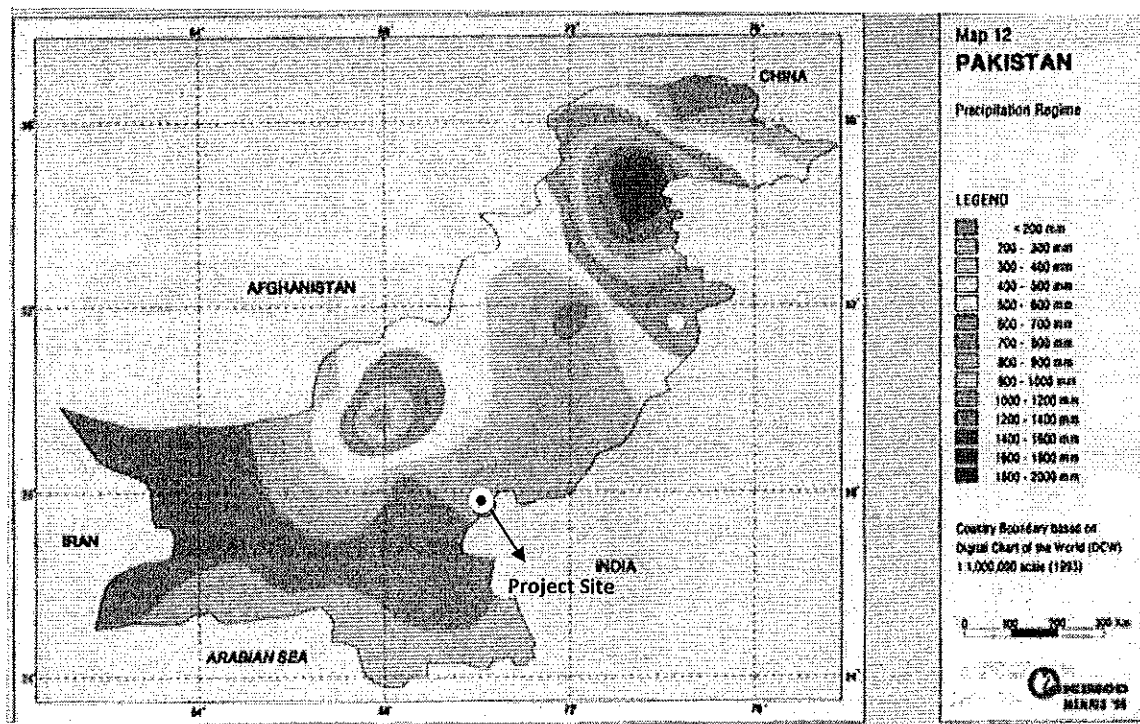


Figure 5-7: Rainfall Map of Pakistan

5.4 Biological Environment

RE2 project team (Flora and fauna experts) done by Dr. Syed Ali Ghalib have conducted the field survey for the study following were the methodology.

A. Methodology

Data in respect of fauna and flora were gathered both from primary and secondary sources. The sampling locations were randomly selected, ensuring that representative locations are sampled for each habitat and the maximum possible number of species belonging to each habitat is recorded.

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Prior to the start of actual field work, there is a need to collect a sift of information to form a general overview on the wildlife populations on the site (and nearby areas) and their likely sensitivity.

This is largely a secondary data collection exercise during which information is sought and collected on:

- (i) Mammals, birds, reptiles, amphibians and plants:
- (ii) Habitats:
- (iii) Designated / protected / sensitive sites in the vicinity of the proposed development

After having made a general overview of the likely animal populations on the site, their likely sensitivity and the proximity of the designated / protected sites forms the main objective of the field survey programme. This allows the selection of target / key species¹ and their principal habitats in the Area.

Data in respect of fauna and flora were gathered from both primary and secondary sources. The sampling locations were randomly selected, ensuring that representative locations are sampled for each habitat and the maximum possible number of species belonging to each habitat is recorded.

Secondary data were collected through literature search including the studies conducted within and in the surroundings of the Project Area and information collected from the local communities and from the Sindh Wildlife Department.

The vegetation surveys were carried out by laying 20 x 20m quadrates within the study area. The plant communities were determined within the habitat.

Field Surveys were undertaken in the project area to collect data about the fauna of the area. Standard direct and indirect methods were applied to record the occurrence, distribution and

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population of various animal species in the area, which included point count surveys, roadside or track counts, line transect method and tracks/signs counts.

Survey Methods

There are two main survey types involved in such studies.

Distribution and status surveys: These are meant to record the occurrence, distribution and population / seasonal status of the various species using the site as breeding, wintering or staging site.

Vantage Point Surveys: These surveys comprise a series of observations from a certain fixed chosen location to quantify the flight activities of the birds at a proposed development site, which provides data to estimate the collision risk of the birds (particularly the migratory ones) against the blades of the turbine.

The survey area must adequately cover the entire development area. This includes access tracks; borrow pits, nearby villages, forested area, water points, farmland, vegetative area and wastelands.

Habitat loss and displacement may affect animals out with the project site. Therefore, surveys are also made in the area extending at least 500m beyond the project area boundary on either side.

Snap shots of Biological Environment survey are attached as Annexure IX.

B. Principal Habitats

The Project Area is mostly a wasteland comprising of the following main habitats.

- Arid
- Sandy Plain Area
- Rocky Plain Area
- Scrubland

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5.4.1 Flora

Flora survey conducted by Project team experts revealed that, during the fieldwork in the Project Area, 14 plant species belonging to 10 families were identified. Out of these, there were eleven shrubs, two grasses and one herb. The quantitative analysis of the floral composition was made and four distinct plant communities were identified based on life forms of the identified species. The dominant vegetation comprises of *Suaeda fruticosa*, *Tamarix indica*, *Acacia jacquemontii*, *Capparis deciduas*, *Calotropis procera*, *Zizyphus nummularia*, *Aerva javanica*, *Leptadenia pyrotechnica*, *Prosopis juliflora*, *Tephrotia strigosa* and *Sacchorum bengalensis* the dominant and widespread plant species of the area, these are well established and surviving well.

Project Area has 14 plant species belonging to 10 families were identified sampled in the main locations within the project Area. Out of these, 11 species were perennial, 02 were annual and 01 were herbs. The quantitative analysis of the floral composition was made and four distinct plant communities were identified based on life forms of the identified species. Summary of Floral composition found in project area is shown in table 5-3;

Table 5-3: Floral Composition found in Project Area

Life Forms	Numbers
Shrubs	11 species
Herbs	02 species
Grasses	02 species

No endemic rare plant species was recorded from the Project Area during the survey.

5.4.2 Fauna

The wildlife in the area has been affected by colonization of the area, and many wild life species have either diminished or vanished. No threatened wildlife species has been reported from the Project Area. The impact assessed on wildlife after flora and fauna survey found minimal to no impact as mentioned in section 7.3.7, however at construction period it will be anticipated up to some limit for specific period that could be mitigated by complying EMP.

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Faunal attributes recorded during the study period is given below in table 5-4.

Table 5-4: Faunal Attributes in the Project Area

Attributes	Numbers
Mammals	07 species
Birds	14 species
Reptiles	07 species

A. Mammals

During the present survey, 07 species were recorded and shown in table 5-4. The area has very thin population of mammals. Only solitary individuals of big mammals such as Indian Jackal and Desert fox have been recorded. Small mammals such as Five Striped Palm Squirrel, Indian and Desert Gerbils, House Mouse and House Rat were less common. Small Indian Mongoose, Desert Hedgehog, Crested Porcupine, and Desert Hare were reported scarce.

B. Birds

14 species were recorded from the area (Table 5-4). Out of which, Ring Dove, Little Brown Dove, Common Myna, Common Babbler and Crested Lark were common, while the other nine species were less common.

C. Reptiles

As regards the Reptiles, 07 species were recorded during the present survey (Table 5-4). Bluetail Sand Lizard, Desert Monitor, Saw scaled Viper, Common Sand Boa, Plain's Racer and Common Tree Lizard have been reported from the area.

List of Flora and Fauna found in the Project area is attached as Annexure VIII

D. Protected Areas

There is no Wildlife Protected Area in the close vicinity of the site. Takkar Wildlife sanctuary and Nara Canal is more than 6.5 km and 16 km away from the site. No Protected / Reserve Forest or any Rangeland lies in the vicinity of the Project Area.

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Cumulative Impact of other project

Cumulative impact shall be analyzed once the project comes into execution.

5.5 HUMAN SETTLEMENT PATTERN

Sukkur is the third largest city of Sindh province, situated on the west bank of Indus River (Pakistan) in Sukkur District. The district of Sukkur covers an area of 5,165 square kilometers. Geographically it is spanned from 27°05' to 28°02' north latitudes and from 68°47' to 69°43' east longitudes. The city of Sukkur is located at an altitude of 220 feet (67 m) from sea level, having terrestrial coordinates 68°52' east and 27°42' north. It is also the narrowest point of the lower Indus course.

Sukkur is divided into 4 administrative strata (tehsils), namely; Sukkur City, Rohri, Saleh Pat and Pano Aqil. Among them Sukkur city and new Sukkur are urban centre while Pano Aqil is famous for having one of largest military cantonment of the country. Rohri is the smallest tehsil of the Sukkur district, both in area and population but it has one of ancient and important railway junction.

At the time of Pakistan's independence in 1947, Sukkur district comprised approximately 200,000 habitants, mostly engaged in agricultural pursuits and fishing industry. Over time, Sukkur has seen a moderate rise in population (2 to 2.5% per annum) as compared to Pakistan's, except in late 1960s and early 70s when population growth rate reached 4.43% (1972 census) due to internal migration and establishment of some large bridges on river Indus. According to official census of 1998, Sukkur has 908370 habitants and density of 175.9 persons per square kilometre. The current estimate (on the basis of 2.88% annual growth) shows that Sukkur population has surpassed 1 million.

The settlements and their population near the project site are Goth Gagrawara, Goth Lagari, Goth Deh-Tarai and Goth Darga is about 250-300 persons living approximately 800 meters to 04 kilometer away from project site.

At social survey, the local community found very optimistic about the Project installation as they have been committed to provide opportunities for Jobs and other required basic necessities as they required along with the development of the area.

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Table 5.3 List of Settlements and Population details

S.No	Name of Settlement/Goth	Coordinates	Distance from Project Land (Boundary) (km)	Population	Status /Type
1.	Goth Gagrawara	27°23'28.24"N 69°0'6.69"E	4km	100-150	Permanent
2.	Goth Lagari	27°22'51.20"N 68°59'33.40"E	3.2m	(20-50 Houses)	Permanent
3.	Goth Darga Shareef	27°23'56.50"N 68°57'49.70"E	800m	150-200 Population	Permanent
4.	Goth Deh-Tarai	27°24'58.30"N 68°59'38.80"E	4.2m	50-60 Houses	Permanent
5.	HBPS School	27°23'31.40"N 69°0'0.30"E	3.7km	20-25 House	Permanent
6.	Basic Heath Unit	27°23'26.30"N 69°0'13.30"E	4.1km	50-60 House	Permanent

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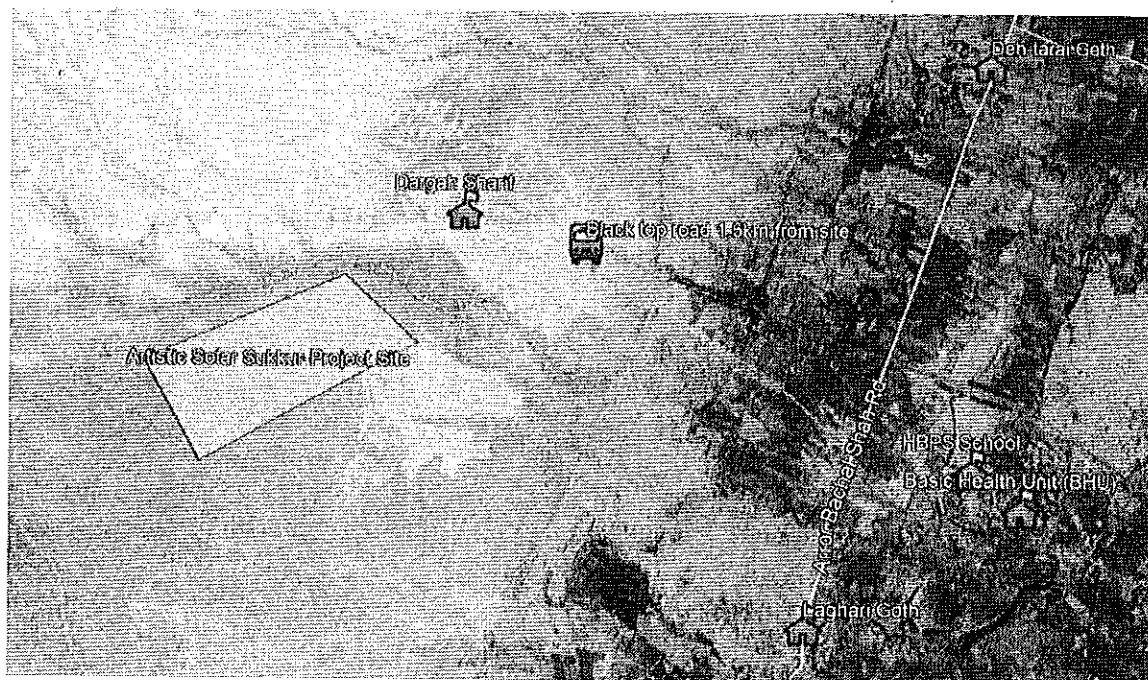


Figure 5-8: Nearest Settlements

5.6 SOCIO-ECONOMIC ENVIRONMENT

5.6.1 Occupational Pattern

Main occupation of the residents of Sukkur district is agriculture and construction labor. The main crops grown in the district are cotton, corn, wheat and sugar cane etc. Sukkur is a hub of many small- and large-scale industries. Among important industries are cotton textiles, cement, leather, tobacco, paint and varnish, pharmaceuticals, agriculture implements, hand pumps, lock making, rice-husking, and sugar mills. Small-scale cottage industries comprise hosiery, boat making, fishing accessories, bricks factories, thread ball spooling, trunk making brass-ware, cutlery and ceramics. The land use pattern is characterized by almost entire residential and limited commercial activities in majority of the central area while institutional and commercial activities are located along main roads.

During the social assessment visit it was observed that peoples are barely meeting their dietary needs. This in a way is exciting for the local population because the ASEPL project is expected to bring job opportunities and raise the living standard of locals.

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5.6.2 Available Facilities

Local people of the nearby Goths have access to urban areas through link roads and public transport available. Electricity is available in some areas. 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 not available but mobile services are available at village level only.

5.6.3 Education and Health Facilities

The number education facilities in district Sukkur is 1373 including 181 (144 for boys and 37 for girls) at urban and 1196 (966 for boys and 226 for girls) schools at rural areas, out of this number 132 schools are closed/non-functional⁴². The urban schools are further consisting 137 primary schools, 15 middle school, 25 high schools and 4 higher secondary schools while rural schools are further consisting 1090 primary schools, 59 middle school, 38 high schools and 5 Higher Secondary Schools. Total number of teachers is 5186 including 3796 male teachers and 1390 female teachers. The average literacy rate of Sukkur district is 46.6 i.e, 59.83 in males and 31.32 in females⁴³. The performance of education department at urban level is good but at rural level is very worst. The major reason is that urban communities monitor and track the school administration. But at rural level there is political influence which has declined education in rural areas.

There is no education facility in the project area especially for the peoples who are living near the project site. There is only one primary school for boys in that area. Also, there is not any health facility available in the nearby project area and the nearest hospital (Basic Health Unit) is located in Gagrawara which is around 5 to 6 km away from the project site and another hospital THQ is located in Taluka Saleh Pat which is approximately 20 kilometers away from the project area.

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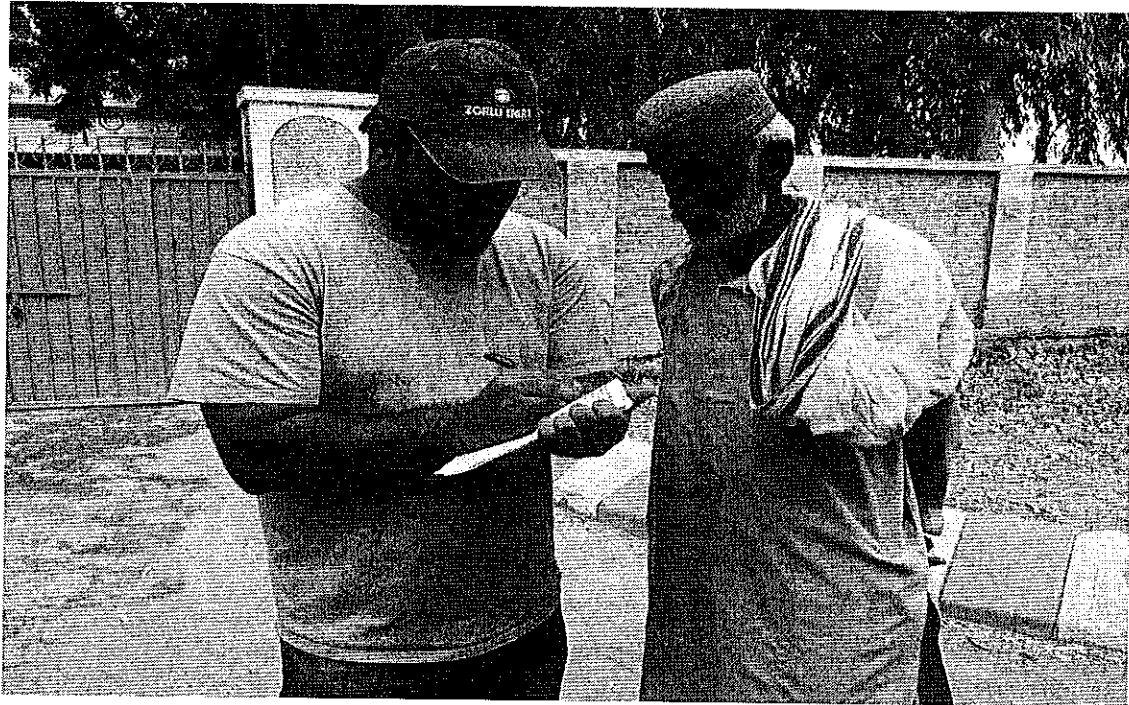


Figure 5-9: A Basic Health Unit in Gagrawara

There is an educational facility available in the project area. This Private school HBPS is located near Gagrawara village with functioning as an institution for primary children providing basic education.

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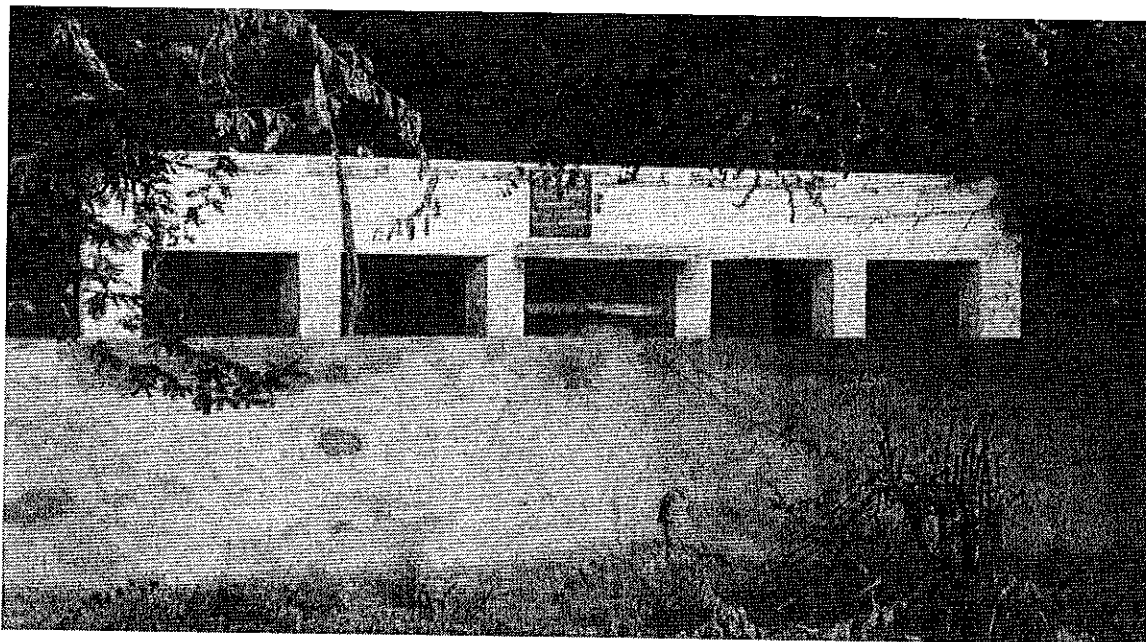


Figure 5-10: A View of School nearby Project Area

5.6.4 Protected Sites

There is no protected area in the vicinity of project site.

5.7 COMMUNICATION NETWORK

5.7.1 Road Links

Sukkur district is connected with Khairpur, Jamshoro, Nawab Shah, Sanghar, districts through metaled roads.

5.7.2 Rail Links

Rohri Junction railway station is located in Rohri town, Sukkur district of Sindh province of the Pakistan. It is a major railway station of Pakistan Railways and the junction of Karachi–Peshawar Main Line and Rohri-Quetta railway line. It is stop of all Express trains. The routes of Rohri are

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linked to Karachi, Lahore, Rawalpindi, Peshawar, Multan, Quetta, Faisalabad, Sargodha, Jhang, Hyderabad, Sukkur and Rahim Yar Khan, Bahawalpur, Gujrat, Gujranwala, Khanewal, Nawabshah, Larkana, Sibi, Attock and Nowshera. Almost all the train comes in this Rohri Junction like Karakoram Express, Jhagar Express, Mehr Express, Khushal Khan Khattak, Khyber Mail and Karachi Express etc.

5.8 WATER RESOURCES

5.8.1 SURFACE AND GROUND WATER HYDROLOGY AND DRAINAGE

The major drinking water sources in urban areas water supply through Tehsil Municipal Administration (TMA) and hand pumps. In rural areas the major sources of water are hand pumps and open ponds. The communities where there is no water available the women and children fetch water from nearby water sources.

In urban areas mainly in Sukkur City and New Sukkur have easy access to water through connections by TMA water supply. In these two tehsils 90% people get water from TMA supply. In case of water load shedding and shortage the community has to fetch water from nearby tanks or other sources. The supply water has unscheduled timings. Due to this the people always suffer from water shortage and have to rely on alternative sources of water i.e. water tanks which are filled from contaminated water and their quality is not certain.

The communities in tehsil Panoaqil and Rohri also get water through TMA water supply but the majority of the people have hand pumps at household and community level also.

Access to water is very difficult in tehsil Saleh pat. Very few people have access to hand pumps and the majority of the people get canal water which they get of rotational basis. Tehsil Saleh pat is the most vulnerable and deprived community in terms of water availability. The other social indicators also make the tehsil the poorest in the district Sukkur. The present main source of water in Sukkur town is ground water. Water table is 40-50 feet below the ground level. The water is mostly saline in nature in that area.

For irrigation purposes, there are several canals present in the area and also the Indus River passes from here. The Sukkur Barrage, which is officially named the Lloyd Barrage, on the Indus about three miles below Sukkur Gorge, is the pride of Pakistan's irrigation system. It is the largest system of its kind in the world. It is the backbone of the economy of the entire country, providing, through its network of canals, irrigation to an area of 7.63 million acres, approximately 25 per cent of the total canal-irrigated area of the country. The Nara Canal, which is one of the seven canals absorbing the runoff from this barrage, is the largest in the country, carrying a discharge almost equal to that of the River Thames. Its bed width in 346 ft. – one and a half times that of the Suez Canal. Some other canals are Dahar canal, Nara canal etc.

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During social survey, it is learned that the availability of drinking water is the major problem of the area. The water of shallow wells present in the expansion areas contains higher values of TDS and mostly saline in nature therefore is not suitable for human consumption. The results are also attached in **annexures VII**.

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.

The project activities will not disturb the water bodies located nearby. As there are no water discharges from the project activities during operations and during construction wastewaters will not be disposed in any water body. However, water from domestic activities like Labor camps will be treated through septic tank / soaking pits.

The drainage system in the area is not developed. The booster pumping station for the water supply pipeline is established to supply water as shown in Figure 5.11.

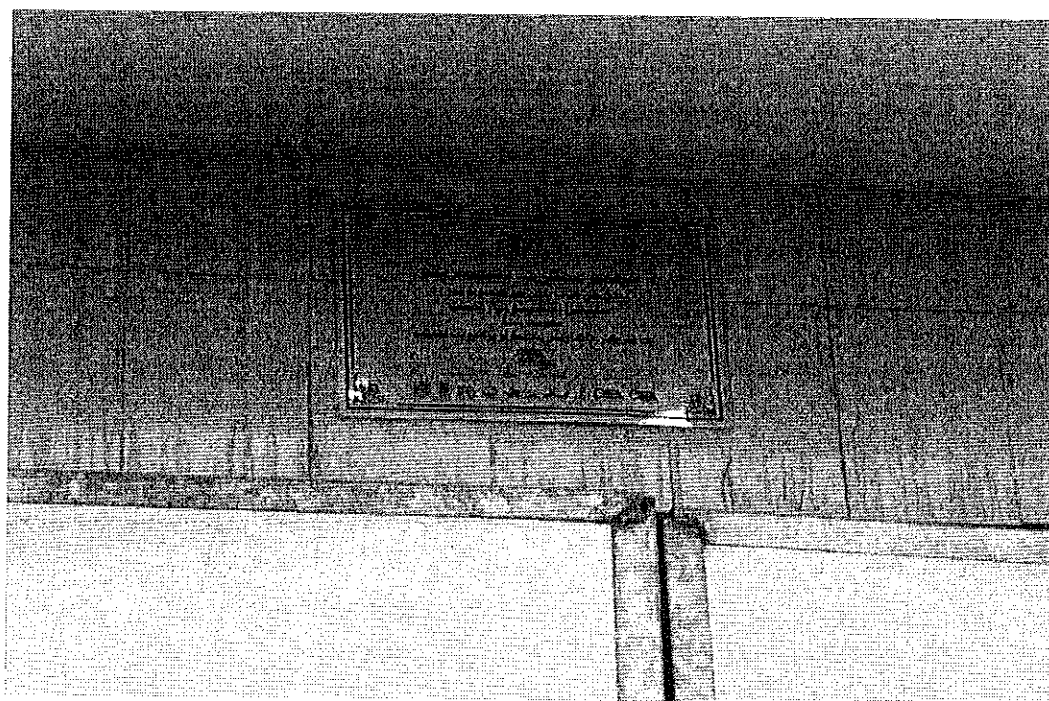


Figure 5-11: RO Plant

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5.9 SOIL CLASSIFICATION

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

These soils are the alluvial deposits of the recent geologic times. The subsurface stratigraphy is as discussed below:

- 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.

The average water table in project area is 40 - 50 feet. The water of shallow wells present in the expansion areas contains higher values of TDS and mostly saline in nature therefore is not suitable for human consumption. The normal quality of water in the town is having TDS value of about 2220 mg/l.

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.

5.10 AIR QUALITY

No authentic data is available regarding air quality measurements specifically of Goth Gagrawara. However; comparing with other cities like Karachi the air quality in Sukkur is far

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better and comparatively less polluted. Major air pollution contributors are the motor vehicle emissions. As the city is surrounded by agricultural land, barren land and desert area, a number of trees and vegetation is there to minimize the impacts of gaseous emissions. No sources of anthropogenic sources of air pollution exist in the immediate vicinity of the site; therefore, the ambient air of the area is likely to be free from the key pollutants such as carbon monoxide (CO), oxides of nitrogen (NO_x), sulfur dioxide (SO₂) and particulate matter (PM). But in very minor quantities. In general, the air quality of the area is high with no significant air pollutants (PM). Ambient air quality recorded by the (SGS) EPA Certified Laboratory during this study. It may be seen that the average level of each parameter in ambient air is on lower side in comparison with Sindh Environmental Quality Standards (SEQS). The results are attached in annexure VII.

5.11 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 Noise level recorded at the unpolluted site in ranges between 41.0 dB (A) and 49.5 dB (A) with the average at 44.0 dB (A), which is characteristic of wilderness and well within 75 dB (A) the level suggested by SEQS. Note that the above-mentioned limit is considered at the time of project construction.

5.12 SEISMIC HAZARDS

According to Seismic Zoning map of Pakistan, Project area falls in Zone II-a (minor to moderate) 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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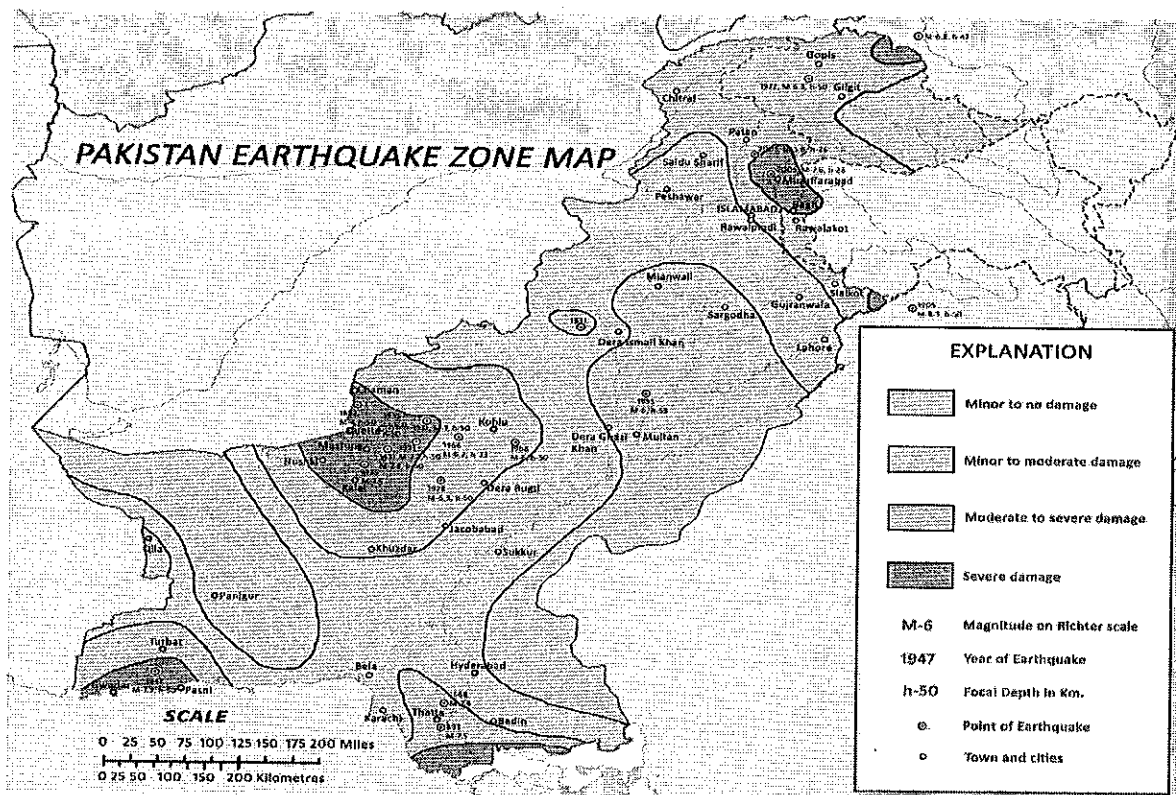


Figure 5-12: Seismic Hazard Zones of Pakistan

5.13 FLOODS

Sukkur is situated on the bank of INDUS River. Most of the villages which were present very near to river area are called as KACHA. Flood had destroyed villages from this portion. Floods can be critical natural hazard in the project with respect to solar PV project due to River Indus flowing around 40-50 km from the project area. Sukkur is considered as flood prone districts of Pakistan according to the map released by Emergency Resource Center (ERC). Below maps in **Figure 5.13** shows Flood Prone districts of Pakistan developed by World Food Programme.

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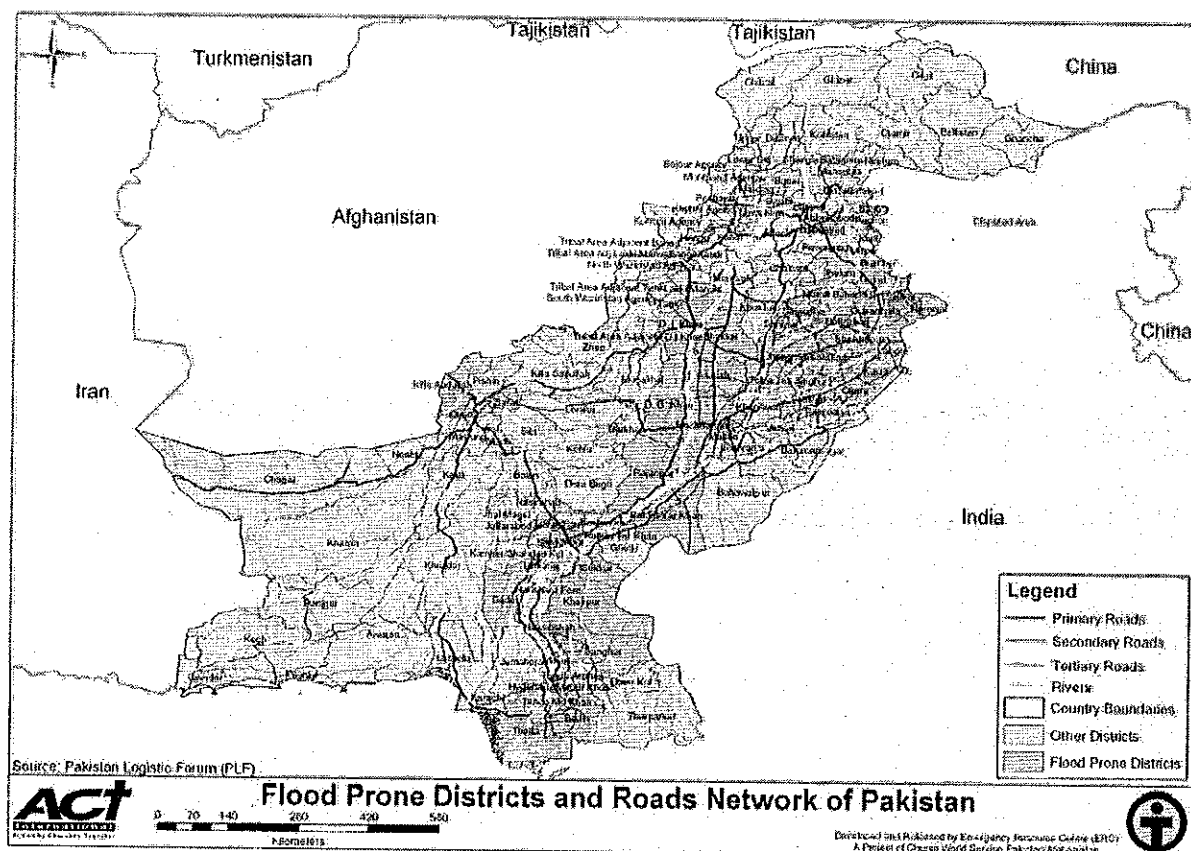


Figure 5.13: River Flood Prone Districts of Pakistan

Figure 5.14 shows closer view of Project area on map for River Flood Prone areas; the area is prone to floods from runoff from river Indus.

The high flood at the Guddu Barrage inundated dozens of villages in Ghotki, Shikarpur and Kashmore districts on monsoon season and the floodwater has hit to sustain pressure at Qadirpur Lope in Ghotki, Sarhad and Obauro areas of Sukkur division. The Sukkur Barrage is witnessing a highest flood tide with water level 11,15365 cusecs. Flood water entered Goth Sommer Mallah at Jamshed Lope Bund and Ali Wahan. In 2010 exceptionally, high level of flood i.e., 10,38,873 Cusecs (Chashma). Reach time from Chashma to boundary of Bhakkar 7 ½ hours and 25 hours from Jinnah Barrage. The challenge posed by flood/rain is two pronged in Bhakkar i.e. River Indus and the inundation of low-lying areas on the city due to Monsoon rains.

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Therefore, it would be necessary to make the foundations of the solar panels high to avoid any damage or short circuiting of the plant.

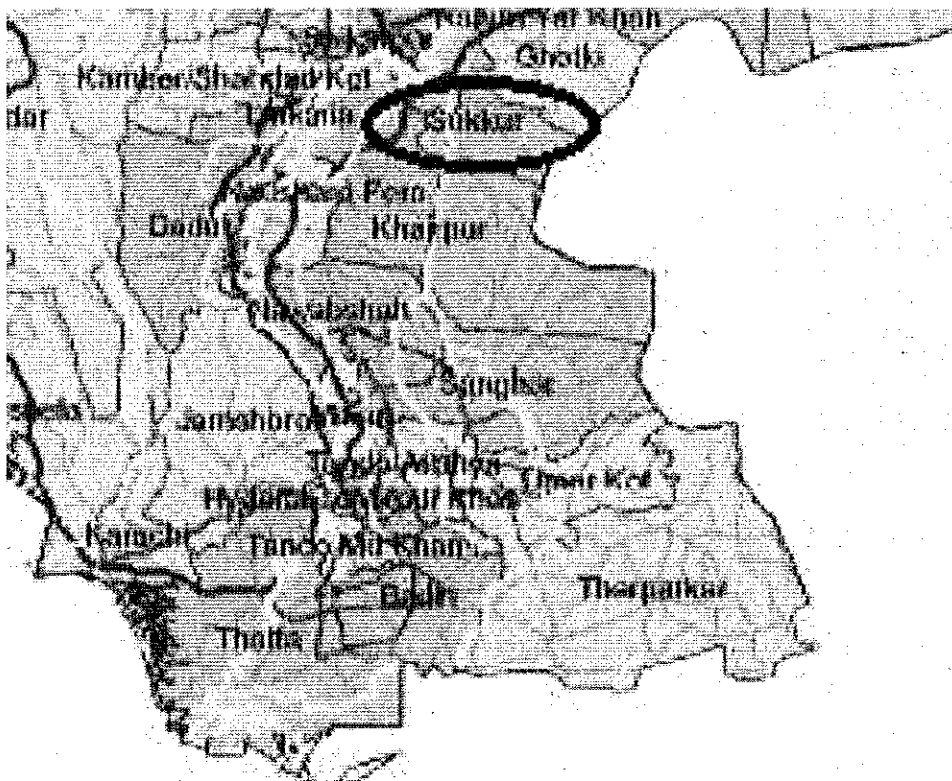


Figure 5.14: Flood Prone Districts-Closer View

5.14 MINES & MINERALS

There are no mines or minerals found in the district of Sukkur.

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SECTION 6

ANALYSIS OF PROJECT ALTERNATIVES

6 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.

6.1 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

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investment in transmission to meet the expected power needs. Moreover, there are varying political stands on hydro-electric power options.

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

6.2 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 Sindh 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 7

ANTICIPATED IMPACT ASSESSMENT AND MITIGATION MEASURES ON IEE BASELINE CHARACTERISTICS

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 hybrid 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

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- Clean up operations
- Landscaping and afforestation

The activities can be divided into two categories, viz. sub-structural and super-structural work. Moreover, construction work will involve cutting of trenches, excavation, concreting etc. All these activities attribute to dust pollution. The super-structural work will involve steel work, concrete work, masonry work etc. and will involve operation of large construction equipment like cranes, concrete mixers, hoists, welding sets etc. There may be emission of dust and gases as well as noise pollution from these activities.

Mechanical erection work involves extensive use of mechanical equipment for storage, transportation, erection and on-site fabrication work. These activities may generate some air contaminants and noise pollution. The electrical activities are less polluting in general. Potential Impacts and Mitigation Measures (for construction and operation phase) is given in **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 the project land is already developed land and the remaining land is barren land, the change in land use will be minimum. Impact is primarily related to the civil works and some intensive impact due to erection of the equipment. The details of the activities and probable impact are brought out in **Table 7.1**:

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Table 7.1: Identification of Activities and Potential Impact (Construction Phase)

Construction Activities	Environment Attribute	Probable Impact
Land Acquisition	Land	❖ No significant impact on land-use is expected.
	Socio-Economics	❖ No Impact due to Rehabilitation & Resettlement issues is expected as the land is lease by the Government & vacant.
Site clearing and Leveling (cutting, stripping, excavation, earth movement, compaction)	Air	❖ Fugitive Dust Emissions ❖ Air Emissions from construction equipment and machinery.
	Water	❖ Run-off from Construction Area.
	Land	❖ Loss of Top Soil.
	Ecology	❖ Loss of diversity and it's a barren land or vacant land.
Transportation and Storage of Construction Material/ Equipment	Air	❖ Air Emissions from vehicles. ❖ Fugitive Dust Emissions due to traffic movement.
	Water	❖ Run-off from storage areas of construction material.
	Public Utilities	Increased flow of traffic.
Civil Construction Activities	Air	❖ Air Emissions from construction machinery. ❖ Fugitive Dust Emissions.
	Water	❖ Run-off from Construction Areas.
Mech. and Elec. Erection Activities	Air	❖ Air Emissions from Machinery /activities
Influx of Labor and construction of temporary houses Transportation and Disposal of Construction Debris	Socio-economics	❖ Employment opportunities shall increase.
	Land	❖ Change in land use pattern of the area.
	Water	❖ Sanitary effluents from labor colonies.
Transportation and Disposal of Construction Debris	Air	❖ Air Emissions from Transport Vehicles. ❖ Fugitive Dust Emissions due to Movement of Traffic. ❖ Spillage and fugitive emissions of debris.
	Water	Run-off from disposal areas.
	Soil	No impact

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7.3.1 Impact on Land Use

The total land allocated for the Project is 250 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 four settlements near the project site and these settlements/Goths are located at 800 meters to 04 kilometers away from the project site and will no/ minor affect due to construction and operation activities of the project. Because the project has huge chunk of land and the panels installed in such a manner that they have no/ minor impact to the nearby surroundings.

Ground roughness is a parameter to define the texture of the ground, ground features like cities, open farm lands, trees, open forest, small and large trees, water bodies, lakes, oceans and other topographic components located on the ground. Roughness has a relation with the wind characteristics like wind shear, ground wind speed along with other environmental factors like dust. With installation of solar panels, there is possible change in the local roughness and so possible change in the wind characteristics on ground. However, no negative change causing reduction in production or structural stability are foreseen with the installation of solar panels.






Therefore, there is no threat to the existing land use or degradation, and there is no net impact on the land use.

Extent of displacement of existing land use
or other environmental resources



Low Impact







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-  =High
-  =Medium
-  =Low
-  =No Impact
-  =Locally Favorable
-  =Regionally Favorable

7.3.2 Impact on Soil Cover

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 Cover	 Low Impact
----------------------	------------------------------------------------------------------------------------------------

-  =High
-  =Medium
-  =Low
-  =No Impact
-  =Locally Favorable
-  =Regionally Favorable

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7.3.3 Impact on Solid Waste

Solid waste during the construction phase consists primarily of scrapped building materials, excess concrete and cement, rejected components and materials, packing and shipping materials (pallets, crates, Styrofoam, plastics etc.) and human waste. During the construction there will be generation of garbage, for which designated disposal area shall be allocated or waste contractor shall be hired.

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

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affected environment is present. It may be the proper dumping site that is used for local municipality. Although the PV cells will not be disposed but sent back under warranty for 25 years. 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. A third party EPA certified contractor will be hired for disposal of solid waste (Low Impact).

Impact on Solid Waste	◆◆ Medium Impact
-----------------------	------------------







◆◆◆	=High
◆◆	=Medium
◆	=Low
○	=No Impact
★	=Locally Favorable
★★	=Regionally Favorable

7.3.4 Air Impacts

As the proposed project is Solar PV Power Project, the impact during construction is expected to be minimal as a Greenfield Project plant. The project does not cause any air emissions to the environment but a minimal impact will occur through the movement of vehicles due to which the 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, water will be used to settle down the dust particles to reduce its impact. 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, NO_x, and particulate matter. The impact is reversible, marginal and temporary in nature.

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Impact on Air Quality	 Low Impact
-----------------------	----------------------------------------------------------------------------------------------

- | | |
|-----------------------------------------------------------------------------------|-----------------------|
|  | =High |
|  | =Medium |
|  | =Low |
|  | =No Impact |
|  | =Locally Favorable |
|  | =Regionally Favorable |







7.3.5 Noise Impacts

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 will have been optimized and vehicular traffic will be routed away from the nearest settlement. The mitigation measures shall be taken into consideration as mentioned in Environmental Management Plan in section 9. Overall, the impact of generated noise on the environment during construction period is insignificant, reversible and localized in nature.

Impact on Noise Quality during Construction	 No Impact
---------------------------------------------	-----------------------------------------------------------------------------------------------

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	=High
	=Medium
	=Low
	=No Impact
	=Locally Favorable
	=Regionally Favorable

7.3.6 Impact on Water Environment

The construction personnel would be housed in temporary settlements. These settlements would discharge considerable amount of domestic wastewater. Stagnant pools of water would increase breeding of mosquitoes and generally create insanitary conditions. Contractor will provide Soak pit with a depth of 2 meter to dispose liquid water so that such water does 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 45 days, where excess suspended solids would be settled out and will collect this into the pond away from the project camp site and naturally evaporate.

During the rainy season or flooding, proper channels will be constructed and the designing the structure in such a way that there will be no impact to the equipment. Also, for the drainage of water that will be used during the cleaning mechanism in such manner that the water will drain into the ground and will have no impact on water table of the land and will not impact the soil cover.

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Impact on Water Environment
 **Low Impact**

=High

=Medium

=Low

=No Impact

=Locally Favorable

=Regionally Favorable
7.3.7 Ecological Impact

The project site is barren land leased by the GoS to the project sponsors therefore no impact on project site. The small bushes and trees 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. For the fauna located in the project area will be carefully managed or monitored by conducting biological studies during the construction phase of the project and will be minimal to affect the fauna of that area that will be compensated with 1:10 ratio (Means one plant removal will be compensated with 10 plants grow). Thus, the site development works would not lead to any significant loss of important species or ecosystems.

Ecological Impact
 **No Impact**
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	=High
	=Medium
	=Low
	=No Impact
	=Locally Favorable
	=Regionally Favorable

7.3.8 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 trees therefore there will be no impact on the climate conditions from the transmission lines during the construction and operation phases.

Impact on Air Quality: During the construction phase, the activity would involve excavation for the tower erection, movement of vehicles carrying the construction materials along the haul road (through un-built roads, which are not maintained).

All these activities would give rise to emission of dust particles thereby affecting air quality marginally at the site. The impact will be temporary in nature and it create short term impact to the environment only in construction phase and therefore is assessed as of low significant impact. 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.

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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 project is clean energy project and noise will generate only during construction phase and vehicular movement. As the predominant land use along most part of the alignment is vacant and there will be no residential areas exposed to noise generated during the construction phase.

Impact on Surface and Ground Water Quality: There are no any major 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.

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.

However, the ecological management plan shall be developed and implemented during construction and operation phase.

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,

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- ❖ 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 electro-cutting, lightening, fires and explosions. Necessary training regarding safety aspects to the personnel working at the line will be provided by the contractor. Personal protective equipment like safety gloves, helmet, harness, Goggles, mufflers will be provided during construction period and during the maintenance work. First Aid facilities will be made available 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 like installation of RO plant inside the vicinity area of the project, 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

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borne diseases or vector borne diseases (Parasitic infections) will be eliminated by adopting proper solid waste disposal procedure on landfill sites. 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 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.
- ❖ 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.

Note: The construction and operation of transmission line will be the scope of Government of Pakistan. Any socio-environmental impact arises due to construction or operation of transmission line shall be compensated by the NTDC (National Transmission Distribution Company) of Government Energy Department.

7.4 IMPACTS DURING OPERATION PHASE

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Various activities of operation and maintenance phase and their probable impacts on various Sectors of environment are presented in table below.

Table 7.2: Identification of Activities and Potential Impact (O & M Phase)

O & M Activities	Environment Attribute	Probable Impact
Waste water	Water	<ul style="list-style-type: none"> ❖ Generation of Waste water during cleaning of modules. ❖ Domestic waste generated by staff employed during operations.
Visual Impact		<ul style="list-style-type: none"> ❖ Visual and reflection of solar modules impact on nearby traffic.
Socio-economic	Socio-economics	<ul style="list-style-type: none"> ❖ Generate employment in the area. ❖ Fast Development in the area.
Reflection of panels		<ul style="list-style-type: none"> ❖ Minor impact on operational staff working inside the plant.
Air	Air	<ul style="list-style-type: none"> ❖ No emissions from solar PV plant.
Ecology	Birds/Animals	<ul style="list-style-type: none"> ❖ No impact on fauna and flora.

7.4.1 Impact on Land Use

The proposed project will be set up on vacant chunk of land or barren land. The site, after completion of its development, would consist of separate 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.

7.4.2 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.

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The soil conditions of the project site would be allowed to stabilize during this period after the impacts of the construction phase. The top soil in areas would be restored and such portions of the site would be replanted with appropriate plantation. Therefore, minimal impact will be occurred during construction phase of the project.

During operation of a project, no appreciable adverse changes in the soils are anticipated.

7.4.3 Air Impacts

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. Therefore, no impact will be created during the operational phase of the proposed project.

7.4.4 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 -SEQS for noise.

7.4.5 Impact on Water Environment

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. 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 once 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; Water consumption is very less, this can conserve water. The cost is low and can create the job opportunities for local people. The wastewater emanating from cleaning operations shall be recycled for plantation around the plant.

7.4.6 Ecology

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There is no sensitive ecological area / protected forest area such as national wildlife park, bird Sanctuary near the project area. Nara Canal is located at a distance of 6.5 km away from the project site so there is no impact on the water body. Takkar Wildlife sanctuary is also 16 km away from project site. The area is vacant land and removal of small bushes and plantation 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. This was discussed as earlier in Section 7.3.7 of the IEE report.

7.4.7 Visual 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 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.

During operation phase PV panels emit the irradiations or cause reflection that will may impact the working staff but these emissions will minor and have low impact on the workplace. As there is no or minor light pollution due to PV panels that may or may not affect or harm the operational staff working in the solar farm. The panels are polycrystalline, whereas the surfaces of solar PV panels are designed to absorb sunlight and minimize its reflections. The panels have more efficiency to absorb heat and there are very low chances of reflection. However, if we assume long term that will affect the operational staff that perform works 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

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- ❖ 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 interference 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 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 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;

7.5.1 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.

7.5.2 Air Quality:

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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. To reduce these emissions, we need to manage the transportation and use good conditioned vehicle that emit less emission.

7.5.3 Ecological Impacts:

Impacts to biological resources from decommissioning activities would be similar in nature to impacts from construction, but of a reduced magnitude.

7.5.4 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. 05 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 30 Kg and the way of Disposal is Reuse and Selling out. PV for Solar 12 Kg weight 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 Employment 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.

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Artistic Milliners Private Limited (AMPL) 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.

Artistic Milliners Private Limited (AMPL) is an independent power producer, aiming to make solar a sustainable source of energy worldwide - sustainability is hence an integral part of the company's business model. The growth of the business is in itself a positive contribution towards meeting the needs of the people in Pakistan.

Artistic Milliners Private Limited (AMPL) works along three principal areas for all employees focuses on: delivering competitive renewable energy, contributing to local value creation and being a trusted business partner.

Delivering competitive renewable energy involves providing predictable energy production and securing capacity growth. It also highlights the significant role of Artistic Milliners Private Limited (AMPL) in promoting and financing solar energy in Pakistan.

Contributing to local value creation focuses on local development and maintaining open dialogues and engagements with the local community. Lastly, being a trusted business partner points to the importance of founding our work on guidelines and principles that are in line with the Equator Principles and the International Finance Corporation (IFC) Performance Standards. In addition, related areas such as HSE, anti-corruption, talent attraction and retention, as well as responsible procurement.

Compliance with national, regional and international rules, laws and conventions is mandatory in Artistic Milliners Private Limited (AMPL), but business ethics and sustainability extend beyond compliance. These efforts are vital to build trust among the local community and stakeholders. Conduct the business in a way that makes people proud to work with and for Artistic Milliners Private Limited (AMPL).

To illustrate their approach to sustainability, AMPL has defined the following themes to contribute to the local development and value creation:

- Employ local labor and enable knowledge transfer and job creation in local communities
- Use local suppliers whenever feasible
- Plan for and contribute to local development initiatives
- Ensure to impact positively on local communities by addressing their needs and improving their live standards
- Train and educate our people in how best to operate in a new, often foreign, culture to make every project friction free and a collaborative enterprise

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- Increase access to renewable electricity generation capacity in the local community

Artistic Milliners Private Ltd has conducted a comprehensive SCR strategy to address the above fields and contribute to the local economic growth and the live standards if the people in the community.

7.6.2 Development of Infrastructure

The job opportunities in non-agricultural sector are likely to increase. The installation of the power plant is expected to further increase the prospects by bringing in direct and indirect employment opportunities. As the project and consequent activities are expected to generate additional employment and income opportunities for the local population, market expansion supported by infrastructural development will foster economic growth in the area. access road, development of houses as compensation, Grid station, infrastructure of transmission line, school, health care center, water wells provision etc are also provided to the locals in that 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.

7.6.3 Resettlement

There are no indigenous peoples living on the project site. Therefore, the Project has no resettlement and indigenous people issues.

7.6.4 Contribute to Economic Growth and Poverty Reduction

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.

7.6.5 Private Sector Development

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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. Farooq Ali and Razzaq of RE2 team themselves filled the questionnaires after asking the questions to the native people. Snapshots of community consultation meeting are attached in **Annexure XI**.

A community consultation consisted of formal and informal meetings at nearest residential area, and project vicinity. The consultation exercise was conducted in both Sindhi 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, IUCN, Sindh Wildlife department Sukkur office, Sindh Forest department and all issues and suggestions raised were recorded in survey forms. Both social and environmental issues were raised. Dr. Syed Ali Ghalib and our team member Mr. Farooq Ali Khan (RE2) has perform the consultations with different departments and officials. These stakeholders are the different government officials and NGOs like IUCN Pakistan, WWF department, Karachi, Sindh Wildlife department Karachi office and Sindh forest department Karachi.

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The people interviewed 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 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 discussions were 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 XI**.

Table 8.8.1: Summary of Concerns Raised during Stakeholder Consultation

Issues	Concerns raised by community	Remarks
Health Care Facilities	Healthcare centers particularly for women and children Schools	Basic health unit is available in the Village Gagrawara with very little facilities, A dispensary may

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Issues	Concerns raised by community	Remarks
		be provided.
Employment	Provision of semi-skilled and unskilled jobs for local labor in the project construction period.	Unskilled jobs will be given to local's people where possible. Training will be provided.
Safety of Community	Comply with the traffic management rules.	Proper traffic management will be resorted to during the construction period.
Drinking water	Community member rated Safe drinking water at highest priority during our survey.	As part of the Social development program AMPL shall provide the safe drinking water through RO filter plant to nearby communities
Educational Facility	Unavailability of Teachers, and School (Primary and Secondary) Vocational training	Only one private school is available near to the project site. Proponent shall provide the required facilities for the local peoples.

Table 8.2: General Public Interviewed during Public Consultation at Sukkur

S.NO	NAME	OCCUPATION	LOCATION
1	Liaqat Ali	Farmer	Deh-Tarai Goth
2	Shib Dino	Labor	Bhambro Goth
3	Dil Murad	Labor	Gagrawara Goth
4	Muhammad Nawaz	Unemployed	Gagrawara Goth
5	Maula Baksh	Labor	Gagrawara Goth
6	Dost Muhammad	Unemployed	Deh-Tarai Goth
7	Ghulam Raza	Labor	Deh-Tarai Goth
8	Umeed Ali	Labor	Deh-Tarai Goth
9	Khairo Mir	Worker	Deh-Tarai Goth

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10	Muhammad Jumman	Student	Deh-Tarai Goth
11	Ashraf	Labor	Deh-Tarai Gothj
12	Abdul Sattar	Unemployed	Deh-Tarai Goth
13	Dedar	Fruit Seller	Deh-Tarai Goth
14	Darban Ali	Labor	Lagari Goth
15	Muhammad Imaad	Student	Lagari Goth
16	Farmanullah Baksh	Unemployed	Dargah Shareef
17	Ghulam Qasim	Labor	Deh-Tarai Goth
18	Mir Muhammad	Labor	Dargah Shareef
19	Muhammad Chandiyo	Labor	Deh-Tarai Goth

8.1.1 Government Agencies

Stakeholders including provincial government officials, international 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- XII**.

a) Sindh Wildlife Department

A consultation meeting was held with Mr. Taj Mohammad Shaikh, Conservator (Wildlife), Sindh to brief him about the project and to obtain a NOC from the Department to the effect that the proposed Project Area for Solar Power Development does not fall into the limits of any Wildlife Protected Area.

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During the meeting the Conservator expressed his views regarding the project and overall appreciated project activities. Their views and concerns / suggestions are re-produced as follows;

- Deputy Conservator along his team identified the Nara Canal as the Wildlife sanctuary and Ramsar site as nearest protected area which is located approx. 6.5 kilometers and he briefed about its importance and patterns.
- He also proposed that to provide the basic facilities to the communities like School, 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) Sindh EPA (Sukkur Office)

A consultation meeting was held with Deputy Director EPA-Sukkur Division at his Sukkur 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 officers expressed his views regarding the project and overall appreciated project activities. They do not have any issue / objection with the project in Sukkur. As they know that this is the barren land and there is very rare vegetation or even no vegetation.

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.

a) WWF (World Wide Fund)

A consultation meeting was held with - WWF-Pakistan Technical Advisor. RE2 team provided information about the project area and obtained their views / concerns / suggestions as the expert conservationist. They supported and appreciated the project activities; they do not have any objection / issue even they are well satisfied with the green energy project and the way the consultant (RE2) making consultation with all concern departments.

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Mitigation Measures:

There are minor impacts on the species and their habitats due to limited impacted area of the solar project in comparison to Wind Energy Projects. However, the following mitigation measures with reference to the present project are suggested:

1. Avoidance of large-scale clearance of vegetation of the Project Area.
2. Safeguarding the rodent's holes as much as possible during the project activities.

Conclusion

No serious threats are anticipated due to project development on the site. There will be slight loss of habitats and loss of vegetation cover of common herbs and shrubs.

It is included that the environment or ecology of any protected or sensitive area will be affected, as Protected Area is quite away and outside the limits of any such areas.

Moreover, no threatened animal or rare plant species has been recorded from the Project Area.

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SECTION 9

ENVIRONMENT MANAGEMENT PLAN

9 ENVIRONMENT MANAGEMENT PLAN

9.1 PURPOSE AND OBJECTIVE OF EMP

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.

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- ❖ 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:
 - 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 9.3 to 9.9.

9.3 INSTITUTIONAL ARRANGEMENT

Artistic Milliners Private Limited (AMPL) 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. Artistic Milliners Private Limited (AMPL) 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.

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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 Artistic Milliners Private Limited (AMPL) 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 ASEPL 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.

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- ❖ Advise and coordinate the contractor(s) activity towards effective environment management.
- ❖ Implement environment health and safety manual.
- ❖ 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.

9.3.1 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 and also supervise the IMC (third party) during the construction of the project and conducting the EHS trainings and preparing weekly reports, HSE plans, CSR policy, ERP and also conducted the Environmental Audits to check the compliance of the standards and regulations.

9.3.2 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.

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- ❖ 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 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**.

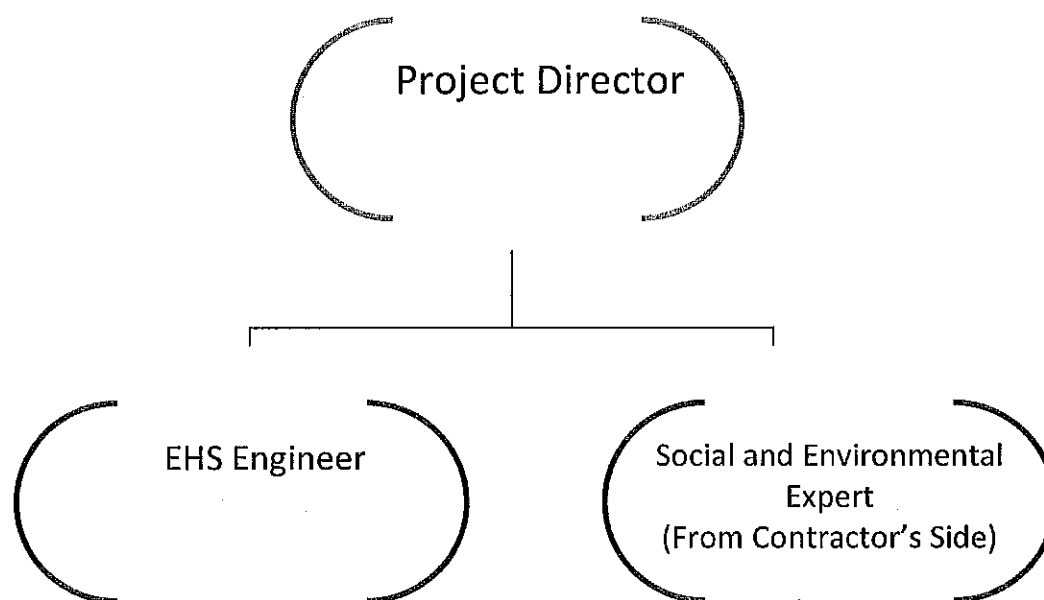


Figure 9-1: Framework of Environment and Social Management Cell (ESMC)

Table 9.1: Responsibilities of ESMC and Potential Impact (O & M Phase)

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S. No	Designation	Responsibility
1	Project Director (01)	❖ Environment and Social Policy and Directions
2	EHS Engineer (01)	❖ Overall in-charge of operation of environment & social management facilities ❖ 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)	❖ Secondary responsibility for environment & social management and decision making for all environmental issues including Safety and Occupational Health ❖ Ensure environmental monitoring and social issues related to project as per appropriate procedures ❖ All the EHS Guidelines, national and international regulation and guidelines should be implemented during the project construction 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.

AMPL Solar 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.

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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.

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 Artistic Milliners Private Limited (AMPL) 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.

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9.8 PUBLIC DISCLOSURE REQUIREMENTS

Artistic Solar Energy Private Limited (ASEPL) 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 Artistic Solar Energy Private Limited (ASEPL) 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 considered 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.

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- ❖ 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.

Proper GRM will have to be implemented by ASEPL Solar Power Project 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 ASEPL Solar Power Project to cover the environmental mitigation and monitoring requirements, and their associated costs.

An environment and social analysis have been carried out looking at various criteria such as topology, air, noise, water resources and water quality, ecology, demography of the area, climate and natural habitat, community and employee health and safety etc. The impact analysis, found that due to careful consideration of environmental and social aspects during route and site selection by AMPL Solar Power Project, 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

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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 IFC's Performance Standard 1. The Project is not considered highly sensitive or complex. Mitigation measures related to 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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Annexure – XII-

Schedule I - Schedule II

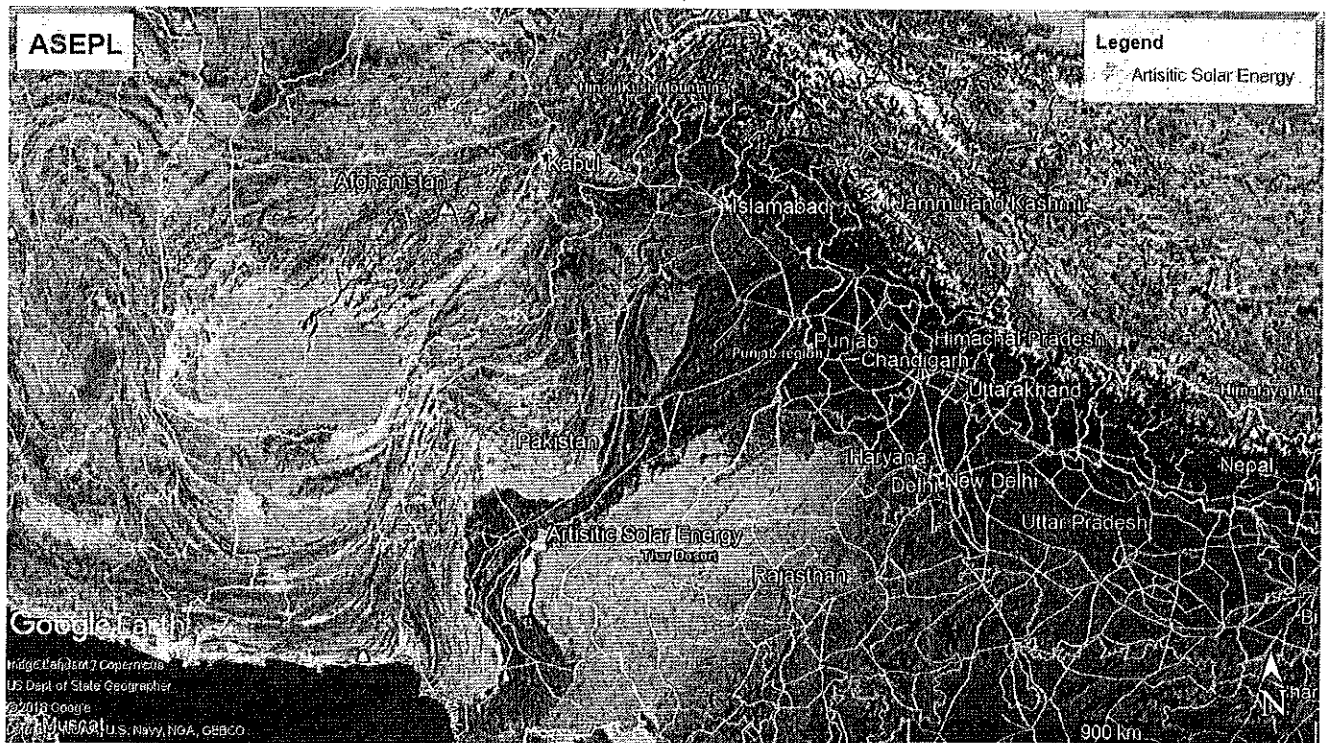
SCHEDULE-I

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

Actual drawings pertaining to Solar Farm Location
Map, Solar Farm Lay Out,
Single Line Diagram (Electrical System of the Solar Farm).

Location of Generation Facility/ Solar Farm

The Solar farm Project is located in Salehpat, District Sukkur, that is located in the North of Sindh. The National Highways (N5) and (N55) and Motorway (M9) are the major connecting roads to the Project site, having total road distance of approximately 500 km from Port Qasim. The Project will be constructed on 250 acre of Government of Sindh land. The geographical location of the project is shown in figure below.



The map with surrounding towns/cities is given in Figure below:

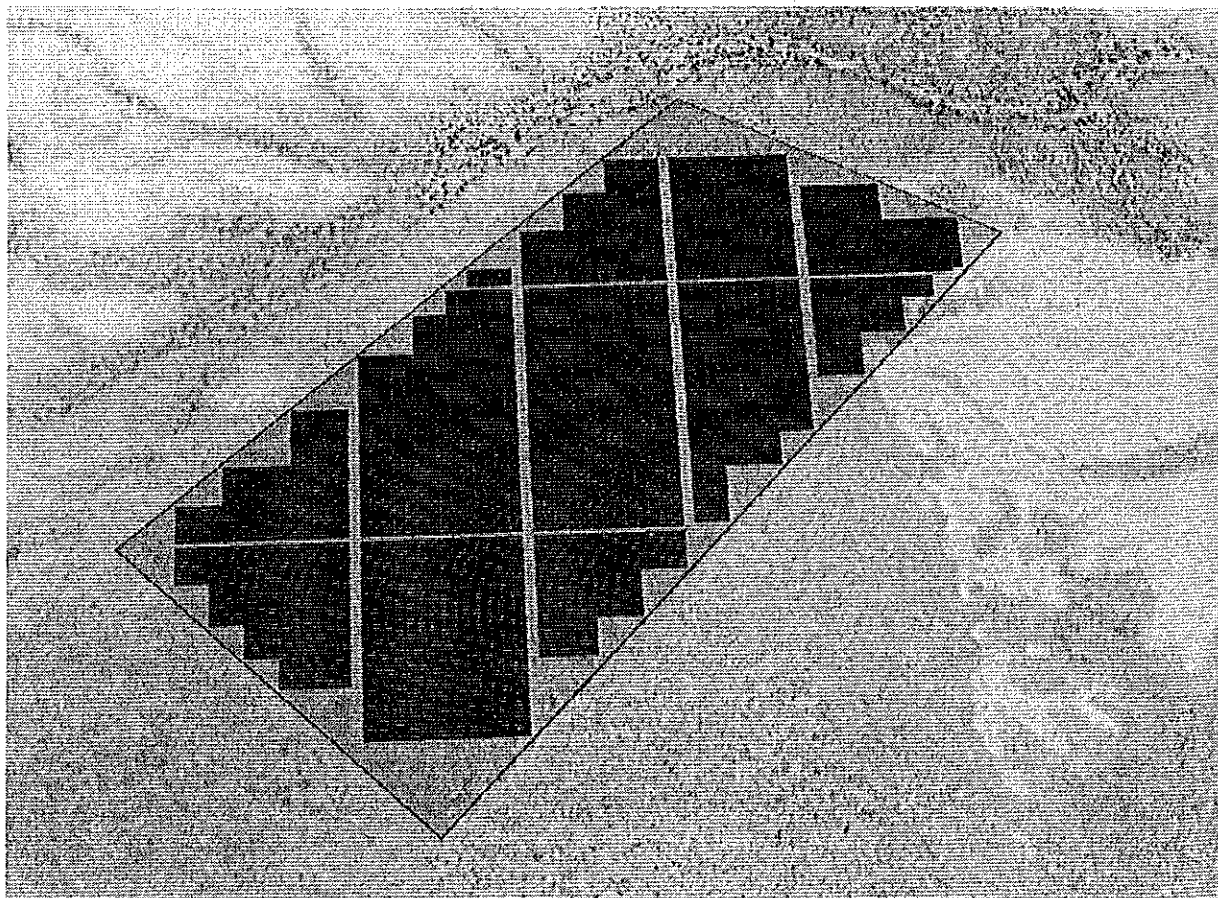


Project Size

The Project shall have an installed capacity of approx. 50 MWp rated power.

Layout of Generation Facility/ Solar Farm

The general layout along with neighboring Solar Farms is shown in figure below.



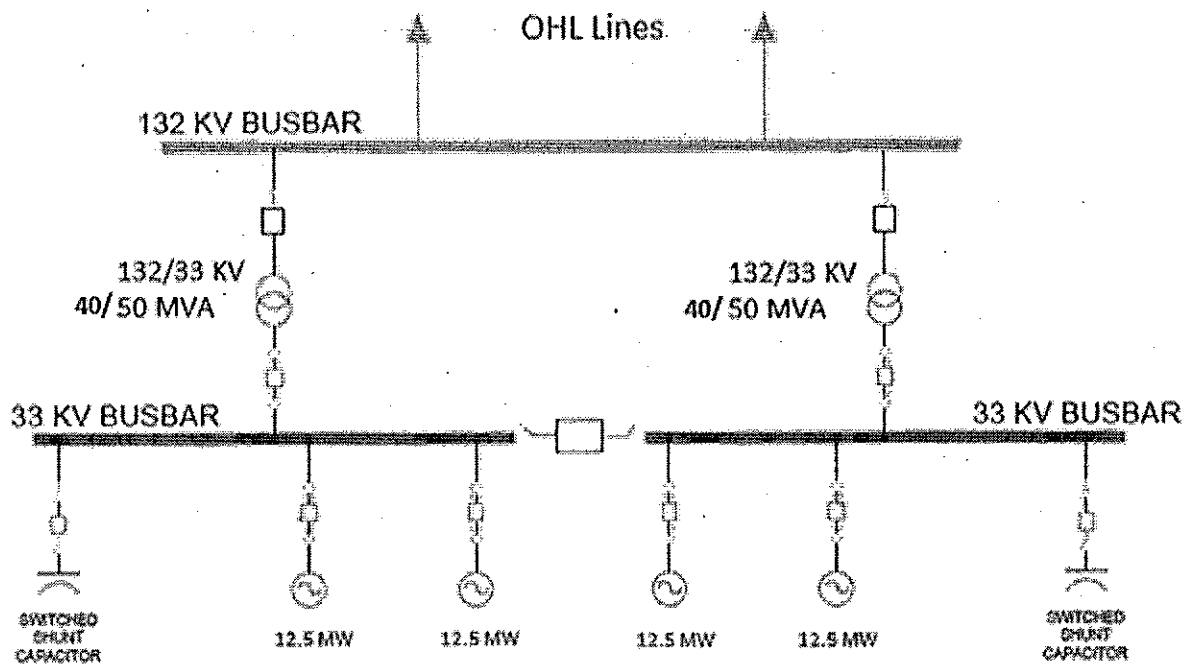
Land Coordinates of Generation Facility/Solar Farm

Location: Sukkar – Sindh, Pakistan

The Site coordinates are given in Table below.

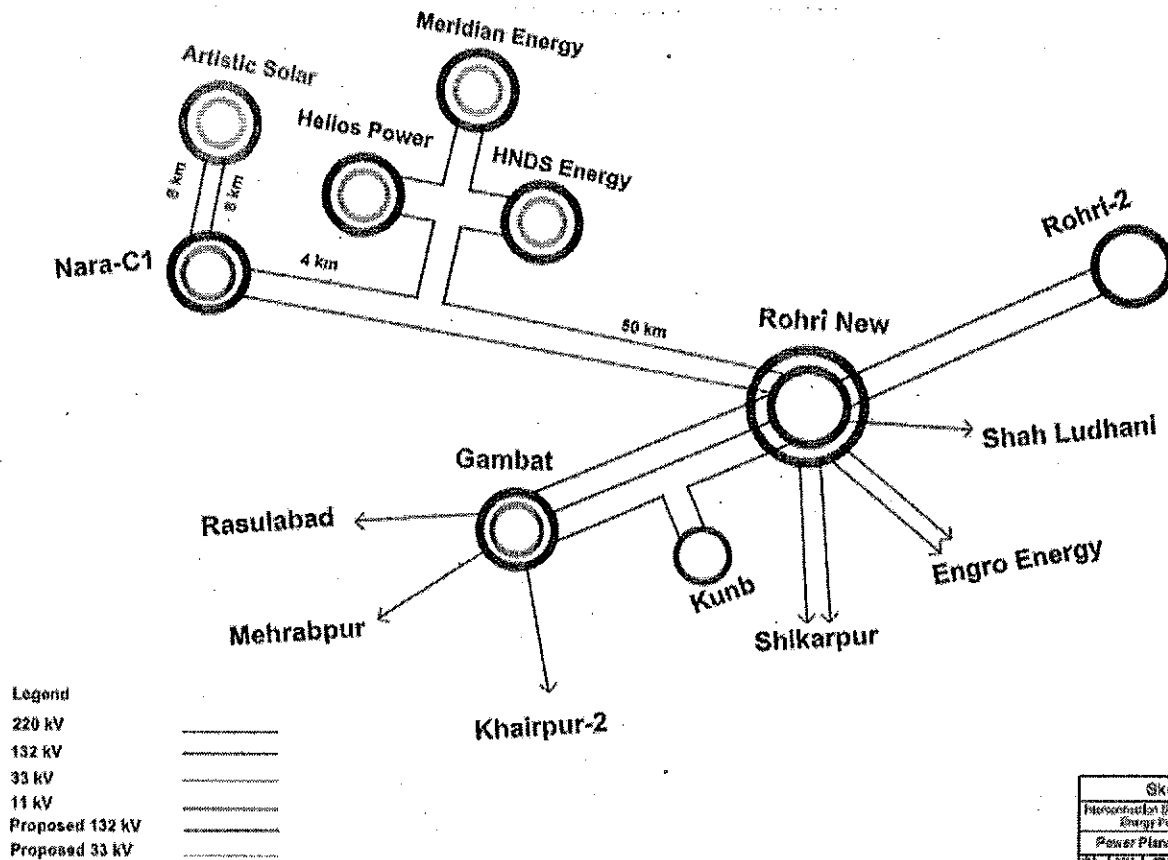
Latitude (°N)	Longitude (°E)
27.391769	68.963281
27.381827	68.952427
27.386644	68.946786
27.394571	68.957380

Electrical System Single Line Diagram of Generation
Facility/Solar Farm



Schematic Diagram for Interconnection
Arrangement/Transmission Facilities for Dispersal of Power from
Solar Farm

220 kV & 132 kV Network Near Rohri New
With Solar Power Plant By Artistic Solar Energy Pvt. Ltd., Year 2021



**Detail of Generation Facility/Power Plant/
Solar Farm**

(A). General Information

(i).	Name of Applicant/Company	Artistic Solar Energy (Private) Limited
(ii).	Postal Address	Plot No. 3A, MACHS, Main Sharah-e-Faisal, Karachi
(iii).	Registered/Business Office	Plot 4 & 8, Sector-25, Korangi Industrial Area, Karachi.
(iv).	Plant Location	Saleh Pat, District Sukkur, Sindh
(v).	Type of Generation Facility	Solar Photovoltaic (PV)

(B). Solar Farm Generation Technology & Capacity

(i).	Type of Technology	Photovoltaic (PV) cell
(ii).	System Type	Grid Connected
(iii).	Installed Capacity of Solar Farm (MW)	<u>50MW_{peak}</u>

(C). Technical Details of Equipment

(a). <u>PV Modules</u>		
(i).	Model of Modules	<u>JA Solar- JAP72S10-340 or any equivalent</u> ✓
(ii).	Type of Cell	<u>Polycrystalline</u>
(iii).	Dimensions of each module	<u>2015x996x40 mm</u>
(iv).	No. of Modules	<u>147059</u>
(v).	Module Area	2.007 m ²
(vi).	Panel's Frame	Aluminium Alloy
(vii).	Weight of one module	<u>22.7 kg</u>

(viii).	No. of cells in each module	144
(ix).	Efficiency of Module	16.9 %
(x).	Maximum Power of each module (Pmax)	340 W
(xi).	Voltage @ (Pmax)	38.08 V
(xii).	Current @ (Pmax)	8.93 A
(xiii).	Open circuit voltage (Voc)	45.89 V
(xiv).	Short circuit current (Isc)	9.43 A
(xv).	Mounting Structure Type	Single Axis Tracking
(b). PV Array		
(i).	No. of Strings	5071
(ii).	Modules in a string	29
(c). Inverters		
(i).	Capacity of each unit	2550 kWac
(ii).	Manufacturer	TMIEC or any equivalent
(iii).	Input operating voltage range	915-1300 V
(iv).	No. of inverters	17
(v).	Total Power	43350 kWac
(vi).	Efficiency of Inverter	99.04%
(vii).	Max. Allowable input voltage	1500 V
(viii).	Max. Current	2337 A
(ix).	Max. Power Point Tracking range	2337 A
(x).	Output Electrical system	3 phase 3 wire
(xi).	Rated Output Voltage	630 V
(xii).	Power Factor	0.85 lead - 0.85 lag
(xiii).	Power Control	Mpp tracker

(xiv).	Rated Frequency	50/60 Hz	
(xv).	Environmental	Relative Humidity	5% to 95 %
		Operating Elevation	Up to 1000m above sea level. 2000m as an option
		Operating Temperature	-20°C to +50°C
(xvi).	Grid Operating Protection	A	DC circuit breaker
		B	AC circuit breaker
		C	DC overload protection
		D	Lighting protection
		E	Grid monitoring
		F	Insulation monitoring
		G	Anti-Islanding
(d). <u>Junction Boxes Installed and fixed on main steel structure in Array yard</u>			
(i).	No. of J/Box Units	<u>317</u>	
(ii).	Input circuits in each box	16	
(iii).	Max input current for each circuit	<u>250 A</u>	
(iv).	Protection level	IP 65	
(v).	Over current protection	Fuse	
(vi).	Surge protection	Yes	
(e). <u>Data collecting system</u>			
(i).	System Data	Continuous online logging with data logging software to portal.	

(f). <u>Power Transformer</u>		
(i).	Rating	2*40/50 MVA
(ii).	Type of Transformer	ONAF
(iii).	Purpose of Transformer	Step-up (33kV to 132kV)
(iv).	Output Voltage	132kV
(g). <u>Unit Transformer</u>		
(i).	Rating	5100/2550kVA
(ii).	Type of Transformer	33KV Box-type transformer
(iii).	Purpose of Transformer	Step-up (630V to 33kV)
(iv).	Output Voltage	33kV

(D). Other Details

(i).	Project Commissioning Date (Anticipated)	2021
(ii).	Expected Life of the Project from Commercial Operation Date (COD)	25 Years

SCHEDULE-II

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

SCHEDULE-II

(1).	Total PV Installed Capacity of the Generation Facility /Solar Farm	50 MW _p
(2).	Global Horizontal Irradiation at site (average per annum)	2029 kWh/m ²
(3).	PV Plant Generation Capacity Annually (as per Simulation for 1 st year)	93,199.00MWh
(4).	Expected Total Generation in 25 years Life Span	2,129,242.00 MWh
(5).	Net Capacity Factor (as per Simulation for 1 st year)	21.3 %

Note

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