BEFORE
THE NATIONAL ELECTRIC POWER REGULATORY AUTHORITY (NEPRA)

APPLICATION FOR A GENERATION LICENSE FOR SOLAR POWER GENERATION FACILITY

PURSUANT TO ENABLING PROVISIONS OF NEPRA ACT 1997 READ WITH ENABLING PROVISIONS OF RULES MADE THEREUNDER, LICENSING (APPLICATION & MODIFICATION PROCEDURE) REGULATIONS AND LICENSING (GENERATION) RULES 2000

ON BEHALF OF

F1 SOLAR PK (PRIVATE) LIMITED

FOR NEPRA'S GRANT OF GENERATION LICENSE FOR
F1 SOLAR PK (PRIVATE) LIMITED

FOR A POWER PROJECT OF 100 MWP (THE **PROJECT**)

AT

JAMSHORO, PROVINCE OF SINDH, PAKISTAN

DATED: 26/06/2020

LEGAL & REGULATORY CONSULTANT

HAIDERMOTABNR & CO.

KARACHI OFFICE
D-79, BLOCK 5, KDA SCHEME 5, CLIFTON
KARACHI, PAKISTAN
TEL: +92-21-111520000
FAX: +92-21-35871054
EMAIL: ali.khan@hmcobnr.com

APPLICANT

F1 SOLAR PK (PRIVATE) LIMITED
REGISTERED OFFICE
3RD FLOOR, ADEEL PLAZA,
FAZAL E HAQ ROAD, BLUE AREA,
ISLAMABAD, PAKISTAN
TEL: 052-2806049
FAX: +92518440513
EMAIL: adeel.ahmed@ibvogt.com

F1 Solar PK

F1 Solar PK Private Ltd, 3rd Floor Adeel Plaza, Fazal-E-Haq Road, Blue Area, Islamabad

F1 Solar PK Private Limited
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Head Office
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Fax +4930397440-10

Directors
Anton Milner
Carl Von Braun
Salar Khan Sanjrani

26/06/2020

The Registrar

National Electric Power Regulatory Authority

Subject: **Applicaiton for Generation License for 100MWp F1 Solar PK Pvt Ltd**

I Adeel Ahmed, Senior Manager Project Development ibvogt GmbH and fully Authorised representative of F1 Solar PK Pvt Ltd by the virtue of Authority Letter dated 22/04/2020, hereby apply to the National Electric Power Regulatory Authority for Grant of Generation License to the F1 Solar PK Pvt Ltd. persuant to section 15 of the regulation of Generation, Transmission and Distribution of Electric Power Act, 1997.

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

An online real time gross transfer (RTGS) in the sum of Rupees 465,600 PKR /- being the nonrefundable license application fee calculation in accordance with Schedule II to the National Electric Power Regulatory Authority Licensing (Application and Modification Procedure) Regulations, 1999, is also submitted with NEPRA.

The application is flied online due to Covid – 19 situation on the following electronic mail of your office.

Receiver: registrar@nepra.org.pk

Sender: adeel.ahmed@ibvogt.com

Your Sicerely,

F1 Solar PK (Private) Ltd F1 Solar PK

Adeel Ahmed

Authorised representative

F1 Solar PK Pvt Ltd

F1 Solar PK

F1 SOLAR PK PRIVATE LTD, 3RD FLOOR ADEEL PLAZA, FAZAL-E-HAQ ROAD, BLUE AREA, ISLAMABAD

F1 Solar PK Private Limited
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Directors
Anton Milner
Carl Von Braun
Salar Khan Sanjrani

AUTHORITY LETTER

THIS AUTHORITY LETTER is executed on this **22nd** day of **April**, 2020 in Berlin.

WHEREAS I, **MR. CHARLES ANTON MILNER** (being the Director of the Company (as defined below) and having Passport No. 525622078), son of Karl-Heinz Milner, resident of Ernst-Ring-Strasse 4, 14129 Berlin (the "**General Attorney**") am the duly constituted authorized representative of **F1 SOLAR PK (PRIVATE) LIMITED** (*a private company duly established and existing under the laws of Pakistan with its registered office located at 3rd Floor, Adeel Plaza, Fazal-e-Haq Road, Blue Area, Islamabad, Pakistan*) (the "**Company**") *vide* the Company's board resolution dated April 14, 2020 (the "**General Authorization**");

AND WHEREAS, THE COMPANY HOLDING A LETTER OF INTENT IN FAVOR OF ITS SPONSORS FOR THE DEVELOPMENT OF A 100 MW DC SOLAR POWER PROJECT TO BE LOCATED AT JAMSHORO, SINDH, PAKISTAN (THE "**PROJECT**") FROM THE DIRECTORATE OF ALTERNATIVE ENERGY, SINDH ENERGY DEPARTMENT GOVERNMENT OF SINDH DATED AUGUST 20, 2015; AND HAVING MADE STEADY PROGRESS IN RESPECT OF THE DEVELOPMENT OF THE PROJECT;

AND WHEREAS, in terms of paragraph B(iv) of the General Authorization, the General Attorney is authorized to sub-delegate to any person or persons all or any of the powers conferred upon the General Attorney under the General Authorization as the General Attorney may deem fit;

AND WHEREAS, the General Attorney, in terms of paragraph B(iv) of the General Authorizations, appoints, nominates and authorizes:

(1) **MR. ADEEL AHMED**, son of Mr. Ahmad Khan Dar, resident of 73 Saville Road Gatley, SK8 4BY having Pakistani passport number AF7999854, to act singly; and
(2) **MR. JENS PIETRUCHA**, son of Mr. Klaus Pietrucha, resident of Germany, Alt-Stralau 22, 10245 Berlin, having a German passport, number C1VYPXM33, to act singly;

as its attorneys in its place and in its name (the "**Sub Attorneys**"), in respect of all matters of any nature whatsoever in relation to the Generation License Application (as defined in the General Authorisation), including without limitation:

i. review, execute, submit, and deliver the Generation License Application and any related documentation required by the National Electric Power Regulatory Authority, Pakistan (the "**Authority**") for its approval, including any contracts, documents, powers of attorney, affidavits, statements, letters, forms, applications, deeds, guarantees, undertakings, approvals, memorandum, amendments, letters, communications, notices, certificates, request statements and any other instruments of any nature whatsoever;

ii. represent the Company in all negotiations, representations,

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F1 Solar PK

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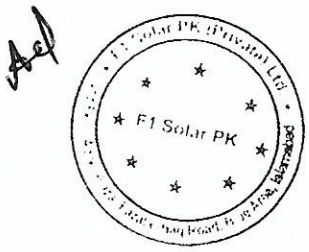
iii. presentations, hearings, conferences and/or meetings of any nature whatsoever with any entity (including, but in no manner limited to the Authority, any private parties, companies, partnerships, individuals, governmental and/or semi-governmental authorities and agencies, ministries, boards, departments, regulatory authorities and/or any other entity of any nature whatsoever);

iv. sign, execute and deliver, for and on behalf of the Company, all necessary documentation (including any contracts, documents, powers of attorney, affidavits, statements, letters, forms, applications, deeds, guarantees, undertakings, approvals, memorandum, amendments, letters, communications, notices, certificates, request statements and any other instruments of any nature whatsoever), pay the necessary fees, appear before any entity (including the 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), as required from time to time, and do all acts necessary for processing and approval of the Generation License Application, by the Authority.



F1 Solar PK

F1 Solar PK Private Ltd, 3rd Floor Adeel Plaza, Fazal-E-Haq Road, Blue Area, Islamabad

AND I HEREBY ratify and confirm all lawful acts done by the said Sub Attorneys pursuant to this Power of Attorney.

SIGNED AND executed in the presence of the following witnesses on the day, month and year first above written.

CHARLES ANTON MILNER

F1 Solar PK Private Limited

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Islamabad, Pakistan

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Directors
Anton Milner
Carl Von Braun
Safar Khan Sanjrani

WITNESSES:

1.....

NAME: Adeel Ahmed

ADDRESS: 73 Saville Road, Gatley Cheadle Cheshire UK

PASSPORT NO.: AF7999854

2.....

NAME: Jens Pietrucha

ADDRESS: Alt-Stralau 22, 10245 Berlin, Germany

PASSPORT NO.: C1VYPXM33

F1 Solar PK (Private) Ltd. F1 Solar PK 3rd Floor Adeel Plaza, Fazal-e-Haq Road, Blue Area, Islamabad

3.....

NAME:.....

ADDRESS:

PASSPORT NO.:

4.....

NAME:.....

ADDRESS:

PASSPORT NO.:

EXTRACTS OF THE RESOLUTION PASSED BY THE BOARD OF DIRECTORS OF F1 SOLAR PK (PRIVATE) LIMITED ON 14/04/2020

BOARD RESOLUTIONS

"It is hereby unanimously resolved that:

(A) **F1 SOLAR PK (PRIVATE) LIMITED** (*a private company duly established and existing under the laws of Pakistan with its registered office located at 3rd Floor, Adeel Plaza, Fazal-e-Haq Road, Blue Area, Islamabad, Pakistan*) (the "**Company**"), holding a Letter of Intent extension in favor of its sponsors for the development of a 100 MW DC solar power project to be located at Jamshoro, Sindh, Pakistan (the "**Project**") from the Directorate of Alternative Energy, Sindh Energy Department Government of Sindh dated August 15, 2015;

BE AND IS HEREBY AUTHORIZED to prepare, finalize, deliver, file, apply and submit, pursuant to the applicable laws of Pakistan, including the '*Regulation of Generation, Transmission and Distribution of Electric Power Act, 1997*' (the **NEPRA Act**) and the rules and regulations made thereunder (including regulation 10(2) of the '*National Electric Power Regulatory Authority Licensing (Application & Modification Procedure) Regulations, 1999*' and the '*National Electric Power Regulatory Authority Licensing (Generation) Rules, 2000*') (the **Applicable NEPRA Laws**), an application (together with all documents attached thereto) (the **Generation License Application**) before the **NATIONAL ELECTRIC POWER REGULATORY AUTHORITY** (the **Authority**) for the Authority's approval of the Generation License Application and to, *inter alia*, enter into and execute all required documents, make all filings, attend all hearings, provide all required information and pay all applicable fees, in each case, of any nature whatsoever.

(B) **FURTHER RESOLVED THAT,** in respect of the matters relating to the Generation License Application, **MR. CHARLES ANTON MILNER** (being the Director of the Company and having Passport No. 525622078 is **HEREBY** singly appointed as authorized representative of the Company and is **HEREBY** authorized and empowered for and on behalf of the Company, as the Company duly appointed **AUTHORIZED REPRESENTATIVE,** to address, perform, negotiate, decide, execute, implement and/or undertake all matters of any nature whatsoever in relation to the Generation License Application including, without limitation:

(i) review, execute, submit, and deliver the Generation License Application and any related documentation required by the Authority for its approval, including any contracts, documents, powers of attorney, affidavits, statements, letters, forms, applications, deeds, guarantees, undertakings, approvals, memorandum, amendments, letters, communications, notices, certificates, request 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 the Authority, any private parties, companies, partnerships, individuals, governmental and/or semi-governmental

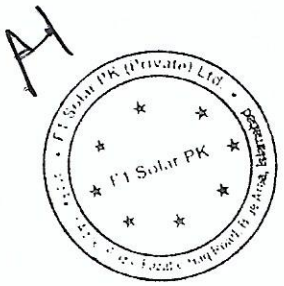
F1 Solar PK

authorities and agencies, ministries, boards, departments, regulatory authorities and/or any other entity of any nature whatsoever);

(iii) sign, execute and deliver, for and on behalf of the Company, all necessary documentation (including any contracts, documents, powers of attorney, affidavits, statements, letters, forms, applications, deeds, guarantees, undertakings, approvals, memorandum, amendments, letters, communications, notices, certificates, request statements and any other instruments of any nature whatsoever), pay the necessary fees, appear before any entity (including the 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), as required from time to time, and do all acts necessary for processing and approval of the Generation License Application, by the Authority;

(iv) further sub-delegate any or all of the aforementioned powers and authorities to one or more officers of the Company or any other person or persons, singly and/or jointly; and

(v) do all such acts, deeds and things as may be necessary for carrying out the purposes aforesaid and give full effect to the above resolutions.



CERTIFICATION
CERTIFIED TO BE TRUE COPY

CERTIFIED, that, the above resolutions were duly passed by the board of directors of **F1 Solar PK (PRIVATE) LIMITED** (*a private company duly established and existing under the laws of Pakistan with its registered office located at 3rd Floor, Adeel Plaza, Fazal-e-Haq Road, Blue Area, Islamabad, Pakistan*) on 14/04/2020.

FURTHER CERTIFIED, that the afore-stated resolutions have not been rescinded and are in operation and in full force and effect as at the date hereof and that this is a true copy of the same.

.....
COMPANY SECRETARY

F1 Solar PK (Private) Ltd
F1 Solar PK
3rd Floor, Adeel Plaza, Fazal-e-Haq Road, Blue Area, Islamabad

1. BACKGROUND TO GENERATION LICENSE APPLICATION

1.1 PROCESS OF ISSUANCE OF LETTER OF INTENT, LEADING TO GENERATION LICENSE APPLICATION

1.1.1 ISSUANCE OF "LETTER OF INTENT"

A Letter of Intent, dated August 20, 2015 via file No. DAE/Solar/80/2015/35, was issued by the Directorate of Alternative Energy, Energy Department, Government of Sindh (the **"DAE"**) to MCC Tongsin Resources Limited (the "**Original Sponsor**") for the development of a 100 MW Sindh PV Power Generation Project in Sindh, Pakistan (the "**Letter of Intent**" or "**LOI**"). The initial expiry date of the LOI was February 19, 2017 however the Original Sponsor was granted multiple extensions in the LOI by DAE[1] and the validity of the LOI has been extended until 13 September 2020 (the "**Extended LOI**"). The Main Sponsor had also submitted a bank guarantee for an amount equal to US$ 50,000/- (United States Dollars Fifty Thousand only) issued by Askari Bank Limited for LOI extension. A copy of LOI and its extension is attached hereto as Annexure – A for NEPRA's perusal.

Approval of DAE was sought by MCCT for the transfer of of hundred percent (100%) of MCCT's the rights in the LOI to be transferred to ibVogt GmBH including all technical approvals, studies, leases, materials, etc. which transfer was approved by DAE vide its letters dated June 20, 2019, July 23, 2019, and September 29, 2019 (attached as **ANNEXURE A**). DAE also acknowledged, vide letter, dated October 31, 2019, the establishment of F1 Solar PK (Private) Limited as a special purpose vehicle for the establishment of the 100 MW solar power project under the Letter of Intent.

1.1.2 ESTABLISHMENT OF SPECIAL PURPOSE VEHICLE

F1 Solar PK (Private) Limited is the Project Special Purpose Vehicle (SPV), (a company duly organized and existing under the laws of Pakistan, with its office located at 3rd Floor, Adeel Plaza, Fazal-e-Haq Road, Blue Area, Islamabad, Pakistan) (the **Project Company**). A copy of the Project Company's Certificate of Incorporation is attached hereto as **ANNEXURE - B** for NEPRA's perusal.

1.1.3 SUBMISSION OF INITIAL ENVIRONMENTAL EXAMINATION.

The Environmental Consultants, EcoChnage, (Private) Limited, who completed the initial environmental examination for the Project (the **Initial Environmental**

[1] The initial expiry date of the LOI was 19 February, 2017 (see paragraph 4 of the LOI), however the Original Sponsor was granted multiple extensions in the LOI by DAE and the validity of the LOI has been extended until 13 September 2020 vide letter dated 11 February 2020, bearing ref No. DAE/solar/80/2015 and entitled as "Extension in the validity period of letter of intent (LOI) issued to M/S F1 Solar PK (Private) Limited for the development of 100 MW Solar Power Project".

Examination) and submitted to the Environmental Protection Agency, Balochistan (the **EPA**) on 25/02/2016.

After careful review and analysis of the Initial Environmental Examination, the EPA accorded its approval for the Project through its decision (Ref: No. (EPA)/2016/02/25/IEE/15 dated *28/03/2016* (the **IEE Approval Decision**). A copy of the IEE Approval Decision is attached hereto at **ANNEXURE - C** for NEPRA's perusal.

1.1.4 GRID INTERCONNECTION STUDIES

The Project Company has engaged independent consultants, ARCO Energy Consultants, who have conducted the grid interconnection studies (the **Grid Interconnection Studies**). The Hyderabad Electric Supply Company (HESCo) has already issued No Objection Certificate (NOC) vide Letter No. CEO/HESCo/CE(P&E)/DM/(SPP)/392-96 dated 10/01/2018 and is attached herewith as **ANNEXURE D** for NEPRA's perusal.

1.1.5 SUBMISSION OF THE FEASIBILITY STUDY

Pursuant to the relevant provisions of the Policy for Development of Renewable Energy for Power Generation Policy, 2006 (the **Renewable Energy Power Generation Policy 2006**) and the LOI, the Project Company hired technical consultants, Pakistan Testing Services (PTS), ARCO Energy Consultants and financial advisors EY Ford Rhodes, who completed the detailed technical feasibility study for the Project with support from ibvogt Gmbh inhouse engineering team, (including geo-technical investigation, topographic survey) and the Project Company submitted the same to Govt. of Sindh Directorate of Alternative Energy (DAE), Energy Department for its approval on 30/03/2020 (the **Project Feasibility Study**). A copy of Project Feasibility Study is attached hereto as **ANNEXURE – E** for NEPRA's perusal. A copy of Govt. of Sindh Directorate of Alternative Energy (DAE), Energy Department approval of the Project Feasibility Study is attached hereto as **ANNEXURE- F**.

1.1.6 REQUEST FOR GRANT OF A GENERATION LICENSE

Based on the matter provided in Section 1.1.1, 1.1.2, 1.1.3, 1.1.4 and 1.1.5. above whereby the Project Company, on its part, has undertaken and completed all activities required for procurement of approvals of the relevant matters from various stakeholders it is submitted that the requirements of the regulatory process for applying to NEPRA for grant of a generation license for the Project Company are complete.

1.2 SUBMISSION

1.2.1 Under the Regulation of Generation, Transmission and Distribution of Electric Power Act (XL of) 1997 (the **NEPRA Act**) and the National Electric Power Regulatory Authority Licensing (Generation) Rules 2000, the National Electric Power Regulatory Authority (**NEPRA**) is responsible for and has the authority to, *inter alia*, grant licenses

for the generation of electric power and other terms and conditions for the supply of electricity through generation.

1.2.2 **PURSUANT TO** 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 Policy for Development of Renewable Energy for Power Generation Policy, 2006: **F1 SOLAR PK (PRIVATE) LIMITED HEREBY SUBMITS,** for NEPRA's kind and gracious consideration, the application for the grant of a generation license along with supporting documents (the **Generation License Application**) for its 100MWp power generation facility to be located at Taluka Kotri District Jamshoro, Sindh, Pakistan.

1.2.3 In order to highlight the advance stage of the progress made by the Project Company with regard to the 'self-EPC' mode, financing arrangements and other activities necessary to culminate the generation facility to its commercial operation, the Project Company hereby encloses as **ANNEXURE G** a copy of the 'Project Management Sheet' dated 30/03/2020 submitted by the Project Company to the Govt. of Sindh Directorate of Alternative Energy (DAE), Energy Department. Self EPC mode explanation also attached as **ANNEXURE G.**

1.2.4 Given the advance stage of the Project, NEPRA is kindly requested to process this Generation License request at the earliest, thereby enabling the Project Company to proceed further with the development process.

1.2.5 This Generation License Application is submitted online due to Covid-19 situation and in scanned version. One hard copy will be submitted to NEPRA, once normal business conditions resume.

1.2.6 The generation license fee, payable by the Project Company, in respect of this Generation License Application is also enclosed in the form of a pay order for an amount of PKR 465,600.00/- (Pakistani Rupees Four Hundred Sixty Five Thousand, and Six Hundred Rupees only,) dated 29 June 2020 drawn in favor of NEPRA.

2. APPLICANT – F1 SOLAR PK (PRIVATE) LIMITED

2.1 The Project Company, being the applicant under this Generation License Application, is a private limited company incorporated under the laws of Pakistan and has been specifically established to undertake power generation business and activities in Pakistan.

2.2 The Project Company (following grant of a generation license and approval of the Project Company's reference generation tariff by NEPRA) proposes to design, engineer, construct, insure, commission, operate and maintain the Project constituting of a 100 MWp solar power generation facility (the **Facility**) to be located at Jamshoro, Province of Sindh, Pakistan (the **Site**).

2.3 The following supporting documents relating to the Project Company are attached herewith as follows:

DOCUMENTS	ANNEXURE
Shareholding Pattern	ANNEXURE H
Memorandum and Articles of Association	ANNEXURE I
Certificate of Incorporation	ANNEXURE B

3. FACILITY UTILIZATION

3.1 ELECTRICITY DEMAND

3.1.1 Pakistan is a developing economy having a constant growth in industrialization, coupled with a constantly rising demand for electricity. The long standing gap between demand and supply of electrical power has resulted in excessive and frequent load shedding, resulting in determinant and loss to the economy and socio-economic development in the country.

3.1.2 The demand for electricity has continued to increase by out pacing the growth rate of the economy. In the past years, shortfall at times crosses 5000 MW and this is the time when urban areas have [8-12] hours of load shedding and small cities/ rural areas have [18] hours of load shedding. While it may be arguable that the demand and supply gap in electricity it is soon to be bridged, however the same does not account for the fact that a developing economy, coupled with growing consumption and demand could result in another cycle of shortfall in potential supply, which could be the major cause for stunned growth in the industrial sector in Pakistan. The industry, having its self-generation on gas, has a suspended supply of gas for 2-3 days a week during winters. Pakistan's major electricity sources at present are thermal and hydro generation, meeting approximately 74% of the country's annual electricity demand. The primary thermal generation fuels employed are furnace oil and gas. While both fuels are produced domestically, demand for them already outstrips supply by a considerable amount. Oil imports are already a significant burden on the national exchequer and the increasing import bill continues to exert further pressure on the foreign exchange reserves. Therefore, securing alternative fuels and the technical management should be strengthened to solve these problems and solar power, a cleaner source of energy can play a very important role in overcoming Pakistan's growing energy crisis.

3.1.3 In light of compliance by the Project Company of all requirements under the Policy for Development of Renewable Energy for Power Generation Policy, 2006 for eligibility of an application for a generation license and following grant of a generation license and approval of Project Company's reference generation tariff, in each case, by NEPRA, the Project Company will finance, design, engineer, procure, construct, install, test, complete, commission, insure, operate and maintain the Project at Site.

3.1.4 The proposed Project will, following its completion, contribute towards relieving the shortage of electric power in the country and continuing to ensure that the supply of electricity continues to meet the growing demand.

3.1.5 Based on a thorough analysis of the national electricity generation structure and in light of technical parameters, it is anticipated that the Project shall operate as one of the most competitive independent power producers in Pakistan.

3.2 POWER OFF-TAKE

3.2.1 Following commercial operation date of the Project, the electricity generated will be sold to the Central Power Purchasing Agency (Guarantee) Limited), as an agent of the ex-Wapda distribution companies (the **Power Purchaser**) pursuant to an energy purchase agreement (the **EPA**), which in turn will distribute and modulate the electricity generated by the Project Company.

3.2.2 The EPA will be finalized and executed by and between the Project Company and the Power Purchaser following NEPRA's approval of the Project Company's [twenty-five (25) years] reference generation tariff, the grant of a generation license to the Project Company and the issuance by the Government of Pakistan of the Letter of Support.

4. THE SPONSORS

4.1 AN INTRODUCTION

4.1.1 The Main Sponsor, IB VOGT GMBH intends to be a major player in developing projects in the energy sector with particular emphasis on development of renewable energy projects through investment in efficient and profitable projects.

4.1.2 The Main Sponsor of the Project has established two subsidiaries, which are the major shareholders in the Project Company: IBV LASBELA HOLDCO 1 LIMITED [established in United Kingdom under the laws of England and Wales] and IBV LASBELA HOLDCO 2 LIMITED [established in United Kingdom under the laws of England and Wales] (collectively the **Major Shareholders**).

4.1.3 Whereas Pakistan Testing Service (PTS) is an Islamabad based developer, who develops solar projects for the end investors. The successfully developed solar projects portfolio of PTS is above 100MW.

(The Major Shareholders and PTSL are collectively referred to as the **Sponsors.**)

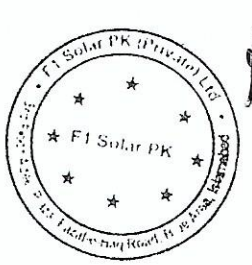
4.2 FINANCIAL HIGHLIGHTS

The Main Sponsors financial highlights for the year ended December 31, 2018 include a collective turnover of > 200 Million Euros. A summary of Main Sponsors' financial highlights are attached herewith as ANNEXURE J.

4.3 COMMITMENT TO PROJECT

4.3.1 The Sponsors are committed to playing their part in the development of Pakistan's various sectors. Realizing the role of clean energy, the Sponsors endeavor to play a positive role in the development of renewable energy in Pakistan and through the Project, the Sponsors intends to promote technological development, construction, operation and maintenance of solar power plants.

4.3.2 The unmatched standards of corporate governance, efficiency, safety and operations established by the Sponsors in projects around the globe are now expected to be replicated in its solar power generation venture in Pakistan – thus raising the bar for all future solar power projects.



5. RESOURCES

5.1 SENIOR MANAGEMENT & PERSONNEL

5.1.1 Given the Sponsors' long standing engagement in the solar industry, the Project Company has access to and has engaged the highly qualified personnel for the development of the Project. The Project Company is presently under the process of appointing various personnel and details of the same will be provided upon finalization of the terms and conditions of their appointment.

5.1.2 In addition, the curriculum vitae of the following individuals currently engaged by the Project Company are attached herewith at ANNEXURES K, L, M, N AND O:

	NAME OF INDIVIDUALS	POSITION	ANNEXURE
1.	ANTON MILNER	Managing Director	K
2.	Carl Von Braun	Managing Director	L
3.	Carsten Stang	Managing Director	M
4.	Adeel Ahmed	Senior Manager Project Development	N
5.	Jens Pietrucha	Project Integration Manager	O

5.3 LEGAL ADVISER

5.3.1 **HAIDERMOTA&CO.** has been selected by the Project Company to provide legal support on all legal aspects of the Project including Project documentation, regulation and financing matters. Haidermota&Co. has been actively involved in the power sector and projects and has advised various project companies and sponsors, lenders and the Government of Pakistan on various transactions and matters. It is ranked by Chamber & Partners as a "*Band 1*" firm in Pakistan for Projects, Banking & Finance and Corporate & Commercial.

5.4 FINANCIAL ADVISORS

5.4.1 **ERNST & YOUNG (FORD RHODES SIDAT HYDER) (E&Y)** has been selected by the Project Company to provide support on all financial aspects of the Project. E&Y has been actively involved in the power sector and infrastructure projects in Pakistan.

6. CAPITAL BUDGET

6.1 The estimated total Project cost (the **Total Project Cost**), expressed in United States Dollars, has been calculated after thorough analysis, evaluation and understanding of the dynamics that affect the development and operation of a solar power plant. The Total Project Cost comes to approximately US$ 83,398,201/- (United States Dollars).

6.2 The capital structure of the Project is proposed as follows:

	USD
DEBT	66,718,561
EQUITY	16,679,640
TOTAL PROJECT COST	83,398,201

7. FINANCIAL PLAN

7.1 The Total Project Cost of US$ 83,398,201/- (United States Dollar Eighty Three Million, Three Hundred Ninety Eight Thousand, Two Hundred and One only) is to be financed in a debt to equity ratio of 80% - 20%.

7.1 DEBT

7.1.1 It is expected that the debt for the Project (the **Debt**) will be secured from **BANK/DFI** which will provide foreign financing in United States Dollars to the Project Company.

7.2 EQUITY

7.2.1 Based on the Debt to Equity ratio of 80% - 20%, the equity required to be injected by the Sponsors (the **Equity**), amounts to USD 16,679,640/- (United States Dollars Sixteen Million, Six Hundred Seventy Ninety Nine Thousand, Six Hundred and Fourty only). The Sponsors will subscribe to the total amount of the Equity required for the Project from time to time.

7.2.2 The financial strength and net worth of the Main Sponsor is illustrated by the attached ANNEXURE J. Further, the recent financial statements of the Project Company are also attached hereto at ANNEXURE J.

8. THE FACILITY

8.1 TECHNOLOGY

8.1.1 Technology Selection Criteria

The technology for the Project has been shortlisted after detailed analyses of various power generation technologies available internationally for the purposes of power generation through solar. Various factors were considered in selection of equipment and technology which included:

(a) equipment to be of latest proven technology, megawatt class and high efficiency;

(b) safe transportation of equipment to the Site;

(c) maintainability of the equipment and availability of personnel;

(d) energy output with warranted power curve and performance warranty;

(e) grid compatibility with proposed energy yields and grid code requirements; and

(f) suitability of operation and maintenance concept for the size and location of projects with suitable availability of spare parts, consumables and main components.

8.1.2 The Selected Technology

The project will use Mono crystalline bifacial solar panels, with string inverters and single axis trackers, trasnformers etc.

The Project Company has selected the following equipment for the Project:

No.	Equipment	Brands
1	PV modules	Tier 1 (Hanwah Q-Cells, Jinko, Trina, Longi solar or similar)
2	Single Axis Tracker	Leading global supplier (Arctech, Soltec, Schletter)
3	Inverters	ABB, GE, Sungrow, HUAWEI
4	DC/AC brand	Faber or Huawei
5	Step – up transformers	Siemens, ABB, TBEA, QRE, Chint
6	Medium voltage switch gear and 132KV substation	Siemens, ABB, Chint
7	SCADA	Gatner, ABB, Schneider

Additional Plant Technical Details

Plant Configuration:

1. Installed Capacity/Project size: 100 MWp/(DC) ~ 93.7 MW (AC)
2. Capacity at Operating Conditions: 90.91 MWp @ 50^{O} C
3. Auxiliary Consumption approx.: 43 KW
4. Net output: 93.7 MW(AC)
5. Life of facility 25 years
6. Number of Solar Modules = 250,000 (Each 400Wp)

The Project will be set up using bifacial monocrystalline PV modules, which will be installed in arrays, and their DC output will be converted in to AC through inverters. Thereafter, a group of arrays/inverters will be routed to step-up transformer(s)/switchgear(s) for connecting to the system as per the interconnection scheme.

Detailed plant configuration is provided in ANNEXURE P and Q Schedule Part I and Schedule Part II attached hereto.

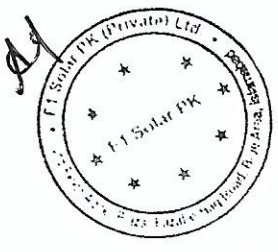
8.2 THE PROJECT SITE

8.2.1 The Site of the Project is located, Jamshoro, Sindh. The area has been extensively surveyed and due to its predominantly flat topography has been identified as having strong potential for the proposed solar project. The following other parameters have also been considered for the implementation of the Project at the proposed Site:

(a) Forecasted power output;
(b) Access to the proposed site (materials and equipment transport feasibility study);
(c) Suitability for the surrounding environment;
(d) Utility connections for electric, gas and water supply; and
(e) Grid Station connection a 132KV grid station is located approximately 7 km from the Site.

8.2.2 The Site is located at 52m to 80m above sea level. The size of the whole solar farm is about 500 acres.

8.2.3 The coordinates of the Site are as follows:



S.No.	Entry	Details
1	Site Name	Jamshoro Solar Farm Site
2	Site Coordinates	P1= Lat 25°22'57.42"N, Long 68° 8'21.72"E P2= Lat 25°22'41.70"N, Long 68° 7'50.04"E P3= Lat 25°21'43.86"N, Long 68° 8'24.30"E P4= Lat 25°22'0.12"N, Long 68° 8'55.74"E
3	Altitude	80 m (Highest recorded value) 52 m (Lowest recorded value)
4	Proposed AC and DC capacity	93.7 MW AC ~ 100 MW DC
5	Global irradiation levels	2271 KWh / m^2 (Solar GIS)

Table 1 showing site coordinates and irradiation levels

FIGURE 1: SITE OVERVIE

Fig 1 showing the location of Jamshoro site

Infrastructure:

1. **Site Access**

Jamshoro solar farm site is located on the Hyderabad Karachi Motorway M-9. The site can be accessed directly from the Motorway M-9. A triple surface treatment road will be constructed, which will be used later during the operation and maintenance stage.

2. **Road types**

Hyderabad Karachi Motorway M-9 is the main artery and primary road through which site will be accessed.

S.No.	Road Type	Name
1	Primary	M-9
2	Secondary	Access Road

Hyderabad Karachi Highway is a multiple carriageway road for one-way traffic. The road width is sufficient to cater the heavy traffic vehicles.

Fig 2 showing connectivity of the site through M9

3. **Utilities:**

   Electricity and water is already present on the site for necessary operations during construction.

4. **Staff colony:**

   There will be no permanent staff colony on the site. Only temporary accommodation for staff will be established during construction.

5. **Amenities:**

   The site is located almost 10-15 km away from Jamshoro Town Centre and hence most of amenities are easily accessible from the site.

6. **Control, metering:**

   Control, metering, instrumentation and protection scheme will be designed as per NEPRA Grid Code.

9. ENVIRONMENTAL AND SOCIAL SOUNDNESS

9.1 INVESTIGATION SUMMARY

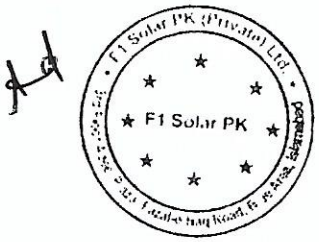
9.1.1 The environmental investigations at Site have shown that in general, the realization of the Project is possible at the Site from an environmental point of view and no adverse impact on the existing flora and fauna at Site is expected. The Facility will not emit any solid, liquid and gaseous waste during the entire life of the Project and thus the power will be generated without polluting the environment of the surroundings.

9.1.2 A data collection survey that 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 available secondary information or data collected in the field. Primary data was collected to establish baseline conditions for the soil, water (surface and ground) quality, flora and fauna, and noise. Secondary data was collected for land, ecology, climate, and socioeconomic factors.

9.1.3 It was observed that the area is highly underdeveloped and there is no industrialization in the area and thus the baseline emissions are very low. The nearest settlements of human habitats are located [four (4)] Km away from the Project Site. There is very sparse vegetation in the forms of herbs and shrubs, there being no reserved forest site or sanctuary located within the Project land area that needs to be demolished. The Site is located in remote areas with very little social and commercial activity and thus limiting the long term social impact.

9.1.4 Noise impacts will be around 60DB(A) at 10m which are within the range as per National Environmental Quality Standards (NEQs) of Pakistan. But at distance of 100m from the noise impact will also be negligible. There are no exceeds of shadow from the permissible limits calculated for all heighted feature type scenarios. The environmental disturbance normally associated with construction activities will be minimized through an Environment Management Plan (EMP), implementation of which will continue during Project operation and which includes monitoring arrangements.

9.1.5 There exist high potential of solar energy at the Site and the proposed Project will help in tapping this potential without impairing the environmental conditions of the area.



9.2 IEE REPORT APPROVAL FROM THE ENVIRONMENTAL PROTECTION AGENCY, SINDH

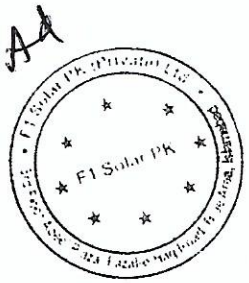
9.2.1 As already submitted in Section 1 (*Background to Generation License Application*) above, the Sindh EPA has already accorded its **approval** to the IEE Report for the Project through its decision dated 25/02/2016. Attached here as Annexure C.

10. SAFETY

10.1 The Project will be implemented in accordance with internationally accepted health and safety standards and in-line with the acclaimed practices and procedures. The Sponsor's, entails introducing and establishing its unmatched safety standards and procedures in the business operations of the Project Company, so as to establish an enviable benchmark in the country's solar energy sector.

11. TRAINING AND DEVELOPMENT

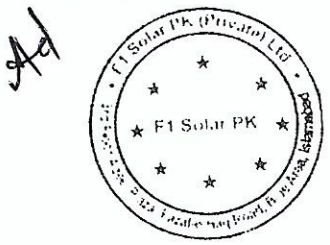
11.1 Periodic environmental and HSE trainings will be given to employees working in the project area. The management of F1 Solar PK Pvt. Limited understands the requirement of diligence and care in this respect and will develop strict stand operating procedures (SOPs) for the health and safety of workers. Various sessions of in-house trainings will also be conducted in the Project.



12. PROJECT FEASIBILITY STUDY

12.1 The Project Company engaged leading technical consultants for elaborating the Project Feasibility Study and for supervising the solar measurements and preparing conceptual design of the Facility.

12.2 A copy of the Project Feasibility Study is attached hereto as ANNEXURE D.



13. IMPLEMENTATION SCHEDULE

13.1 The following provides the key milestones and dates for the Project's development to date:

MILESTONES ACHIEVED TO DATE	
ACTIVITIES	**COMPLETION DATE**
Issuance of Letter of Intent	August 20, 2015
IEE approval by EPA	February 25, 2016
NOC from Hyderabad Electric Supply Company	January 10, 2018
Letter of Intent Extension	February 11, 2020
Approval letter of the Project Feasibility Study	June 8, 2020

13.2 The following provides the key upcoming milestones and dates for the Project's development:

MILESTONES TO BE ACHIEVED	
ACTIVITIES	**COMPLETION DATE**
Grant of Generation License	Upon NEPRA's approval
Execution of major supply contracts	Upon NEPRA's determination
Reference Tariff Determination	Upon NEPRA's determination
Submission of Performance Guarantee by Project Company for issuance of LOS	15 days after Tariff determination by NEPRA
Issuance of LOS to Project Company by Government of Pakistan	7 days after submission of Performance Guarantee
EPA Signing with CPPA(G)	Within the time period allowed under the LOS
IA Signing with Government of Pakistan	Within the time period allowed under the LOS
Project Financial Close & ordering of equipment	Within the time period allowed under the LOS
Commercial Operation Date	18 months following Financial Close
Adjustment of reference tariff by NEPRA	Following Commercial Operations Date

14. CONCLUSION

14.1 In light of the submissions, the relevant financial analysis and information contained in this Generation License Application, along with the Annexures attached hereto, this Generation License Application is submitted for NEPRA's kind consideration and grant of the Generation License to the Project Company.

Respectfully submitted for and on behalf of:
F1 Solar PK (PRIVATE) LIMITED

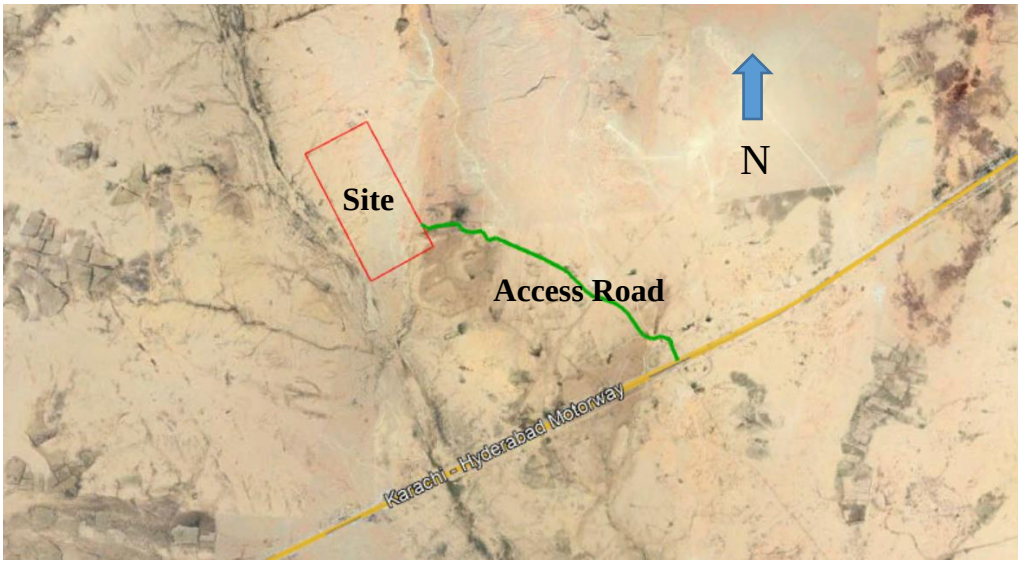
.....

MR. ADEEL AHMED
AUTHORIZED REPRESENTATIVE OF
F1 SOLAR PK (PRIVATE) LIMITED

SCHEDULE-I

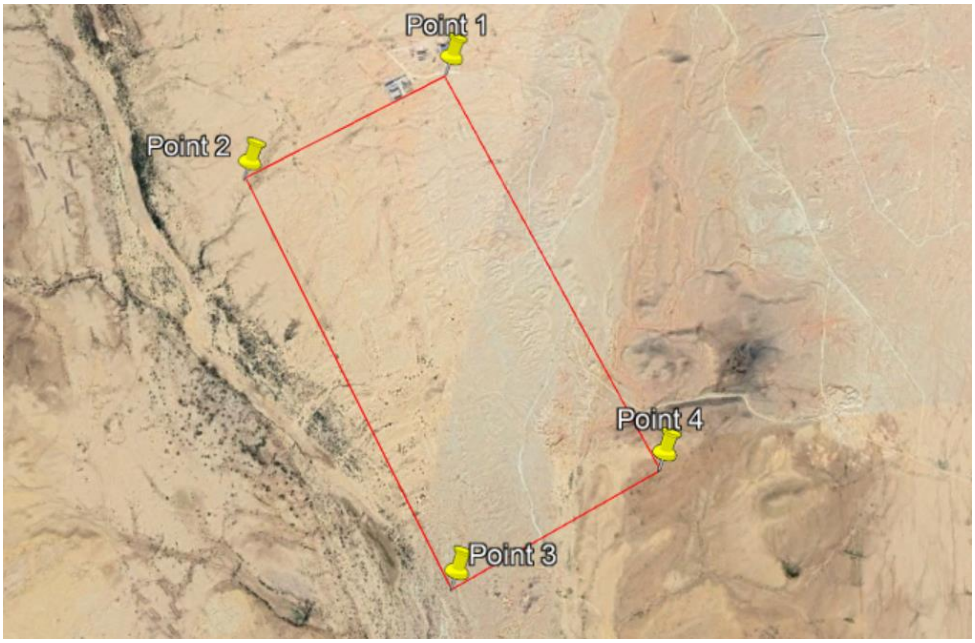
The Location, Size (i.e. Capacity in MW), Type of Technology, Interconnection Arrangements, Technical Limits, Technical/Functional Specifications and other details specific to the Generation Facilities of the Licensee are described in this Schedule.

Near Taluka, Kotri District Jamshoro, Sindh, Pakistan

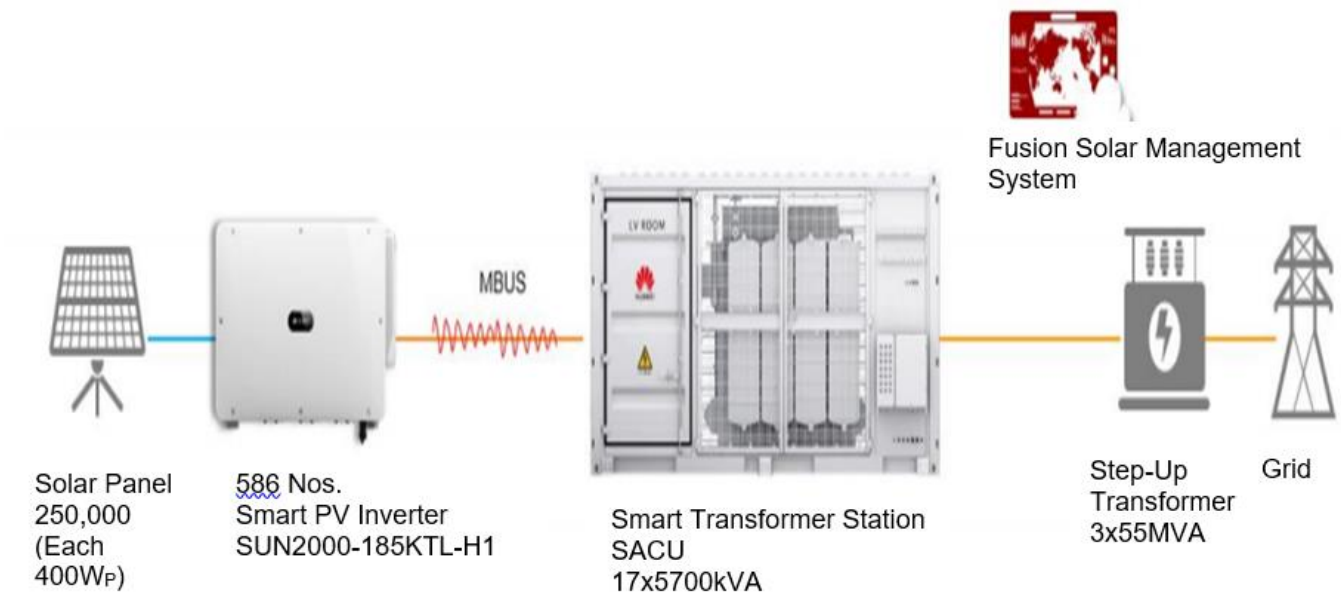


Location of the Generation Facility/Solar Power Plant/ Solar Farm

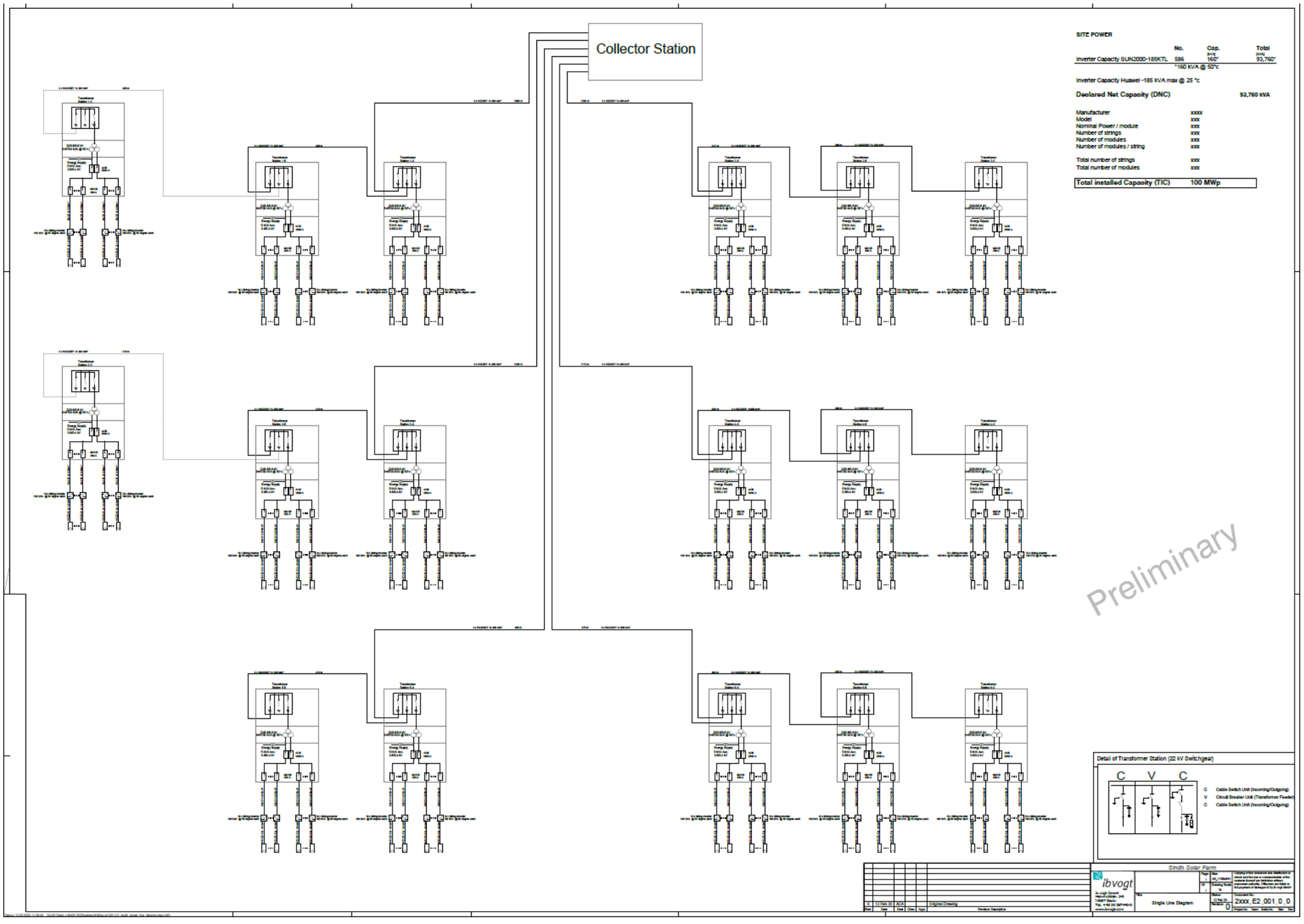
Location	Coordinates
Point 1	Lat 25°22'57.42"N, Long 68° 8'21.72" E
Point 2	Lat 25°22'41.70"N, Long 68° 7'50.04"E
Point 3	Lat 25°21'43.86"N, Long 68° 8'24.30"E
Point 4	Lat 25°22'0.12"N, Long 68° 8'55.74"E



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



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



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

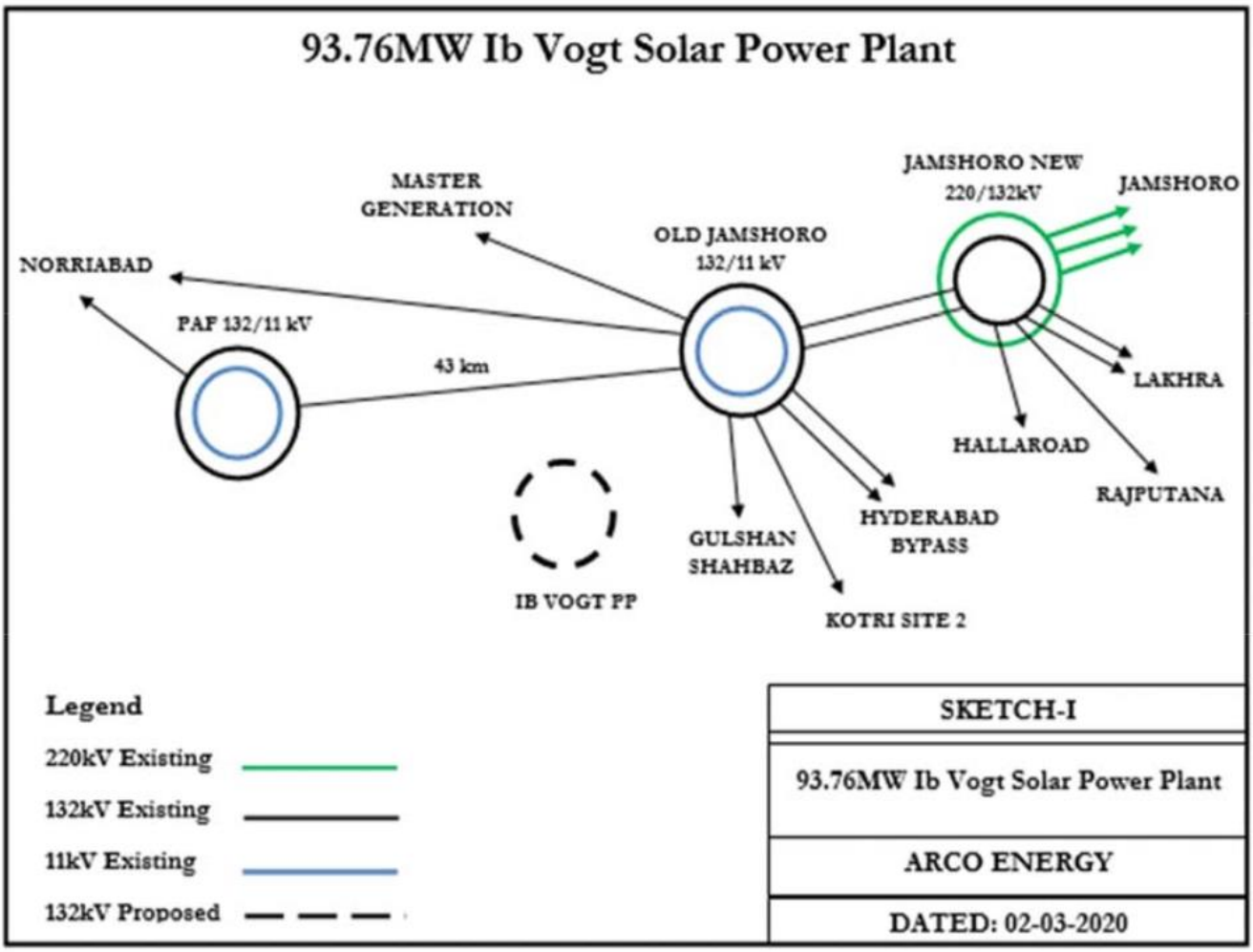
The power generated from the Generation Facility/Solar Power Plant/Solar Farm of the Licensee/Helios Power Private Limited shall be dispersed to the load center of HESCO.

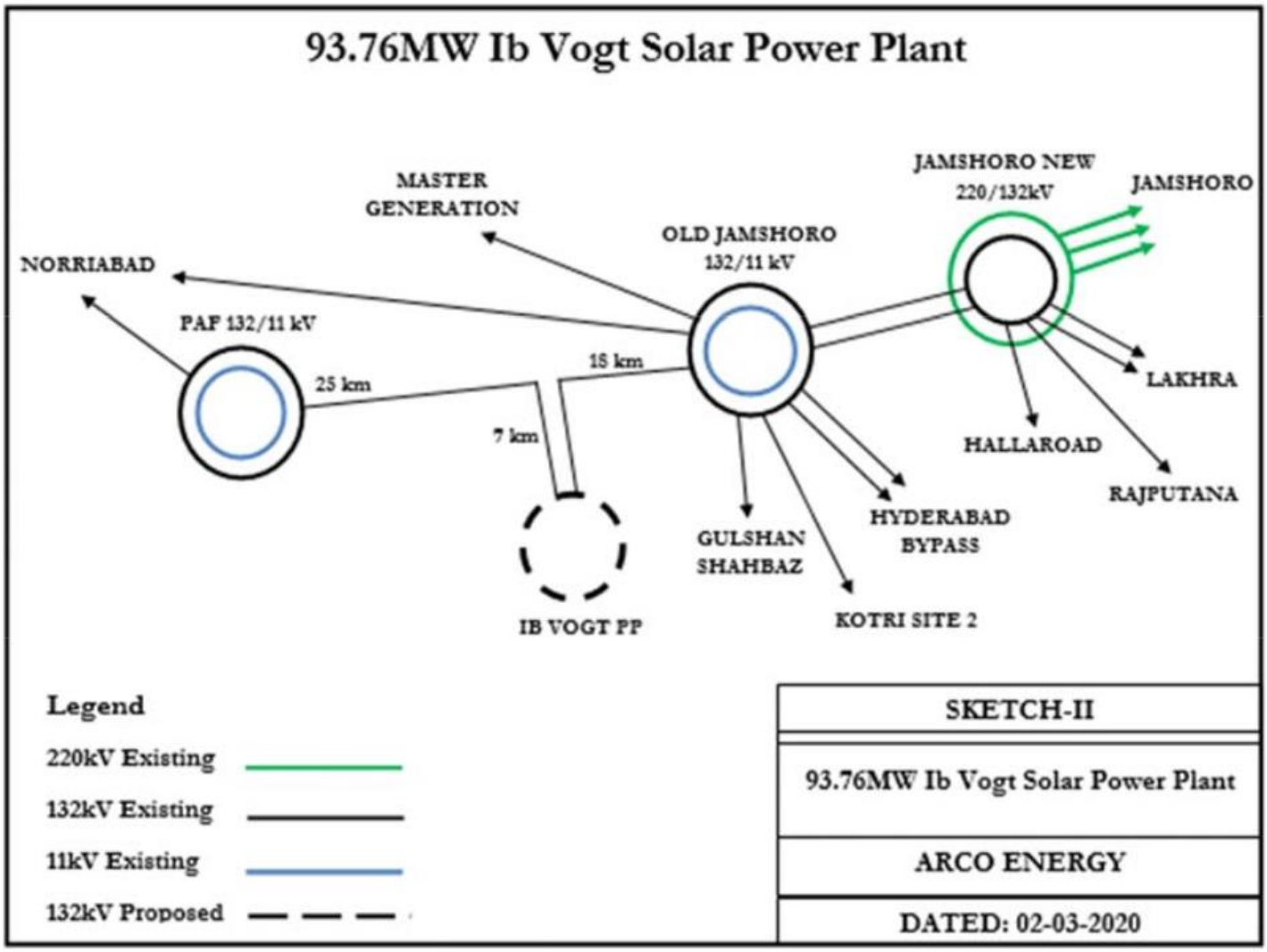
(2). The proposed Interconnection Arrangement/Transmission Facility for dispersal of electric power for the Generation Facility/Solar Power Plant/Solar Farm will be consisting of following:-

a. Interconnection scheme for F1 Solar PK Pvt Ltd Solar Plant is done by looping in-out on 132kV Transmission Line between the PAF – Old Jamshoro grid station, equipped with three 55MVA (ONAN/ONAF), 22/132kV Power Transformers and with feed length of 7km. The conductor used would be Lynx with a thermal capacity of 112 MVA.

(3). Any change in the above Interconnection Arrangement/Transmission Facility duly agreed by Licensee/ F1 Solar PK Private Limited, NTDC and HESCo, shall be communicated to the Authority in due course of time.

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




93.76MW Ib Vogt Solar Power Plant
MASTER GENERATION
JAMSHORO NEW 220/132kV
JAMSHORO
OLD JAMSHORO 132/11 kV
NORRIABAD
PAF 132/11 kV
25 km
18 km
7 km
LAKHRA
HALLAROAD
RAJPUTANA
HYDERABAD BYPASS
GULSHAN SHAHBAZ
KOTRI SITE 2
IB VOGT PP
Legend
220kV Existing
132kV Existing
11kV Existing
132kV Proposed
SKETCH-II
93.76MW Ib Vogt Solar Power Plant
ARCO ENERGY
DATED: 02-03-2020

Detail of Generation Facility/Solar Power Plant/ Solar Farm

(A). General Information

(i).	Name of Company/ Licensee	F1 Solar PK (Pvt.) Limited
(ii).	Registered/Business Office	3rd Floor, Adeel Plaza, Fazl-e-Haq Road Blue Area, Islamabad Pakistan.
(iii).	Plants Location	Near Taluka, Kotri District Jamshoro, Sindh, Pakistan Lat 25°22'57.42"N, Long 68° 8'21.72" E
(iv).	Type of Generation Facility	Solar Photovoltaic (PV) Power Plant

(B). Solar Technology & Capacity

(i).	Type of Technology	PV Cell
(ii).	System Type	Grid Connected
(iii).	Installed Capacity* of the Generation Facility/Solar Power Plant/Solar Farm (MW)	=100.00 MW_p

(C). Technical Details of Equipment

(a).	**Solar Panels – PV Modules**	
(i).	Type of Module	Bifacial Monocrystalline PV Module Type Peak Energy 400Wp;
(ii).	Type of Cell	Monocrystalline
(iii).	Dimension of each Module	2034mmx1000mmx30mm

* The exact Installed Capacity of the Generation Facility/Solar Power Plant/Solar is 100.00 MW_P

(iv).	Module Surface Area	$2.034m^2$	
(v).	No. of Panel /Modules	250,000	
(vi).	Total Module Area	123 acres	
(vii).	Total Land Area Used	500 acres	
(viii).	Panel's Frame	Anodized Aluminium Alloy type 6063T5, Silver Color	
(ix).	Weight of one Module	27kg	
(x).	Module Output Warranty	For 1st year	For 2nd to 25th year
		Not more than 2.5% Output Reduction	Not more than 0.5% Output Reduction Each Year
(xi).	Number of Solar Cells in each module	72 Cells	
(xii).	Efficiency of module	19.7%	
(xiii).	Environment Protection System	Encapsulation and sealing arrangements for protection from environment.	
(xiv).	Nominal Maximum Power (Pmax) at STC	400 W	
(xv).	Power Tolerance at STC	0 ~ +5W	
(xvi).	Optimum Operating Voltage at STC	40.45 V	
(xvii).	Optimum Operating Current at STC	9.90 A	
(xviii).	Open circuit voltage (Voc) at STC	48.60 V	
(xix).	Short circuit current (Isc) at STC	10.50 A	
(xx).	Optimum Operating Voltage at NOCT	37.05 V	
(xxi).	Optimum Operating Current at NOCT	8.08 A	
(xxii).	Open circuit voltage (Voc) at NOCT	43.36 V	
(xxiii).	Short circuit current (Isc) at NOCT	44.70 A	
(xxiv).	Maximum system Voltage at STC	1500VDC	

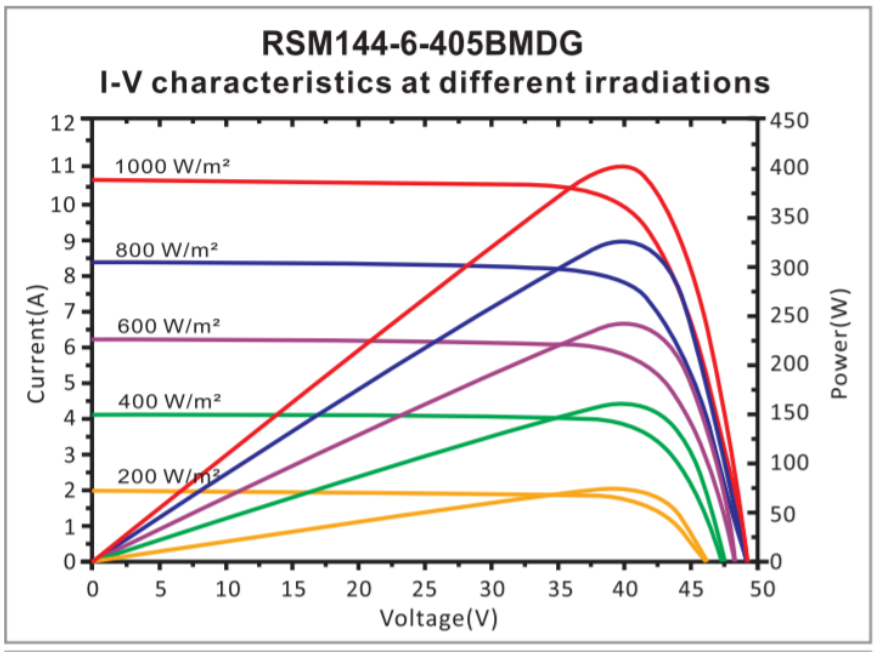
(b).	**PV Array**		
(i).	No. of PV modules	250,000	
(ii).	Modules in a string	26	
(iii).	Total number of strings	9615	
(c).	**PV Capacity**		
(i).	Total	100 MWp	
(d).	**Inverters**		
(i).	Max. DC power Input	185 kW	
(ii).	Inverter Model	Huawei SUN2000	
(iii).	Rated Input Voltage	500VDC~1500VDC	
(iv).	Minimum Input Voltage	500VDC	
(v).	Number of Inverters	9615	
(vi).	Efficiency	euro:98.69%; Max:99.03%	
(vii).	Max. Allowable Input voltage	DC 1500V	
(viii).	Max. Input Current	DC 40 A	
(ix).	Output electrical system	3-phase, 3-wire	
(x).	Nominal Output Voltage (AC)	315 V	
(xi).	Rated Frequency	50 Hz /60Hz	
(xii).	Power Factor Range	0.8 LG - 0.8 LD	
(xiii).	Power Control	9 MPP Tracker	
(xiv).	Environmental Enclosures	Operating Temperature Range	-25º C to 60º C
		Relative Humidity	0 - 100%
		Audible Noise	<55 dB(A)
		Operating Elevation	4000m (Derating above 4000m)
(xv).	Grid Operation Protection	(a).	DC overvoltage protection
		(b).	AC overvoltage protection

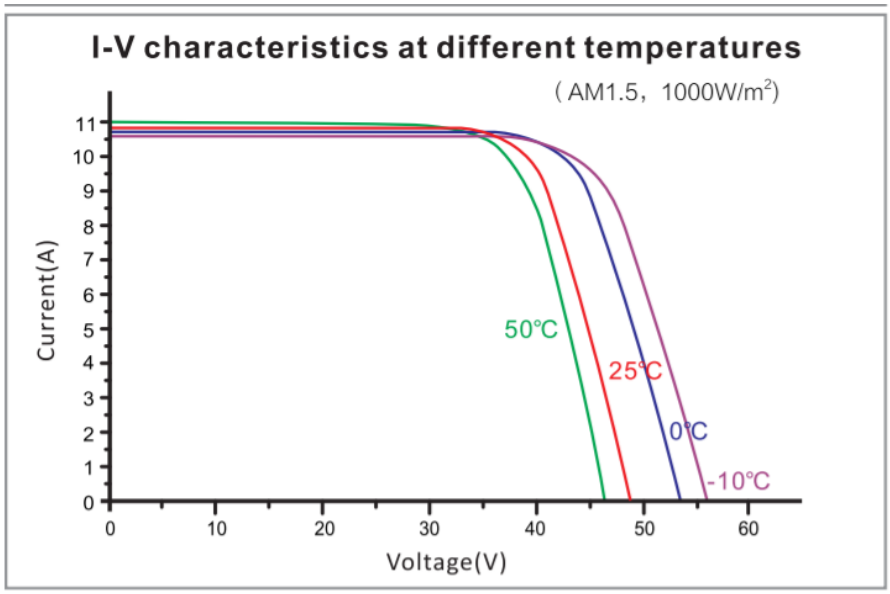
		(c).	Grid monitoring
		(d).	Ground fault monitoring
		(e).	Insulation monitoring
		(f).	Overheat protection
(e).	**Isolating Transformer**		
(i).	Rating	5700 KVA	
(ii).	Type of Transformer	LV/MV 22kV transformer	
(iii).	Input voltage	AC800V	
(iv).	Output Voltage	AC22KV	
(v).	Purpose of Transformer	Step Up Voltage	
(vi).	Efficiency	99.51%	

(D). Other Details

(i).	Expected COD of the Generation Facility/Solar Power Plant/Solar Farm (Anticipated)	March 30, 2023
(ii).	Expected Useful Life of the the Generation Facility/Solar Power Plant/Solar Farm (Anticipated) from COD	25 Years

V-I Curve of Solar Cell





SCHEDULE-II

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

SCHEDULE-II

(1).	Total PV Installed Capacity of Generation Facility	≈100.00 MW_P
(2).	Average Sun Hour Availability/Day (Irradiation on Inclined Surface)	4.8 Hours
(3).	Days per Year	365
(4).	PV Plant Generating Capacity Annually (As Per Simulation)	P75 value = 211,200 MWh/year
(5).	Expected Total Generation in 25 years Life Span	5,280,000 MWh
(6).	Generation per Year from plant keeping 24 Hours Working	100.00 x 24 x 365 = 876,000 MWh
(7).	Net Capacity Factor (4/6)	24.10%

Note

All the above figures are indicative as provided by the Licensee. The Net Delivered Energy available to Power Purchaser for dispatch will be determined through procedures contained in the Energy Purchase Agreement (EPA) or the Applicable Document(s).

A047412

SECURITIES AND EXCHANGE COMMISSION OF PAKISTAN

COMPANY REGISTRATION OFFICE

CERTIFICATE OF INCORPORATION

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

Corporate Universal Identification No. **0124706**

I hereby certify that **F1 SOLAR PK (PRIVATE) LIMITED** is this day incorporated under the Companies Act, 2017 (XIX of 2017) and that the company is **limited by shares.**

Given under my hand at **Islamabad** this **Fifth** day of **October,** Two **Thousand** and **Eighteen**

Incorporation fee Rs. **2000.0/=** only

(Khalida Perveen)
Joint Registrar
Islamabad

COMPANIES ACT, 2017

MEMORANDUM OF ASSOCIATION

OF

F1 SOLAR PK (PRIVATE) LIMITED

1. The name of the company is **F1 SOLAR PK (PRIVATE) LIMITED**.

2. The registered office of the Company will be situated in Islamabad Capital Territory.

3. (i) The principal line of business of the company shall be to carry on all or any of the businesses of generating, purchasing, importing, transforming, converting, distributing, supplying, exporting and dealing in electricity and all other forms of energy and products or services associated therewith and of promoting the conservation and efficient use of electricity and to perform all other acts which are necessary or incidental to the business of electricity generation, transmission, distribution and supply, subject to permission of concerned authorities; and to locate, establish, construct, equip, operate, use, manage and maintain solar power plants, thermal power plants, coal fired power plants, hydal power plants, wind mills, power grid station, grid stations, cables, overhead lines, sub-stations, switching stations, tunnels, cable bridges, link boxes, heat pumps, plant and equipment for combined heat and power schemes, offices, computer centres, shops and necessary devices, showrooms, depots, factories, workshops, plants and to provide transforming, switching, conversion and transmission facilities, subject to permission of relevant authorities.

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

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

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

(a) engage in any of the business mentioned in sub-clause (iii) above or any unlawful operation;

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

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

4. The liability of the members is limited.

5. The authorized capital of the company is PKR 100,000/- (Pak Rupees One Hundred Thousand only) divided into 10,000 (Ten Thousand) ordinary shares of PKR 10/- (Pak Rupees Ten only) each.

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

Name and surname (present & former) in full (in Block Letters)	NIC No. (in case of foreigner, Passport No)	Father's/ Husband's Name in full	Nationality (ies) with any former Nationality	Occupation	Usual residential address in full or the registered/principal office address for a subscriber other than natural person.	Number of shares taken by each subscriber (in figures and words)	Signatures
IBV LASBELA HOLDCO 1 LIMITED THROUGH CARL FRIEDRICH EDLER VON BRAUN VIDE BOARD RESOLUTION DATED AUGUST 14, 2018	11395345 C84PRLM13	NA Franz Josef Von Braun	British German	 Businessman	Murrell Associates Limited, 14 High Cross, Truro, Cornwall, TR1 2AJ, United Kingdom Ferdinand-Lassalle-Strasse 15, 04109 Leipzig, Germany	5100 (Five Thousand One Hundred)	-sd-

IBV LASBELA HOLDCO 2 LIMITED THROUGH CHARLES ANTON MILNER VIDE BOARD RESOLUTION DATED AUGUST 14, 2018	11395354 525622078	NA Karl Milner	British British	 Businessman	Murrell Associates Limited, 14 High Cross, Truro, Cornwall, TR1 2AJ, United Kingdom Pfalzburger Straße 60, 10717 Berlin, Germany	2900 (Two Thousand Nine Hundred)	-sd-
PAKISTAN TESTING SERVICE (PRIVATE) LIMITED THROUGH SALAR KHAN SANJRANI VIDE BOARD RESOLUTION DATED AUGUST 10, 2018	0090867 54103-7208000-1	NA Muhammad Asif	Pakistani Pakistani	 Entrepreneur	3rd Floor, Adeel Plaza, Fazal-e-Haq Road, Blue Area, Islamabad, Pakistan H.No.13-A, Street 31, Sector F-8/1, Islamabad	2000 (Two Thousand)	-sd-
		Total number of shares taken (in figures and words)				10000/- (Ten Thousand Only)	

Dated the 13 day of September 2018

CERTIFIED TO BE TRUE COPY

Additional Joint Registrar
Company Registration Office, Islamabad

No. ADI _____

Dated _____

COMPANIES ACT, 2017

ARTICLES OF ASSOCIATION

OF

F1 SOLAR PK (PRIVATE) LIMITED

1. The Regulations contained in "Table A" to the First Schedule to the Companies Act, 2017 (the "**Act**") shall be the regulations of **F1 SOLAR PK (PRIVATE) LIMITED** (the **"Company"**) so far as these are applicable to a private company.

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

   i. No invitation shall be made to the public to subscribe for the shares or debentures of the Company;

   ii. The number of Members in the Company is restricted to fifty (50) excluding the persons who are in the employment of the Company; provided that where two or more persons hold one or more shares in the Company jointly they shall be treated as a single member; and

   iii. The right to transfer the shares in the Company is restricted in the manner and to the extent appearing herein.

TRANSFER OF SHARES

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

DIRECTORS

4. The number of directors shall not be less than two or a higher number as fixed under the provisions of the Act. The following persons shall

be the first directors of the Company and shall hold the office up to the date of First Annual General Meeting:

a) Salar Khan Sanjrani;
b) Carl Friedrich Edler Von Braun; and
c) Charles Anton Milner.

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

Name and surname (present & former) in full (in Block Letters)	NIC No. (in case of foreigner, Passport No)	Father's/ Husband's Name in full	Nationality (ies) with any former Nationality	Occupation	Usual residential address in full or the registered/principal office address for a subscriber other than natural person.	Number of shares taken by each subscriber (in figures and words)	Signatures
IBV LASBELA HOLDCO 1 LIMITED THROUGH CARL FRIEDRICH EDLER VON BRAUN VIDE BOARD RESOLUTION DATED AUGUST 14, 2018	11395345 C84PRLM13	NA Franz Josef Von Braun	British German	Businessman	Murrell Associates Limited, 14 High Cross, Truro, Cornwall, TR1 2AJ, United Kingdom Ferdinand-Lassalle-Strasse 15, 04109 Leipzig, Germany	5100 (Five Thousand One Hundred)	-sd-
IBV LASBELA HOLDCO 2 LIMITED THROUGH CHARLES ANTON MILNER VIDE BOARD RESOLUTION DATED AUGUST 14, 2018	11395354 525622078	NA Karl Milner	British British	Businessman	Murrell Associates Limited, 14 High Cross, Truro, Cornwall, TR1 2AJ, United Kingdom Pfalzburger Straße 60, 10717 Berlin, Germany	2900 (Two Thousand Nine Hundred)	-sd-

PAKISTAN TESTING SERVICE (PRIVATE) LIMITED THROUGH SALAR KHAN SANJRANI VIDE BOARD RESOLUTION DATED AUGUST 10, 2018	0090867 54103-7208000-1	NA Muhammad Asif	Pakistani Pakistani	 Entreprenuer	3rd Floor, Adeel Plaza, Fazal-e-Haq Road, Blue Area, Islamabad, Pakistan H.No.13-A, Street 31, Sector F-8/1, Islamabad	2000 (Two Thousand)	-sd-
		Total number of shares taken (in figures and words)				10000/- (Ten Thousand Only)	

Dated the 13th day of September 2018

CERTIFIED TO BE TRUE COPY

Additional Joint Registrar
Company Registration Office Islamabad

29/12/18

No. ADI 64542

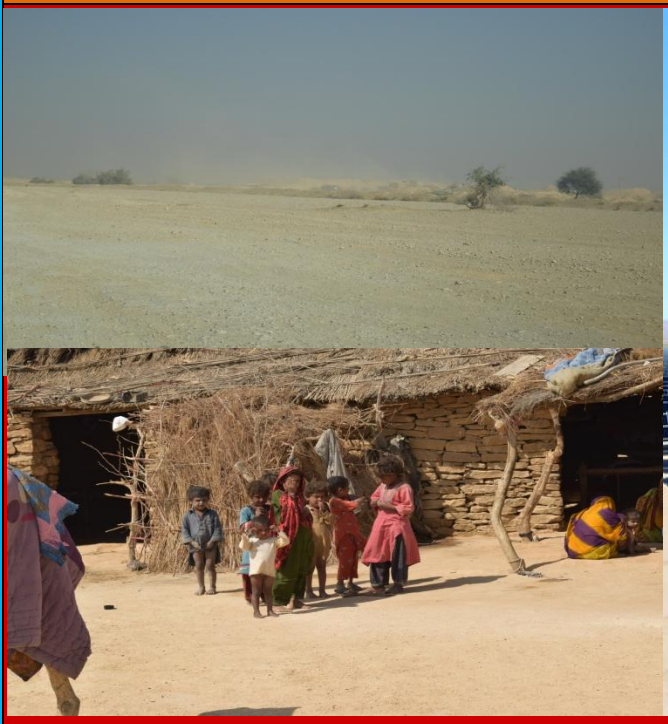
Dated 29/12/18

ORIGINAL

INITIAL ENVIRONMENTAL EXAMINATION OF 100 MW SOLAR PV PROJECT IN JAMSHORO SINDH-PAKISTAN

A PROJECT OF

MCC TONGSIN RESOURCES LIMITED - CHINA



Project Company:

MCC NEW ENERGY COMPANY (PK) PRIVATE LIMITED

MCCT Karachi Office
Add: No.68/1 Khayaban-e-Badban
Off 4th Street, Phase V
D.H.A., Karachi, Pakistan

Project Consultant:

EcoChange Pvt. Ltd
48, Begum Sarfraz Iqbal Road
Sector-G-6/4, Islamabad
www.ecochaneg.com.pk

FEBRUARY, 2016

Disclaimer Notice

The information contained in the report is meant for the purpose of Approval of Project from Environment Protection Agency as per requirement of "Sindh Environment Protection Act, 2014". Subsequently, EcoChange Private Limited (ECPL) is also not responsible for the content of the website and information resources that may be referenced in the report. While we have made every attempt to ensure that the information contained in the report has been obtained from reliable and up-to-date sources.

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Prepared in February, 2016
by
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LIST OF ABBREVIATIONS

ADB	Asian Development Bank
CBD	Convention on Biological Diversity
CITES	Convention on Trade of Endangered Species
db	decibel
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	Green house Gas Emissions
GRM	Grievance Redressal Mechanism
IEE	Initial Environmental Examination
IFC	International Finance Corporation
JICA	Japan International Cooperation Agency
km	Kilometers
LAA	Land Acquisition Act
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	Nitrogen 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
ECPL	EcoChange (Pvt.) Ltd
SCR	Social Complaint Register
SOx	Sulpher Oxides
UNFCC	United Nation Framework on Climate Change
WHO	World Health Organization

COMPANY CONTACT INFORMATION

Project Company	MCC New Energy Company (Pk) Private Limited
Sponsor / Holding Company	MCC Tongsin Resources Limited
Address	MCCT Karachi Office Add: No.68/1 Khayaban-e-Badban Off 4th Street, Phase V D.H.A., Karachi, Pakistan Tel: +92-21-35247197 Fax:+92-21-35351682 www.mccchina.com
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Email	chuangshaolin@mcc-mining.com

CONSULTANT CONTACT INFORMATION

Consultant Name	EcoChange (Pvt) Ltd
Address	48, Begum Sarfraz Iqbal Road, Sector G-6/4 Islamabad
Telephone	0092 51-8733308
Fax	0092 51-8733309
Website	www.ecochange.com.pk
Contact Person	Sana Ahmed, CEO
Email	sana@ecochange.com.pk

EXECUTIVE SUMMARY

Introduction:

MCC New Energy Company (Pk) Private Limited, the Project Company got Letter of Intent (LOI) from Government of Sindh, Directorate of Alternative Energy Energy Department for setting up Solar PV Power Projects of 100 MW in Province of Sindh Pakistan. The LOI of the Project Company is attached as **Annexure-I** of this document. The Project is sponsored by MCC Tongsin Resources Limited (MCCT). MCC Tongsin Resources Limited (MCCT) got registered under the aegis of Ministry of Commerce of China, totally financed by MCC. MCCT is a company engaged in a wide variety of business, integrating project development, investment, construction, production, operation and management with Copper deposits as its chief targets.

The 100 MW Solar Power Project of MCCT shall be developed as per Renewable Energy Policy for Power Generation, 2006. A land of 500 acres has been allotted to the Project Company in Deh Son Walhar, Taluka Kotri, District Jamshoro. The land is allotted on lease for the period of thirty years by Land Utilization Department, Government of Sindh. The copy of Land Lease documents is attached as **Annexure-II**

This report is **Initial Environmental Examination (IEE) Report** prepared to fulfill the obligation given in Sindh Environmental Protection Agency (Review of IEE and EIA) Regulations, 2014 (attached as **Annexure-VI**) made by Sindh Environmental Protection Agency in exercise of power by section 33 of Pakistan Environmental Protection Act, 1997. According to Sindh Environment protection Agency IEE/EIA guidelines, projects falling in any category listed in Schedule-I of the regulations shall require Initial Environmental Examination and the projects listed in Schedule-II of the regulations shall require a detailed Environmental Impact Assessment (EIA).

As Solar Projects falls in the category of Schedule-I, therefore Initial Environmental Examination (IEE) of the Project has been conducted for 100 MW Solar Power Project of MCC New Energy (Pk) Private Limited.

Sponsor's Introduction:

MCC Tongsin Resources Limited (MCCT) got registered under the aegis of Ministry of Commerce of China, totally financed by MCC. MCCT is a company engaged in a wide variety of business, integrating project development, investment, construction, production, operation and management with Copper deposits as its chief targets.

As a top level subsidiary of MCC Group, MCCT is the important executive power of the resources development. There are more than 1900 Chinese and foreign employees. Scope of business is spread throughout Pakistan and Afghanistan. Relying on the professional management team, advanced technical force, strong capital strength, rich development experience and good business reputation, MCCT has made remarkable achievements for these years.

The Company Profile of the Project Proponent is attached as **Annexure-X.**

Consultant's Introduction:
EcoChange Pvt. Ltd is the consultant of MCC New Energy Company (Pk) Pvt. Ltd for conducting IEE study of its 100 MW Solar Power Project in Taluka Kotri, District Jamshoro Sindh Pakistan. ECPL provides consultancy services in the fields of Renewable Energy (RE), Energy Efficiency (EE) and Environment.

The consultant responsible for this assignment is well comprehended with the renewable energy power projects; including the environmental studies. So far so forth, the Consultant has conducted more than twenty five EIA/IEEs of renewable energy power project which got approval from national EPAs as well as from International lenders.

The Profile of EcoChange Private Limited is attached as **Annexure-XI**

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

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

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

The IEE report stands on following strings:

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

Statutory Requirements:
The report fulfils the following regulatory requirements

- Sindh Environment Protection Act, 2014 and respective IEE/EIA Guidelines
- Asian Development Bank Polices and Guidelines
- Performance Standards of IFC and World Bank group
- The best practices followed at international level.

Project Overview:
MCC New Energy Company (Pk) Private Limited is planning to setup Solar PV Power Project of 100 MW near Deh Walhar Son, Taluka Kotri, District Jamshoro, Province of Sindh-Pakistan.

The Government of Sindh allotted land of 500 acres on lease to the Project Company for the period of thirty years. The Project site is located at 135 km from Karachi on Karachi-Hyderabad motorway and is located 2.4 km off the main Karachi-Hyderabad Motorway on left side of the road when travelling from Karachi.

The land is vacant semi deserted piece of land with self grown small shrubs and bushes. There is no planned agricultural activity on the site.

There are three temporary settlements comprised of 10 people living within the boundary of the Project site. Rest of the land is empty and is there is no human settlement or any other critical structure within one kilometer of the Project boundary.

The Project site is easily accessible from Karachi by paved road till 135 km on Karachi-Hyderabad Motorway, from where an unpaved road on the left side leads to the Project site at 2.4 km.

Description of Environment

The detailed environmental and social survey was conducted by Team of Experts on 7th of February, 2016. The survey was conducted to assess the baseline information on the environment and socio-economic features of the area. The socio-economic features of the area were assessed through door to door personal interviews with the local community. The surveyors conducted these interviews in their local language and also gave a brief overview of the project. The female surveyor conducted the interviews with female community and documented their views on the Project. During interviews, the surveyors assessed the socio-economic conditions of the community including their occupational patterns, culture, education and health facilities. The local community was also given a brief overview of the project and its benefits to the local community during interviews. The overall response of the local community was positive and they welcome the new development of wind technology in their area.

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

The Project site of MCC New Energy Company is located in Deh Son Walhar, Taluka Kotri, District Jamshoro Sindh. There are three Goths namely Nawab Khan Khaoso, Kando Khan Khoso and Rano Khan Khoso exists within 05 km radius of the Project boundary. These are scattered settlements of 05 to 10 houses each with total population of about 100. The nearest settlement is located around 2.4 km from the Project boundary. The nearby Goths were visited during the social and environmental baseline survey conducted by ECPL and consultation with villagers and local stakeholders were conducted.

The Project site location and access is provided in detail in Section-3.

The Project area is a completely vacant area with barren semi deserted land and self grown small shrubs and (10 ft height) and very few trees. There is no planned agricultural activity.

Three temporary mud houses exist within the boundary of the Project site which can easily be avoided to displace or resettlement.

Based on topography, the area is mainly plain land with elevation ranging from 150 to 250 feet. The area is covered by self grown bushes and few trees. The Project site is completely vacant with no human settlement and planned agricultural activity.

The climate in Kotri is called a desert climate. In Kotri, there is virtually no rainfall during the year. With an average of 34.3 °C, June is the warmest month. January has the lowest average temperature of the year. It is 17.8 °C.

Due to minimal rainfall, agricultural activities are negligible in the area. The socio-economic conditions of the nearby Goths are very poor. There is no permanent source of income for the people. The literacy rate in the area is scant in the area around Project site. There are two school buildings available in the area but those are not functional due to lack of infrastructure and unavailability of teachers. Most of the people living in these Goths are labors and work in nearby urban areas of Jamshoro or Kotri areas. Few people are dependent on livestock development and kept goats, buffaloes and cows for meat and milk production.

Unemployment rate in the area is high due to lack of skills and education. There are number of employment opportunities exist in the nearby urban areas of Jamshoro and Kotri. The overall socioeconomic condition of the people living in the area is below poverty line.

Advance health facilities are available at around 14 km in Jamshoro. Basic health care facility is not available within 05 km of the Project boundary. People used to go to Kotri or Jamshoro to visit hospital and for getting other health facilities.

Darwat Dam is located in west at around 20 km from the Project site. There is no other protected ecosystem exists in close proximity to Project site.

The town has excellent road communication to Karachi. There are two routes – one by Thano Bula Khan, and the other via Jhirk, Thatta, Gharo and Landhi. The overall condition of roads in the town is satisfactory. Main roads of the town are without footpaths and proper street lighting.

The sub soil water depth varies from 35 to 90 ft below ground level and is directly linked up with rain fall frequency. In some portion of the town it is brackish where as in other areas, TDS value is within permissible limits. Installation of hand pumps is not possible. The soil permeability is low hence limited quantity of underground water can be drawn. Indigenous

hand pumps, ejector (motorized) pumps and open wells exist in the town. In summer, water vending is common. Water is sold through tractor tankers, donkey carts, motorcycle rickshaws etc.

The area in and around project site up to 5 km is having no industrial development.

The project site is complete quite area with no significant noise heard. The area of Project site is lying vacant with no minor or major noise activities in the surroundings.

According to seismic map of Pakistan project site falls under category of "minor to no damage" zone.

Stakeholder Consultation:

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

Impact Assessment and Mitigation

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

Environmental Management Plan

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

Finding and Recommendation

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

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

SECTION 1

INTRODUCTION AND PURPOSE OF STUDY

1 INTRODUCTION AND PURPOSE OF STUDY

1.1 PROJECT PROPONENT

MCC Tongsin Resources Limited (MCCT) got registered under the aegis of Ministry of Commerce of China, totally financed by MCC. MCCT is a company engaged in a wide variety of business, integrating project development, investment, construction, production, operation and management with Copper deposits as its chief targets.

As a top level subsidiary of MCC Group, MCCT is the important executive power of the resources development. There are more than 1900 Chinese and foreign employees. Scope of business is spread throughout Pakistan and Afghanistan. Relying on the professional management team, advanced technical force, strong capital strength, rich development experience and good business reputation, MCCT has made remarkable achievements for these years.

There are 3 subsidiaries of MCCT including MCC Resources Development Company (Pvt.) Ltd (MRDL), MCC Duddar Minerals Development Company (MDMD) and MCC –JCL Aynak Minerals Company Ltd (MJAM).

The detailed company profile and project experience of the Proponent is attached as **Annexure-X.**

1.2 PROJECT BACKGROUND AND JUSTIFICATION

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

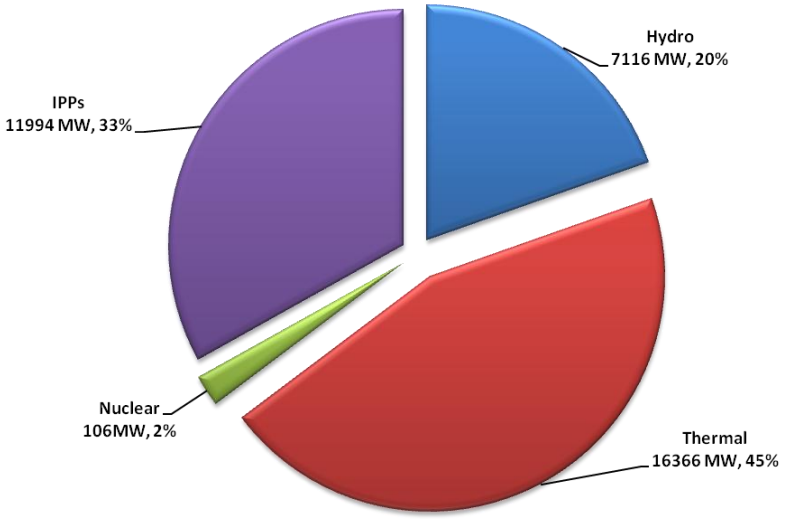


Figure 1.1: Installed Generation Capacity of Pakistan[1]

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

[1] State of Industry Report 2014

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. Hydro electric power already supplies almost 30% of electricity, and numerous sites for future investment exist, but due to their locations, this would also require significant investment in transmission to meet the expected power needs. Moreover, there are varying political stands on hydro-electric power options.

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

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

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

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

A quick idea for the potential of solar energy in Pakistan can be obtained from the satellite map of solar radiation released by National Renewable Energy Lab (NREL) of USA shown in **Figure 1.2.**

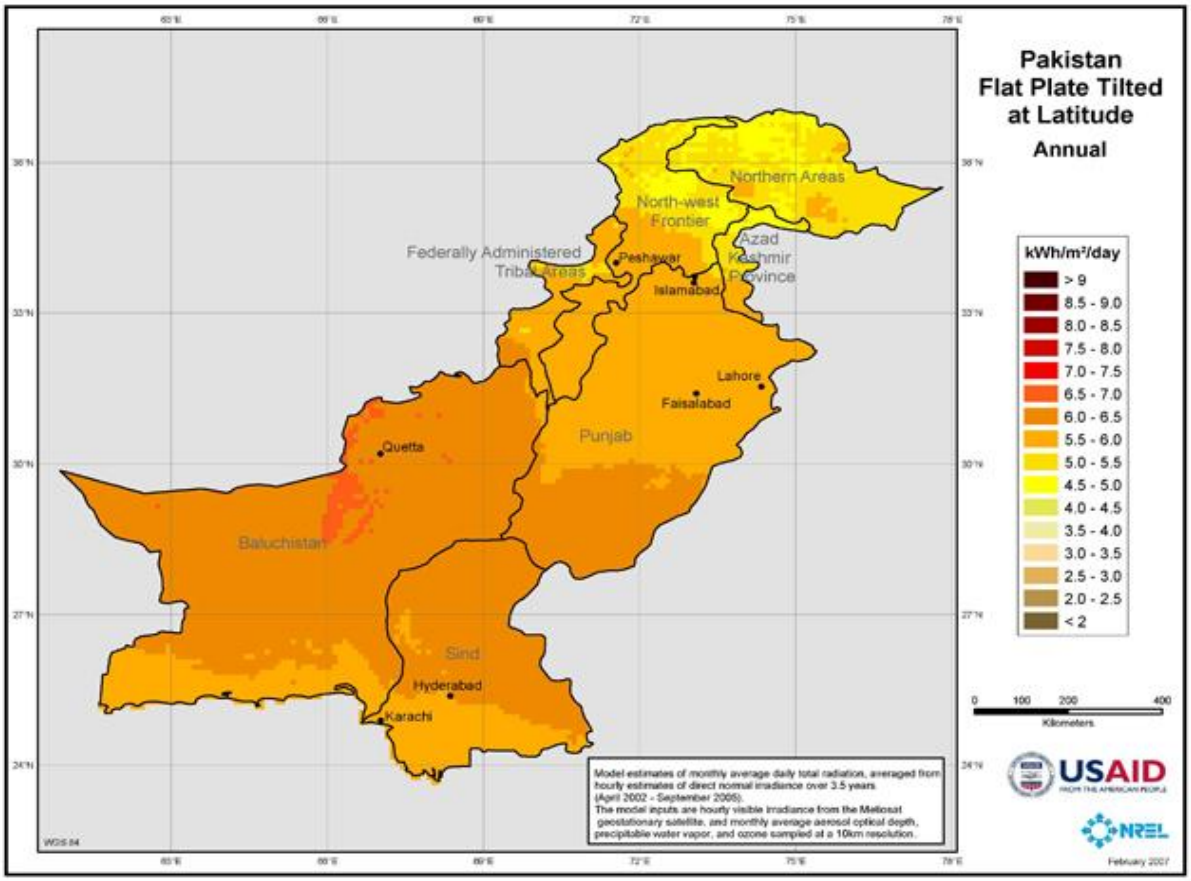


Figure 1.2: NREL Solar Map of Pakistan

1.3 PROJECT OVERVIEW AND OBJECTIVES

MCC New Energy Company (Pk) Private Limited, the Project Company got Letter of Intent (LOI) for setting up Solar PV Power Projects of 100 MW capacity in Taluka Kotri, District Jamshoro Sindh Pakistan as per Renewable Energy Policy for Power Generation, 2006.

MCC Tongsin Resources Limited (MCCT) got registered under the aegis of Ministry of Commerce of China, totally financed by MCC. MCCT is a company engaged in a wide variety of business, integrating project development, investment, construction, production, operation and management with Copper deposits as its chief targets.

As a top level subsidiary of MCC Group, MCCT is the important executive power of the resources development. There are more than 1900 Chinese and foreign employees. Scope of business is spread throughout Pakistan and Afghanistan. Relying on the professional management team, advanced technical force, strong capital strength, rich development experience and good business reputation, MCCT has made remarkable achievements for these years.

The Project site of MCC is considered as an ideal land for the development of solar power project due to high annual irradiance ranging from 5.3 to 5.6 khw/m^2/h..

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 which is vacant barren land into clean energy producing hub which will be replicated to install many solar projects in the same area.

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

Table 1.1: Project at a Glance

S. No	Particulars	Description
1	Project Site	Taluka Kotri, District Jamshoro Province of Sindh Pakistan
2	Land Available	500 Acres
3	Project Capacity	100 MW
4	Total number of Solar PV modules to be installed	387,200 approx of 260Wp each
5	Annual Electricity supplied to the Grid	140 million kWh approx

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. By using indigenous renewable resources of power generation, avoid depletion of natural resources for future generation and environmental stability.

iii. Contribute to improved electricity supply service delivery to a limited extent specifically having a wide rural outreach.

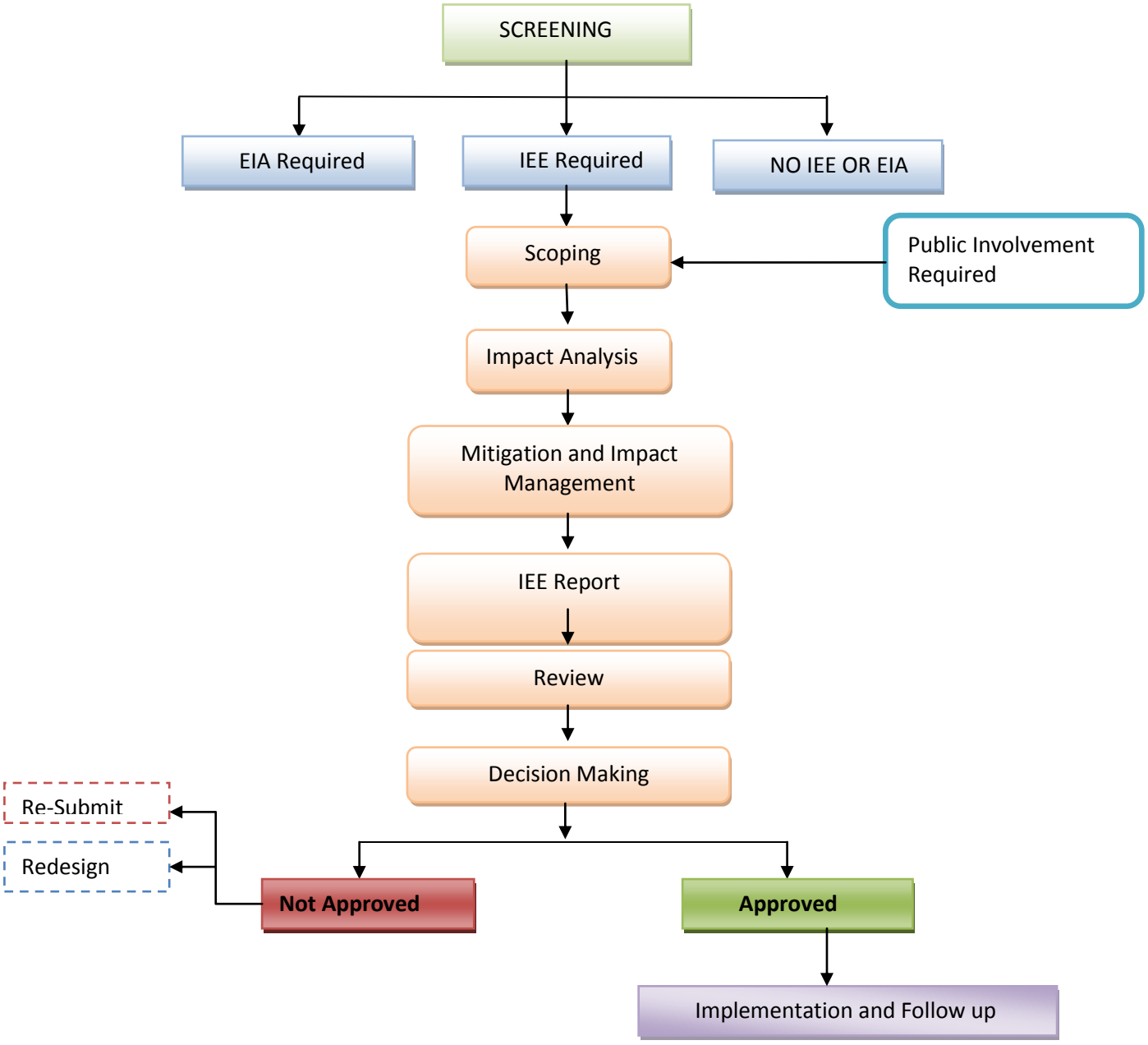
iv. Improve microeconomic efficiency of the power sector by reducing fossil fuel usage.

v. Reduce greenhouse gas emissions from power generation and contribute to negligible emission, effluent, and solid waste intensity of power generation in the system.

vi. Conserve natural resources including land, forests, minerals, water, and ecosystems.

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

1.4 IEE PROCESS FLOW CHART



1.5 NEED AND OBJECTIVES OF IEE STUDY

Sindh Environmental Protection Act 2014 (SEPA 2014) requires the proponents of every development project in the country to submit either an Initial Environmental Examination (IEE) or Environmental Impact Assessment(EIA) to the concerned environmental protection agency.

The IEE/EIA Regulations 2000 issued under SEPA 2014 provides separate lists for the projects requiring IEE or EIA. According to these regulations, projects falling in any category listed in Schedule-I of the regulations shall require IEE and the projects listed in Schedule-II of the regulations shall require EIA and provision of section 12 of the regulations shall apply to such projects.

As the Solar Projects falls under Schedule-I of the regulations, therefore IEE study has been conducted for the Project.

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

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

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

- Category of the project consistent with Pakistan Environmental Protection Act, 1997
- Highlight baseline environmental and social conditions of the project area along with identification of environmentally sensitive area and concerned stakeholders
- 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

1.6 APPROACH AND METHODOLOGY

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

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

The overall methodology and main phases of the IEE are briefly given below;.

1.6.1 Scoping

The key activities of this phase included:

Project Data Compilation: A generic description of the proposed activities relevant to environmental assessment was compiled. A list of potential environmental well as social issues was developed. A stakeholder analysis was carried out for the consultation carried out subsequently.

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.

***Baseline Data Collection*:** A considerable amount of baseline information on the project area was available from existing literature and other studies conducted close to the project area. A field visit was conducted to verify and collect primary data on the site alternatives.

A questionnaire was developed and views of local inhabitants were taken about the solar power project.

1.6.2 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, with particular reference to the coast
- Ambient air quality and ambient noise levels
- Ecology of area, including flora and fauna
- Local communities
- Noise impact
- Visual Impact

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

- The present baseline conditions
- The potential change in environmental parameters likely to be effected by project related activities
- The identification of potential impacts
- The evaluation of the likelihood and significance of potential impacts
- The defining 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

1.6.3 Documentation

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

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.

Following Annexure are attached with the IEE report to supplement the information;

Annexure-I: Letter of Intent
Annexure-II: Land Documents
Annexure-III: Environment Management and Monitoring Plan
Annexure-IV: Budgetary Estimates for EMMP
Annexure-V: Fauna and Flora Study
Annexure-VI: Sindh Environment Protection Agency IEEE/EIA regulations, 2014
Annexure-VII: National Environmental Quality Standards (NEQs)
Annexure-VIII: Social Survey Forms
Annexure-IX: Social Survey Snapshots
Annexure-X: Company Profile of Project Proponent
Annexure-XI: Company Profile of Project Consultant

1.7 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 and Monitoring Plan (EMMP) (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

SECTION 3

STATUARY REQUIREMENTS OF IEE

2 STATUARY REQUIREMENTS OF IEE

This chapter discusses the national and international policies, legal and administrative framework as well as institutional setup relevant to environmental and social assessment of the proposed project.

The laws relevant to the developmental projects are briefly reviewed below.

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

The National Conservation Strategy (NCS) is the primary document addressing environmental issues of the country. NCS is duly recognized as the National Environmental Action Plan. The document identifies 14 core areas in which policy intervention is considered crucial for the preservation of Pakistan's natural environment. The areas include restoration of rangelands, pollution prevention and abatement, and preservation of cultural heritage etc.

The Pakistan Environment Protection Act, 1997 is the key legislation empowering the government to frame regulations for the protection of the environment.

Detailed rules, regulations and guidelines required to enforce the Environment Protection Act are still in various stages of development.

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

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

The provincial Environment Protection Agencies (Environment Protection Department in 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.

2.3 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 natural environment. Brief description of the laws is given below;

2.4 SINDH ENVIRONMENTAL PROTECTION ACT, 2014

The Sindh Environmental Protection Bill, 2014 having been passed by the Provincial Assembly of Sindh on 24th February, 2014 and assented to by the Governor of Sindh on 19th March, 2014.

The Sindh Environmental Protection Act, 2014 is made to provide for the protection, conservation, rehabilitation and improvement of the environment, for the prevention and control of pollution, and promotion of sustainable development. It extends to the whole of the Province of Sindh. According to Section 17 (1) of SEPA, 2014, "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 the Agency approval in respect thereof".

As per SEPA –EIA guidelines solar power projects fall in Schedule-I, requiring IEE, therefore the same has been conducted for the Project.

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

The Sindh 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, 2014 also provide the necessary details on the preparation, submission, and review of IEEs and EIAs. The following is a brief step-wise description of the approval process:

- A project is categorized as requiring an IEE or EIA using the two schedules attached to the Regulations.
- An EIA or IEE is conducted as per the requirement and following the Pak-EPA guidelines.
- The EIA or IEE is submitted to the concerned EPA—provincial EPAs if the project is located in the provinces or the Pak-EPA if it is located in Islamabad.
- A fee, depending on the cost of the project and the type of the report, is submitted along with the document.
- The submittal is also accompanied by an application in the format prescribed in Schedule IV of the Regulations.

- The EPA conducts a preliminary scrutiny and replies within 10 days of the submittal of a report, a) confirming completeness, or b) asking for additional information, if needed, or c) returning the report requiring additional studies, if necessary.
- The EPA is required to make every effort to complete the IEE and EIA review process within 45 and 90 days, respectively, of the issue of confirmation of completeness.
- When the EPAs accord their approval subject to certain conditions:
- Before commencing construction of the project, the proponent is required to submit an undertaking accepting the conditions.
- 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 Sindh Environment Protection Act are given in Annexure-VI for reference

2.6 NATIONAL AND INTERNATIONAL ENVIRONMENTAL STANDARDS

2.6.1 National Environmental Quality Standards, 2005

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

- Maximum allowable concentration of pollutants (16 parameters) in gaseous emissions from industrial sources,
- Maximum permissible limits for motor vehicle exhaust and noise,
- For power plants operating on oil and coal:
  - Maximum allowable emission of sulfur dioxide,
  - Maximum allowable increment in concentration of sulfur dioxide in ambient air,
  - Maximum allowable concentration of nitrogen oxides in ambient air, and
  - 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).

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-VII

2.6.2 National Environmental Policy, 2005

The National Environmental Policy (NEP) was approved by the PEPA 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 sectoral and cross-sectoral guidelines to achieve its Goal of sustainable development.

a. Sectoral 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 Sectoral 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; and
- Public private civil society partnership.

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

2.6.3 Land Acquisition Act, 1984

The Land Acquisition Act (LAA) of 1894, amended from time to time, has been the de-facto policy governing land acquisition and compensation in the country. The LAA is the most commonly used law for acquisition of land and other properties for development projects.

It comprises of 55 sections pertaining to area notifications and surveys, acquisition, compensation and apportionment awards and disputes resolution, penalties and exemptions.

For the proposed project, the proponents have owned private land and no settlement or any structure existed at the site, the LAA is not applicable to the land acquisition for the proposed project.

2.6.4 Telegraph Act, 1985

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

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

2.6.5 The Sindh Wildlife (Protection, Preservation, Conservation and Management Act), 1974

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

This Act will be applicable to the construction as well as operation and maintenance (O & M) activities of the proposed project.

2.6.6 Forest Act, 1927

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

There is no forest area in the vicinity of 5 km radius of the Project area. Therefore the act is not applicable on the Project.

2.6.7 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.

2.6.8 Provincial Local Government Ordinance, 2001

These ordinances were issued under the devolution process and define the roles of the local governments. Under this Ordinance, three tiers of the local governments have been introduced at the district, Tehsil and union levels. The top most tier is 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.

2.6.9 Antiquity Act, 1975

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

Under this Act, the project proponents are obligated to:

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

This Act will be applicable to the construction as well as O & M activities of the proposed project.

2.6.10 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 proposed project.

2.6.11 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.

2.6.12 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.

2.6.13 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.

MCC New Energy Company and its contractors will be bound by the ECA to disallow any child labor at the project sites or campsites.

2.6.14 Civil Aviation Rules, 1994

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

- No person shall erect any temporary or permanent structure, nor position a vehicle or other mobile object on or in the vicinity of an aerodrome (airport), that will be within the clearance area, or will protrude through an obstacle limitation surface, at that aerodrome.

- No person shall operate a light in the vicinity of an aerodrome which because of its glare is liable to dazzle pilots of aircraft taking off from or landing at that aerodrome; or which can be mistaken for an aeronautical ground light. If such a light is operated it shall be extinguished or satisfactorily screened immediately upon notice being given to the person or persons operating the light, by the Director-General or by the Manager or by a person authorized by him.

- No person or persons shall operate a radio station or electrical equipment in the vicinity of an aerodrome or of a radio aid to navigation serving an airway or an air route in Pakistan which is liable to cause interference with radio communications between aircraft and an Air Traffic Services Unit, or which is liable to disturb the signal from a navigational radio aid.

- A captive balloon or a kite shall not be flown at a height above 200ft within 6km of an aerodrome, and a free balloon shall not be flown at any place, except with the express permission of the Director-General and in compliance with the conditions attached to such permission

- An aircraft shall not be flown over congested areas of cities, towns, or settlements or over an open air assembly of persons, except by permission of the Director-General, 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

2.6.15 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.

2.7 ASIAN DEVELOPMENT BANK (ADB) POLICIES & STANDARDS

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

- Safeguards Policy Statement
- Policy on Gender and Development
- Social Protection Strategy
- Public Communications Policy
- Core Labor Standards

2.7.1 2009 Safeguard Policy Statement

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

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

Policy of Indigenous Peoples
Help burrowers/clients to strengthen their safeguard system and develop the capacity to manage environmental and social risks

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

2.7.2 Policy on Gender and Development

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

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

***Gender sensitivity*:** to observe how ADB operations affect women and men, and to take into account women's needs and perspectives in planning its operations

***Gender analysis*:** to assess systematically the impact of a project on men and women, and on the economic and social relationship between them

***Gender planning*:** to formulate specific strategies that aim to bring about equal opportunities for men and women

***Mainstreaming*:** to consider gender issues in all aspects of ADB operations, accompanied by efforts to encourage women's participation in the decision making process in development activities

***Agenda setting*:** to assist Developing Member Country (DMC) governments in formulating strategies to reduce gender disparities and in developing plans and targets for women's and girl's education, health, legal rights, employment, and income-earning opportunities

2.7.3 Social Protection Strategy

It is the set of policies and programs designed to reduce poverty and vulnerability by promoting efficient labor markets, diminishing people's exposure to risks and enhancing their capacity to protect themselves against hazards and interruption/loss of income. Social Protection consists of five major elements

Labor Markets policies and programs designed to facilitate employment and promote efficient operation of labor markets;

Social Insurance programs to cushion the risks associated with the unemployment, health, disability, work injury and old age.

Social Assistance and Welfare Service program for the most vulnerable groups with no other mean of adequate support

Micro and Area Based Schemes to address vulnerability at the community level and

Child Protection to ensure the healthy and productive development of future Asian Workforce

Social Protection System in Asia and Pacific Region

In considering the demand of social protection with Asian sub regions, it is important to identify the circumstances faced by their vulnerable groups. A common trait to all countries in the region is the need to address child and youth priorities, extend coverage to poorer communities, improve governance, and promote institutional development.

2.7.4 2005 Pubic Communications Policy

ADB's public communications policy provides a framework to enable ADB to communicate more effectively. The policy aims to enhance stakeholder's trusts in an ability to engage with ADB. The policy promotes

- Awareness and understanding and results of ADB activities, policies, strategies, objectives and result;
- Sharing and exchange of development knowledge and lessons learned<, so as to provide fresh and innovative perspectives and development issues;
- Greater two-way flow of information between ADB and stakeholders' including project affected people, in order to promote participatory development; and
- Transparency and accountability of ADB operations

2.7.5 Core Labor Standard

ADB adopted a commitment to Core Labor Standards (CLS) as part of its Social Protection Strategy in 2001. Since then, ADB ensures that CLS are duly considered in the design and implementation of its investment projects. In this regards a handbook for CLS has been developed by ADB with cooperation of International Labor Organization (ILO). The objective is to convince decision makers that the introduction of CLS and labor standards in general will not impede development. The labor standards are simple the rules that govern how people are treated in a working environment. Labor standards cover a very wide variety of subjects, mainly concerning basic human rights at work, respect for safety and health and ensuring that people are paid for their work. CLS are a set of four internationally recognized basic rights and principles at work.

- Freedom of association and the effective recognition of the right to collective bargaining;
- Elimination of all forms of forced or compulsory labor;
- Effective abolition of child labor; and
- Elimination of discrimination in respect of employment and occupation

2.8 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 projects would be located in the Sindh Province. Hence this IEE report will be sent to the Sindh-EPA for review and approval.

2.9 OBLIGATION UNDER INTERNATIONAL TREATIES

Pakistan is signatory of several Multilateral Environmental Agreements (MEAs), including:

- Basel Convention on the Control of Trans-boundary Movements of Hazardous Wastes and their Disposal,
- Convention on Biological Diversity (CBD),
- Convention on Wetlands (Ramsar)
- Convention on International Trade in Endangered Species (CITES),
- UN Framework Convention on Climate Change (UNFCCC),
- Kyoto Protocol,
- Montreal Protocol on substances that deplete the ozone layer,
- UN Convention to Combat Desertification,
- Convention for the Prevention of Pollution from Ships (MARPOL),
- 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.

SECTION 3

PROJECT DESCRIPTION

3 PROJECT DESCRIPTION

3.1 LOCATION OF PROJECT

MCC New Energy Company (Pk) is planning to setup Solar PV Power Project of 100 MW Deh Son Walhar, Taluka Kotri District Jamshoro, Province of Sindh-Pakistan.

Jamshoro District, is a district of Sindh province, Pakistan. Jamshoro city is the capital of Jamshoro District. Jamshoro district was split from Dadu district in December 2004. It consists of four Talukas Sehwan, Manjhand, Kotri and Thano Bola Khan. The Project is located in Taluka Kotri. The district borders Dadu district to the north. To the east, the Indus separates it from Nawab Shah, Matyari and Hyderabad districts. Thatta district lies to the south, and Karachi district to the south west. To the west, the Kheerthar Range separates it from the Sindh and Lasbela district of Baluchistan. The total geographical area of the district is 11,517 square kilometers. It is about 220 kilometers from north to south and about 100 kilometers wide from east to west.

The Project site is located on Karachi – Hyderabad Motorway at around 135 km from Karachi, from where an unpaved road on left side leads to the Project site at around 2.4 km.

The Government of Sindh allotted 500 acres of land to the Project Company on lease for the period of thirty years. The land is vacant with self grown small shrubs and bushes and few trees. There is no planed agricultural activity on Project site. Three temporary settlements exists on the Project site comprise of three houses of 10 people.

The location of site can be viewed in **Figure 3.1 and Figure 3.2.**

Figure 3.1: Location of Site on Pakistan Map

Figure 3.2: Satellite view of Project Site

The coordinates of Project Site are given in **Table 3.1** and marked in **Figure 3.3**;

Table 3.1: Geographical Coordinates of Project Site

Ref	Northing	Easting
M1	25° 22.957'N	68° 8.362'E
M2	25° 21.731'N	68° 8.405'E
M3	25° 22.002'N	68° 8.929'E
M4	25° 22.695'N	68° 7.834'E

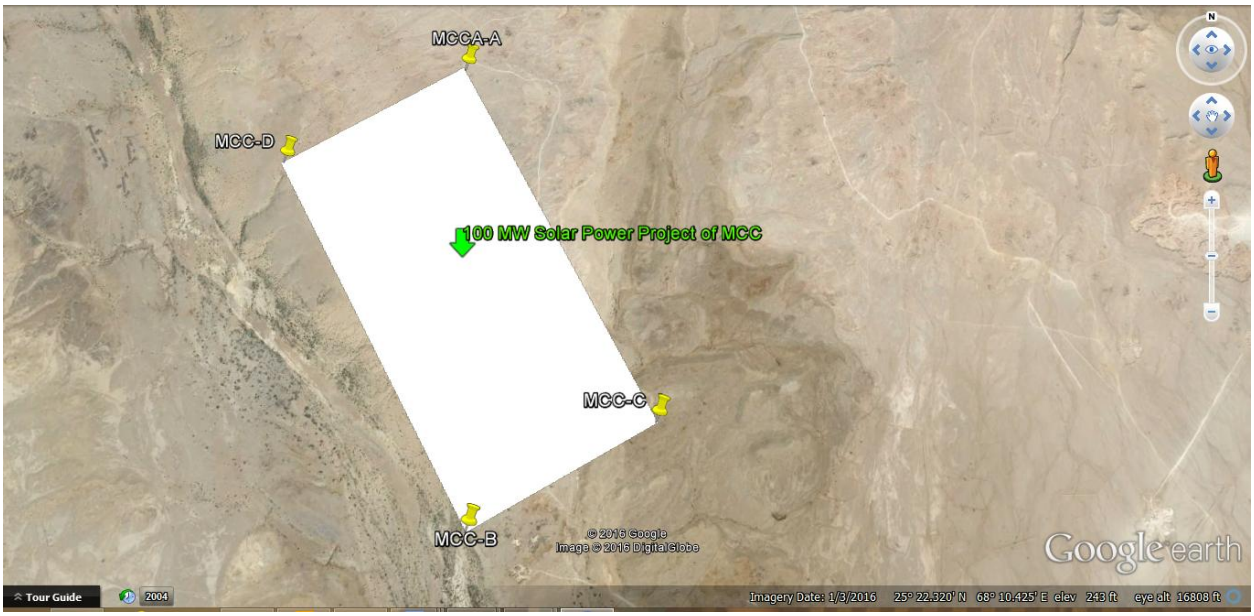


Figure 3.3: Project Site Coordinates

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

Project Site (View-1)

Project Site (View-2)

Figure 3.4: A View of Project Site

3.2 ROAD ACCESS

The Project site is connected to Karachi through Karachi Hyderabad Motorway.

The Project Site is located at around 135 km on Karachi Hyderabad Motorway. The Project site is 2.4 km off the road towards left from main Karachi-Hyderabad Motoeway.

The Karachi-Hyderabad Motorway is very busy road however wide enough for movement of heavy vehicles and traffic. The road Access to project site is marked with blue line from Karachi to the Project site in **Figure 3.5**. The actual road view of Karachi to Project site via Karachi-Hyderabad Motorway is shown in **Figure 3.6.**

The portion of the road of 2.4 km towards Project site is unpaved shown in **Figure 3.7** , however vehicles can easily move till the start of the Project Site.

Figure 3.5: Road Access to the Project Site from Karachi City

Figure 3.6: Karachi-Hyderabad Motorway –Road Overview

Figure 3.7: Unpaved Road towards Project Site

3.3 PROJECT SCOPE AND CONFIGURATION

A 100 MW solar PV plant will be constructed and operated on the site. The solar pant will consist of approximately 387200 of 260 Wp solar PV panels, approximately 200 of 500KW inverters, 100 of 0.315/0.315/35kV(1000kVA) transformers, and associated control instruments and control equipment and a control room on site. The Project is at very initial stage of development. The exact configuration of the Plan design will be finalized after EPC Contract finalization. The Project will be operation by end of year 2017.

SECTION 4

BASELINE ENVIRONMENTAL CONDITIONS

4 BASELINE ENVIRONMENTAL CONDITIONS

4.1 BASELINE SOCIAL AND ENVIRONMENTAL SURVEY

The detailed environmental and social survey was conducted by Team of Environmental Experts on 7th February, 2016. The team for conducting IEE study comprised of following experts;

Mr. Merghoob Ahmed	Social Survey Expert
Ms. Syeda Sumbul Kazmi	Environmentalist
Mr. Abdur Razaq	Fauna Expert
Dr. Ghalib Ali	Flora Expert
Mrs Sana Ahmed	Environmentalist

The survey was conducted to assess the baseline information on the environment and socio-economic features of the area. The Primary information on environmental baseline conditions was assessed by visual observation, information from local stakeholders like villagers; NGOs working in the area, union council representative and secondary data was gathered from internet sources, available literature documents and information on the Project area. Detailed assessment of the social and biological environment of the area was conducted through field survey for the distance up to 10 km radius of the project site, however the influence zone of the environmental impacts is considered as 5 km.

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

The socio-economic features of the area were assessed through door to door personal interviews with the local community. The surveyors conducted these interviews in their local language and also gave a brief overview of the Project. A female surveyor from the local NGO

National Rural Support Program also participated in the survey and provided support in getting the local data. During interviews, the surveyors assessed the socio-economic conditions of the community including their occupational patterns, culture, education and health facilities. The local community was also given a brief overview of the Project and its benefits during interviews. Social and Environmental survey forms with responses of the local community is attached as **Annexure-VIII** of the IEE report. All the interviews and verbal conversation between the surveyor and the local community was conducted in their local language. Here it may be note that most of the personal during the survey were unable to read the questionnaire in English. Therefore, verbal communication was adopted in their local language and their responses were documented by surveyors themselves.

4.2 PROJECT AREA GENERAL CHARACTERISTICS

The Project site of MCC New Energy Company is located in Deh Son Walhar, Taluka Kotri, District Jamshoro.

The Project site location and access is provided in detail in Section-3.

The elevation of the Study Area generally ranges between 150 and 250 m above mean sea level. There are small sedimentary hills in the western and southwestern side of the Project Site that rise to an elevation of about 250 meters. The western side of the study area is gravel plain with very little natural vegetation cover.

Climate is the average course or condition of the weather at a place usually over a period of years as exhibited by temperature, wind velocity, and precipitation. The climate of the Project Site is broadly hot and dry summer mild winter and rainfall in monsoon.

There are three Goths in the radius of 5 km of the Project boundary namely Nawab Khan Khoso, Rano Khan Khoso and Knado Khan Khoso. The nearest Gothis 2.4 km from the Project boundary close to the Karachi – Hyderabad motorway.

An area of 5 km from the Project site can be considered as influence zone shown in **Figure 4.1** and hence it has been taken as study area during site survey and collection of primary and secondary environmental and social data. It was found that the land is completely vacant in the south and west direction of the Project area. Three mud shelters are located in the east of the within Project site and could be the area under Project influence. There is no other human settlement or any critical landmark close to the Project site within 2.4 km boundary of the Project site..

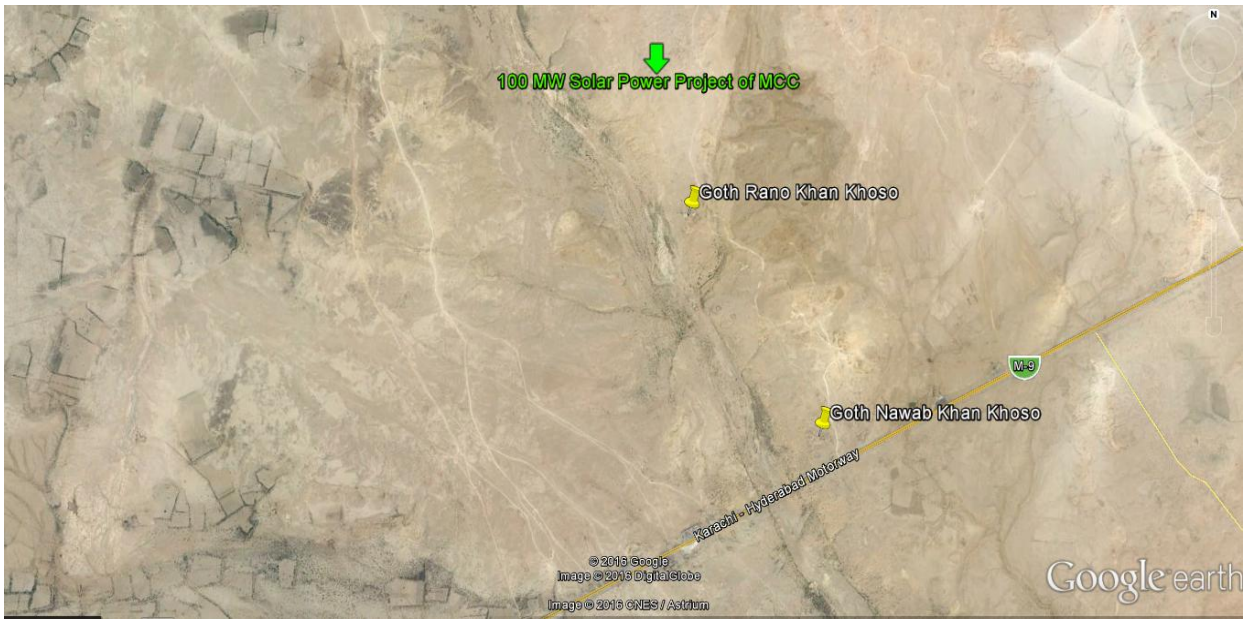


Figure 4.1: Nearby Goths near Project Site

4.3 TOPOGRAPHY

The elevation of the Study Area generally ranges between 150 and 250 m above mean sea level. There are small sedimentary hills in the western and southwestern side of the Proejct Site that rise to an elevation of about 250 meters. The western side of the Project Site is graveling plain with very little natural vegetation cover. A separate topographic survey and Geo-technical investigation has been conducted by the Project company as part of Technical feasibility study.

4.4 CLIMATOLOGY

Climate is the average course or condition of the weather at a place usually over a period of years as exhibited by temperature, wind velocity, and precipitation. The climate of the Project area is broadly hot and dry summer mild winter and rainfall in monsoon.

The hottest month is June in which the maximum average monthly temperature exceeds 40 ^{o}C. The winters are mild with temperature dropping to 20 ^{o}C in January. The average long term temperature data from year 1999 to 2015 has been obtained from Solar GIS which reveals that average maximum temperature of the area is 34 degree Centigrade while minimum average temperature is 17 degree Centigrade.

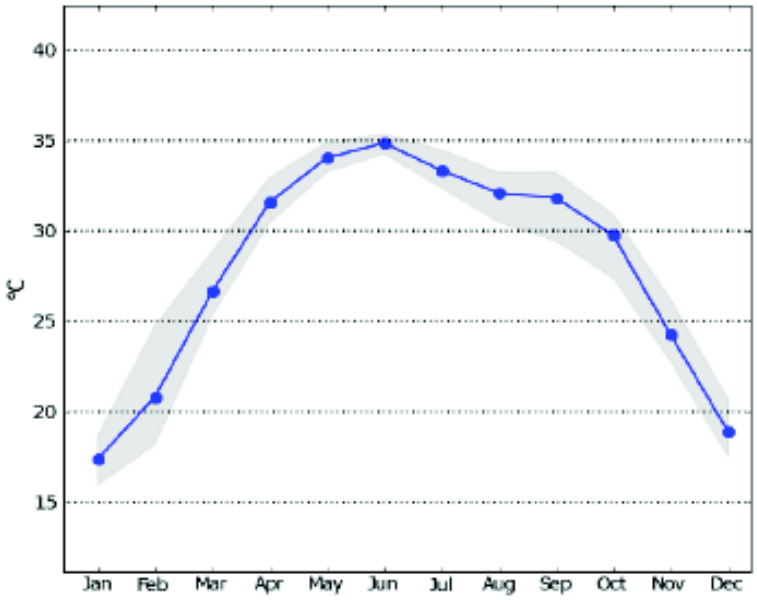


Figure 4.2: Annual Average and Extreme Temperature chart of Project Site

The Project Area receives approximately 60 to 177 mm of rain annually. Almost 65 % of the rain is concentrated in the monsoon months of July and August.

Month	Mean Monthly (mm)	Wettest Month*		Mean Number of Rainy Days
		Value (mm)	Year	
Jan	1.2	49.0	1888	0.2
Feb	3.9	55.1	1906	0.4
Mar	5.1	92.2	1911	0.4
Apr	5.8	46.7	1963	0.3
May	3.5	56.4	1889	0.3
Jun	13.9	149.8	1964	0.6
Jul	56.7	401.6	1908	0.6
Aug	60.8	276.6	1944	2.4
Sep	21.4	286.0	1962	0.9
Oct	1.5	26.2	1956	0.1
Nov	2.1	48.3	1890	0.1
Dec	2.0	28.8	1979	0.2
Annual	177.7	546.7	1913	8.5

* Based on data collected at the Hyderabad station since it was established in 1877

** 'Rainy day' is defined as a day on which at least 0.1 mm of rain is recorded

Source: Pakistan Meteorological Department

Figure 4.3: Annual Precipitation in District Jamshoro

Maximum and Minimum Temperature Regime Map of Pakistan is shown in **Figure 4.4**, **Figure 4.5** & **Figure 4.6.**

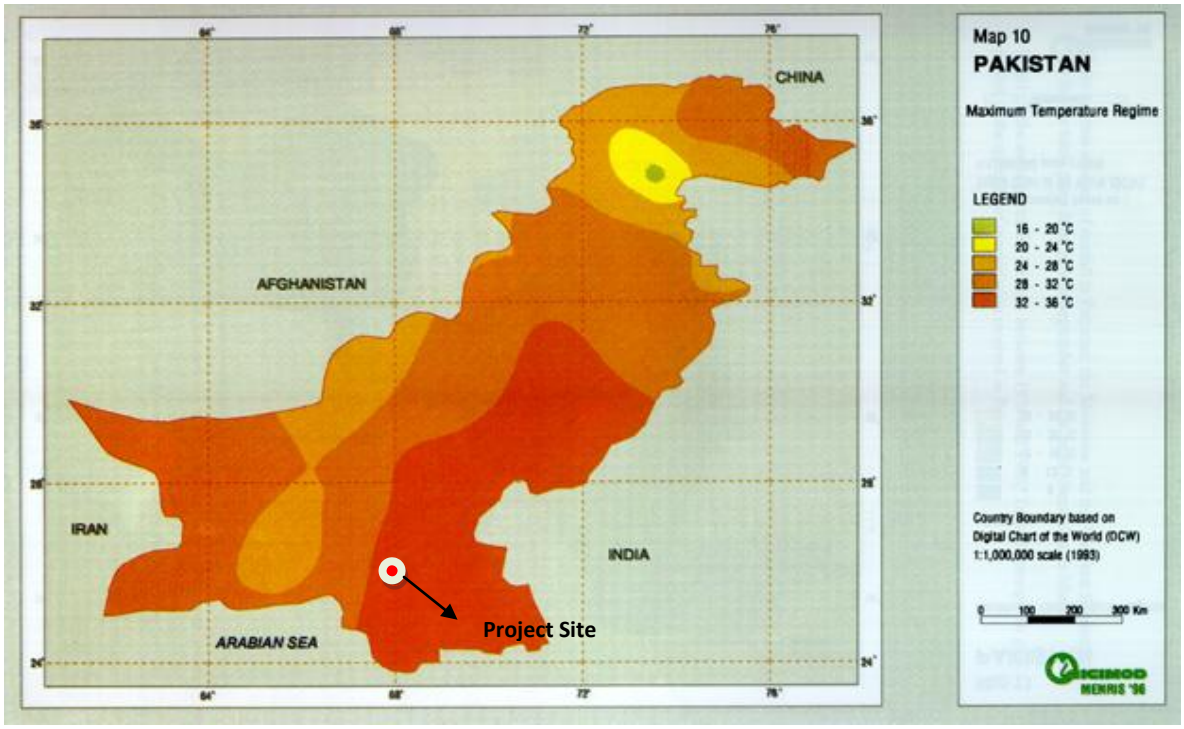


Figure 4.4: Maximum Temperature Regime Map of Pakistan

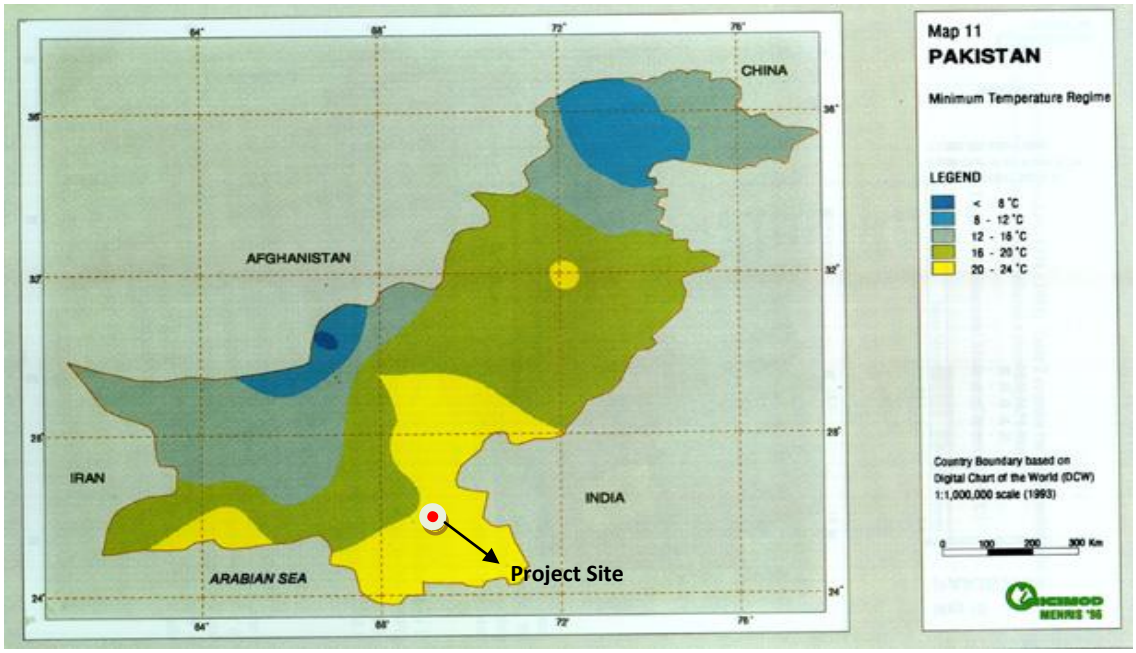


Figure 4.5: Minimum Temperature Regime Map of Pakistan

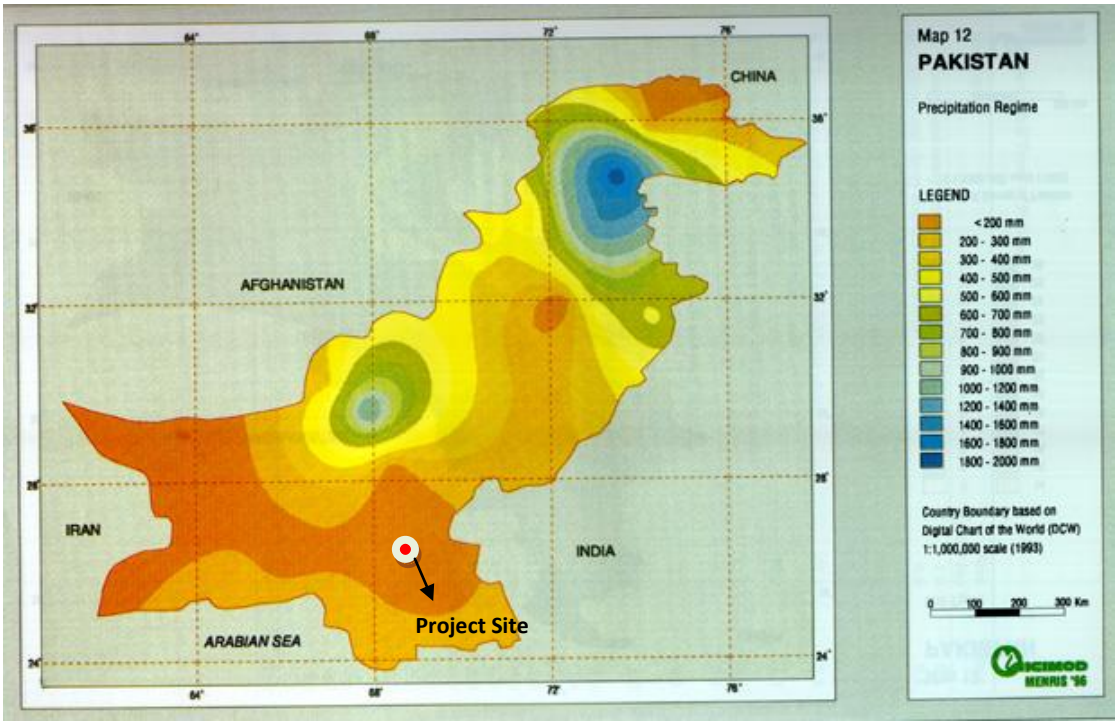


Figure 4.6: Rainfall Map of Pakistan

4.5 Biological Environment

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.

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

Field Surveys were made in the project area in February, 2016 to collect data about the fauna of the area. Standard direct and indirect methods were applied to record the occurrence, distribution and population of various animal species in the area, which included point count surveys, roadside or track counts, line transect method and tracks/ signs counts. The vegetation surveys were carried out by laying 20 m x20 m quadrates within study area. The plant communities were determined within the habitat.

The brief description of Fauna and Flora of the area is given belo. The detailed study on Fauna and Flora of the area is attached as **Annexure-V.**

4.5.1 Flora

During the fieldwork in the Project Area, 17 plant species belonging to 10 families were identified sampled in the main locations within the project Area. Out of these, 14 species were perennial, 2 were annual and 01 was 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.

Life Forms	Numbers
Trees	05 species
Shrubs	09 species
Herbs	01 species
Grasses	02 species

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

4.5.2 Fauna

The faunal attributes recorded during the period have been given below:

Attributes	Numbers
Mammals	10 species
Birds	28 species
Reptiles	07species

4.6 HUMAN SETTLEMENT PATTERN

The total number of Talukas in District Jamshoro is given in **Table 4.2**

Table 4.1: Talukas of Jamshoro District

Talukas
Kotri
Jamshoro
Sehwan Sharif
Thana Bulla Khan
Man Jhand

The Project Site came under Taluka Kotri. Density population in District Jamshoro is only 05 persons per square kilometers.

The population of Jamshoro District increased from 582,094 in 1998 to 1,176,969 in 2011, an increase of 102.2%. Roughly, 95% of the Population of the city consists of immigrants from various parts of interior Sindh who migrated to the town in around 1948-2001 & to a lesser extent from 2002-2014 decades. Therefore, the city holds a number of diverse Sindhi clans & ethinic groups mainly from Jamshoro District, Dadu District, Sukkur District, Larkana District, Khairpur District, Umarkot District, Matiari District, Nawabshah District, Shikarpur District, Tharparker, Naushahro Feroze District, Badin District & Jacobabad District. The city is predominantly Sindhi with a substantial community of Pathans, Baloch people & Seraikis. Small communities of Brahuis, Punjabis, & to a lesser extent Muhajir people are also present. Goth Nawab Khan Khoso, Goth Kando Khan Khoso are the nearby human settlements within the

vicinity of the Project site at around 2.4 km. There are only three small mud shelters exists within the Project boundary consist of 10 people.

Figure 4.7: Mud Shelter within Project Boundary

4.7 SOCIO-ECONOMIC ENVIRONMENT

4.7.1 Occupational Pattern

The literacy rate in the area was negligible. Most of the people living in these Goths are either farmers or labors. Few people are dependent on livestock development and kept goats, buffaloes and cows for meat and milk production.

Unemployment rate in the area is very low as there are number of employment opportunities exist nearby urban areas of Jamshoro and Kotri. The socioeconomic condition of the people living in the area is very poor.

4.7.2 Available Facilities

Local people of the villages have access to urban areas through link roads and public transport available. Electricity is not available in the area. Sui gas facility is also not available in the communities and people are using fuel wood as a source of fuel. PTCL and other mobile network facilities are available in the nearby areas of Project site.

Almost 74% of households dump their waste in open fields which is a threat to local environment in terms of heath as it encourages fly breeding; attract rodents and vermin, cause water and soil pollution, and continually troubles the people from bad odors. Percentage of municipal waste collection is not available. The collected waste is dumped in open spaces more often along road sides and becomes highly troublesome for passengers and for inhabitants of nearby localities. This practice is another serious cause of environmental health risks rather than their reduction and control.

The sewage system and sanitation facilities in nearby Goths are also not satisfactory and most of the households disposed off their household discharge into open fields or a pit inside or outside their houses.

4.7.3 Education and Health Facilities

A school up to primary level is available in Goth Nawab Khan Khoso near the Project site for both boys and girls. However there is no infrastructure and teachers available in the school and the school is not functional from many years. However advanced education facilities are available in urban areas of Jamshoro and Kotri.

There is no hospital facility in the nearby Goths around Project site. People used to go to Jamshoro or Kotri to visit hospital and for getting other health facilities.

Figure 4.8: A view of Primary school near Project site

4.7.4 Protected Ecosystems

There is no existence of any protected ecosystem in the vicinity of 05 km from the Project area.

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4.8 COMMUNICATION NETWORK

4.8.1 Road and Rail Links

Kotri taluka being the hub of all economic, political, religious and district government activities of Jamshoro district, has relatively well developed infrastructure in comparison to the other four Talukas of Jamshoro district. The communication network of the taluka is well developed. Kotri Taluka has four railway stations namely Kotri, Jamshoro, Bulari and Petaro.

Figure 4.9: View of Major Connecting Roads from Jamshoro

4.9 SURFACE & GROUND WATER HYDROLOGY

The main source of drinking water in the Jamshoro district is stored water in tanks, which is used by 30% of the households. Almost 22% households have access through hand pump and 12% through motor pumps. Remaining 21% and 15% use dug wells and other sources, respectively. The Kotri Barrage is one of the oldest barrages in the Kotri Taluka. This barrage through a 20 km long feeder canal provides water for irrigation purposes. The main source of drinking water in the Urban areas of Kotri is river water, which is pumped from the river and supplied to the settlements through pipelines. In the rural areas, the pipeline feeds into a central storage tank from where the households draw water in large water coolers, for drinking purposes. In some villages, the water is cleaned using filter systems installed by various NGOs. There is no effluent disposal and treatment system reported in the surveyed settlements. According to the findings of the field survey, pit latrine system was available in all rural areas.

4.10 AIR QUALITY

The area in and around project site up to 5 km is having no industrial development. The traffic movement on the road beside Project site is the major source of air quality disturbance at the moment.

4.11 NOISE QUALITY

The Project site is complete quite area with no significant noise heard. The area of Project site is lying vacant with no minor or major noise activities in the surroundings.

4.12 SEISMIC HAZARDS

According to Seismic Zoning map of Pakistan, Project area falls in Zone II-b which is minor to moderate damage area. There is no major 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.

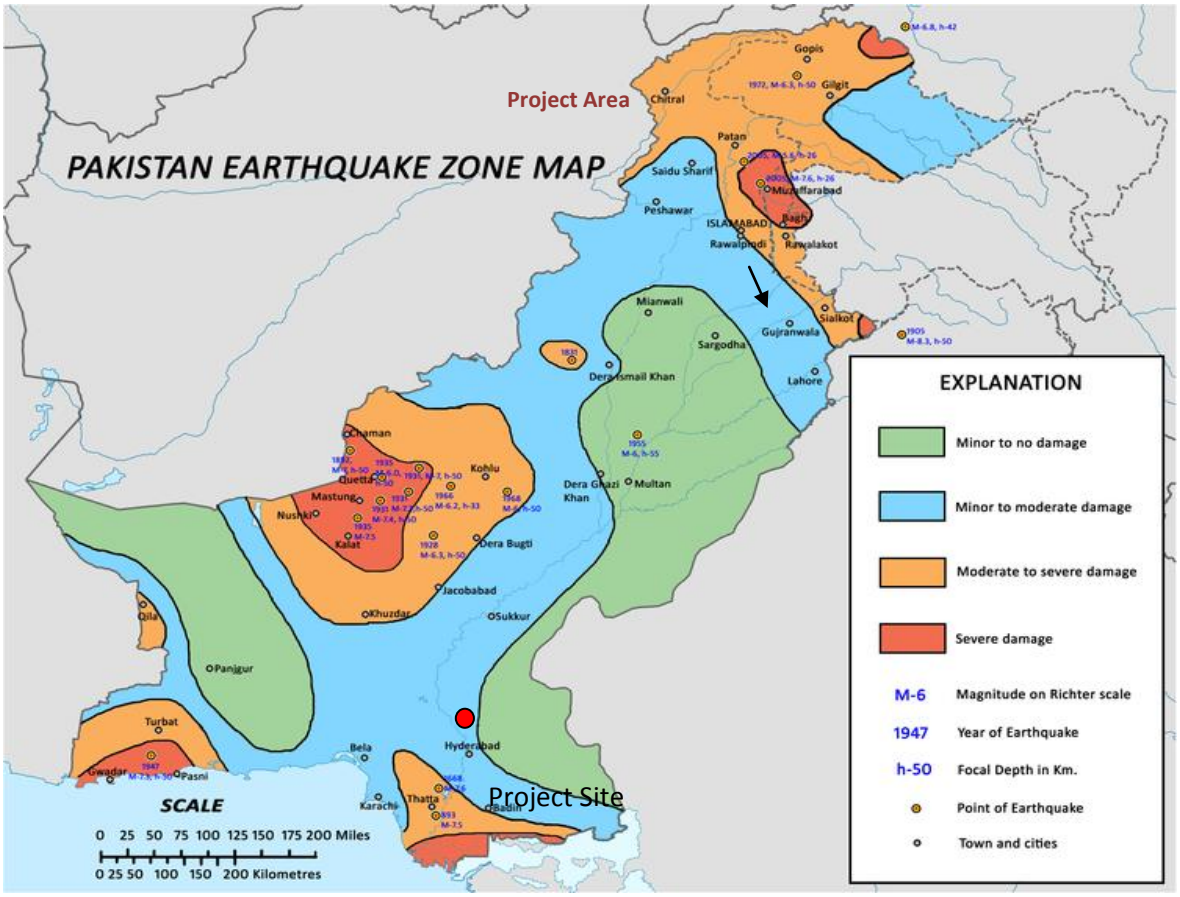

Figure 4.10: Seismic Hazard Zones of Pakistan

SECTION 5

ANALYSIS OF PROJECT ALTERNATIVES

5 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.

5.1 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. Hydro electric power already supplies almost 30% of electricity, and numerous sites for future investment exist, but due to their locations, this would also require significant

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

Looking at how the country's future electricity needs might be met in a way that supports the environmental objectives of the Government of Pakistan; solar power generation has the potential of being a strong contributor. The development of solar power generation projects could reduce dependence on fuels for thermal power generation, increase diversity in Pakistan's electricity generation mix, and reduce greenhouse gas (GHG) emissions avoiding thermal power generation. The Project will also add to the power generation from Renewable energy resources and help in meeting target of Government to achieve 5 % power generation from RE by 2015.

In view of the above, the "Without Project" option is not a preferred alternative.

5.2 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 like solar power to replace fossil fuel based power generation to achieve long term power solution of the country.

SECTION 6

ANTICIPATED IMPACTS AND MITIGATION MEASURES

6 ANTICIPATED IMPACTS AND MITIGATION MEASURES

The proposed Project may have impact on the environment during construction & operation phases. During the construction phase, the impacts may be regarded as temporary or short-term; while long term impacts may be observed during the operation stage. Spatially the impacts have been assessed over the study area of 5 km radius of the Project site.

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

6.1 POTENTIAL IMPACT GENERATION ACTIVITIES

The construction and operation phase of the proposed Project comprises various activities each of which may have an impact on environmental parameters. The impacts of the Project are envisaged during the design and planning, during pre-construction phase, construction phase.

During the construction phase, the following activities may have impacts on environment:

- Site preparation
- Minor excavation and leveling
- Hauling of earth materials and wastes
- Cutting and drilling
- Erection of concrete and steel structures
- Road construction
- Painting and finishing
- Clean up operations
- 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-III.

6.2 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.

6.3 IMPACTS DURING CONSTRUCTION PHASE

The environmental impact during construction phase is localized and of short term magnitude. However, as this Project 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 6.1**:

Table 6.1: 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 barren and 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	❖ No impact
	Ecology	❖ Minimal Loss of vegetation as the land is vacant with almost no vegetation
Transportation and Storage of Construction Material/ Equipment	Air	❖ Air Emissions from vehicles ❖ Fugitive Dust Emissions due to traffic movement
	Water	❖ Run-off from storage areas of construction material
	Public Utilities	❖ Increased flow of traffic
Civil Construction Activities	Air	❖ Air Emissions from construction machinery ❖ Fugitive Dust Emissions
	Water	❖ Run-off from Construction Areas
Mech. and Elec. Erection Activities	Air	❖ Air Emissions form Machinery /activities
Influx of Labor and construction of temporary houses	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 materials**
	Water	Run-off from disposal areas
	Soil	No impact as the area is already barren due to salinity

6.3.1 Impact on Land Use

The mobilization of construction equipment and construction materials will require space for storage and parking of construction vehicles and equipment, construction material storage yards, disposal sites, and labor camps for human resource to avoid environmental impact and public inconvenience. These locations shall comply with the local laws and regulations and need approval from authorities to utilize these facilities (access roads, telecommunication, and pipe borne water supply). The selection of temporary lands shall be made in such a way that it is at least 500 m away from nearby populated areas, water bodies, natural flow paths, agricultural lands, important ecological habitats and residential areas. The area is already barren due to salinity with almost no vegetation; therefore site clearance activities will have no potential impacts on land use.

The land acquired by MCC New Energy Company is 500 acres, where Solar PV Projects of 100MW will be installed. The construction activities attract a sizeable population and the influx of population is likely to be associated with construction of temporary hutments for construction work force, having an effect on land use pattern of the areas surrounding the Project.

However, this impact is envisaged to be insignificant due to following reasons.

- ❖ Temporary labor colonies shall be situated in the areas already acquired for the Project.
- ❖ It will be only a temporary change (restricted to construction period). After construction phase, the areas acquired by labor colonies shall be reverted back similar to preconstruction stage

6.3.2 Impact on Soil Cover

As the construction activities for the main plant units of Project would be confined in the land which is already barren, 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 is already vacant.

6.3.3 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 practices of solid waste disposal shall be followed.

Solid waste disposal will be done as follows;

- A waste inventory of various waste generated will be prepared and periodically updated.
- The excavated material generated will be reused for site filling and leveling operation to the maximum extent possible.
- The scrap metal waste generated from erection of structures and related construction activities will be collected and stored separately in a stack yard and sold to local recyclers.
- Food waste and recyclables viz. paper, plastic, glass etc will be stored in designated waste bins/containers. The recyclables will be periodically sold to local recyclers while food waste will be disposed through waste handling agency.
- Hazardous waste viz. waste oil etc will be collected and stored in paved and bounded area and subsequently sold to authorized recyclers.

6.3.4 Air Impacts

As the proposed Project is Solar PV Project, the impact during construction of is expected to be minimal as a Greenfield Project plant. Particulate matter in the form of dust would be the predominant pollutant affecting the air quality during the construction phase. Dust will be generated mainly during excavation, back filling and hauling operations along with transportation activities. However, a high boundary wall of green dust control cloth will prevent the dust generated due to construction activities going outside the Project area. The main source of gaseous emission during the construction phase is movement of equipment and vehicles at site. Equipment deployed during the construction phase is also likely to result in marginal increase in the levels of SO2, NOX, and particulate matter. The impact is reversible, marginal and temporary in nature.

6.3.5 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).

There will be no major noise impacts on the nearby Goths, which is located at 2.4km from the power plant site. Also the noise level is substantially lower near the plant boundary due to attenuation caused over the distance. Overall, the impact of generated noise on the environment during construction period is insignificant, reversible and localized in nature.

6.3.6 Impact on Water Environment

There is already lack of surface water available in the area. Ground water may be utilized during the construction of the Project arranged from nearby village. The construction personnel would be housed in temporary settlements. These settlements would discharge considerable amount of domestic wastewater. Contractor will provide Soak pit with a depth of 2 meter to dispose liquid water so that such water do not form stagnant pools nor aggravate soil erosion. The main pollutants are organic components and microorganisms with the potential to cause contamination of water quality. To address potential impacts on water quality, disinfected washroom (e.g., through regular liming) will be used as main component of the sanitation

system. Construction processes include fabrication of concrete and related water usage. Wastewater from construction activities would mostly contain suspended impurities. The waste water will be arrested before discharge, to prevent solids buildup in the existing drains. Thus, the construction site wastewater would be led to sedimentation basins, allowing a hydraulic retention time of 1 ½ to 2 hours, where excess suspended solids would be settled out and relatively clear supernatant would be discharged to the plant drain.

6.3.7 Ecological Impact

The Project site is mainly vacant land and there are no major habitats near the site. The impact of the construction activities would be primarily confined to the Project site. Since, the entire land is vacant land with some shrubs. Thus, the site development works would not lead to any significant loss of important species or ecosystems.

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

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

All these activities would give rise to emission of dust particles thereby affecting air quality marginally at the site. The impact will be temporary in nature and therefore is assessed as of low significance. Covering of stockpiles and sprinkling of water during excavation will reduce

the dust emission to a great extent. The construction of transmission line and the substation will not have any negative impact on the air quality of the region during the operation phase.

Impact on Noise Level: During the construction phase, the major sources of noise pollution are movement of vehicles carrying the construction material and equipment to the site. Most of the access roads along the alignment are motor able and Project traffic would be negligible. The major work of the construction is expected to be carried out during the day time. Apart from vehicles bringing in materials to the nearest road, construction works for the transmission line will require minimal powered equipment. As such, noise emissions will be minor. As the predominant land use along most part of the alignment is vacant and inhabitated, there will be no residential areas exposed to noise generated during the construction phase and the noise produced during the construction period will have negligible impact on residents.

Impact on Surface and Ground Water Quality: There are no any 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.

The impacts related to above activities are temporary and can be mitigated through following measures:

- Strict attention on worker force regarding disturbance to surrounding habitats, flora and fauna including hunting of animals,
- Selection of approved locations for material storage yards and labor camps away from the environmental sensitive areas, and
- Avoid entering of construction waste (cement particles, rock, rubbles and waste water) and sanitary waste to the surrounding water bodies.

Disposal of Debris: As a result of construction related activities, spoil and debris will be generated during the construction stage. Proper disposal of the debris shall be ensured to minimize the impact on the surrounding ecology, public health and scenic beauty.

Impact on Human Environment: Project activities could impact the health and safety of the work force and of the general public, in particular, in terms of risk of accidents and exposure to electromagnetic fields along the alignment. The accidents may be caused due to 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, sanitary facilities and drainage in the temporary sheds of the construction workers should be provided to avoid the surface water pollution.

Provision of adequate washing and toilet facilities should be made obligatory. This should form an integral component in the planning stage before commencement of construction activity. There shall be proper solid waste disposal procedure to enhance sanitation of workers who stay in camps. Septic tank will be used for sanitation purpose. Thus possibilities of infecting water borne diseases or vector borne diseases (Parasitic infections) will be eliminated by adopting proper solid waste disposal procedure. Unacceptable solid waste disposal practices such as open dumping of solid waste and poor sanitation facilities will lead to pollution of surrounding environment, contamination of water bodies and increase adverse impact to the aquatic; terrestrial lives 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 workers' accommodation.

Contractor shall provide garbage bins to all workers' accommodation and construction sites, for dumping wastes regularly in a hygienic manner in the area

6.4 IMPACTS DURING OPERATION PHASE

Various activities of operation and maintenance phase and their probable impacts on various sectors of environment are presented in table below.

Table 6.2: Identification of Activities and Potential Impact (O & M Phase)

O & M Activities	Environment Attribute	Probable Impact
Waste water	Water	❖ Generation of Waste water during cleaning of modules ❖ Domestic waste generated by staff employed during operations
Visual Impact		❖ Visual and reflection of solar modules impact on nearby traffic
Socio-economic	Socio-economics	❖ Generate employment in the area ❖ Fast Development in the area
Air	Air	❖ No emissions from solar PV plant
Ecology	Birds/Animals	No impact on fauna and flora

6.4.1 Impact on Land Use

The proposed Project will be set up on vacant land. The site, after completion of its development, would consist of built structures, landscaped to give a pleasing outlook.

Following the construction phase, the temporarily modified land use pattern, such as construction of temporary tents to accommodate some construction personnel will be totally removed during the operation stage. Land released from the construction activities would be put to economic and aesthetic use to hasten recovery from adverse impacts.

6.4.2 Impact on Soil Cover

Most impacts of Solar PV Project on soil are restricted to the construction phase, which will get stabilized during operation phase.

The soil conditions of the Project site would be allowed to stabilize during this period after the impacts of the construction phase. The topsoil in non-built up areas would be restored and such portions of the site would be replanted with appropriate plant species which can grow in saline environment. The concerned District Forest Officer can be consulted for selection of species and technical guidance, if required.

During operation of a Project, no appreciable adverse changes in the soils are anticipated.

6.4.3 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.

6.4.4 Noise Impact

During plant operations, there would be no significant noise generated activity expected. There might of use of machinery during maintenance of plant, but the activity will be restricted to day time. The noise generated will not exceed 65 db(A) which is the permissible limit for residential areas as per NEQs for noise.

6.4.5 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. The wastewater emanating from cleaning operations shall be recycled for plantation around the plant.

6.4.6 Ecology

There is no sensitive ecological area / protected forest area such as national wildlife park, bird Sanctuary near the Project area. The area is already barren and removal of small herbaceous vegetation during initial period of construction will be minimal. There will be no impact on the ecology of the area during operation phase.

6.4.7 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.

6.4.8 Impact of Transmission Lines during Operation Phase

Electric Shock: This may lead to death or injury to the workers and public in the area. This shall be minimized or avoided by;

- Security fences around substation
- Establishment of warning signs
- Careful design using appropriate technologies to minimize hazards.

Noise Generation: Nuisance to the community around the substation site can occur during the Project operation stage. Provision of appropriate noise barriers at substations shall be made in this regard.

Maintenance of Transmission Line and Substation: Possible exposure to electromagnetic inter phase. could occur during these activities. Design of transmission line shall comply with the limits of electromagnetic interference from overhead power lines.

Oil Spillage: 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.

6.5 IMPACTS DURING DECOMMISSIONING PHASE

Dismantling operation however will have impact on environment due to noise and dust arising out of it. During de-installation, a specific strategy shall be adopted in order to handle the each type of item to keep the impact during the actual activity low. The decommissioning will also have social impact. The decommissioning of the power house which was a part of the local social fabric for many years will certainly create vacuum in the lives of the people directly and 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.

6.6 SOCIAL IMPACTS

6.6.1 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.

MCC New Energy Company 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

6.6.2 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. 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.

6.6.3 Resettlement

There are no indigenous peoples living on the Project site. Therefore, the Project has no resettlement and indigenous people issues. The three temporary settlements/mud shelters shall not be relocated and the area will be excluded for any construction activities.

6.6.4 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 2030.

6.6.5 Private Sector Development

Solar energy holds the most potential of all renewable energy sources in Pakistan, possibly offering at a rate of 1000 watts per square meter. The Project will be the first to demonstrate this unrealized potential for large-scale solar Projects to meet power needs in the region. The Project will establish the commercial viability of large-scale solar farms connected to the grid and set off the necessary growth in the sector by advancing a model that can be replicated by other private sector investors throughout the region.

SECTION 7

INFORMATION DISCLOSURE, CONSULTATION AND PARTICIPATION

7 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. The social survey expert of ECPL team himself filled the questionnaires after asking the questions to the native people. Filled questionnaires are attached in **Annexure-VIII** and snapshots of consultative meeting are also attached in **Annexure IX.**

During construction phase, residents of the local; area, elected representatives, local councilors and informal community leaders including members of NGO's will be asked to state their current perceptions of priorities for improvements to the urban environmental infrastructure in their areas and about the likely impacts of the Project during construction and operation phases.

The stakeholder consultation is a continued process, and should be maintained throughout the Project. The consultations carried out during the present IEE and reported in this Chapter are essentially a first step in this process.

During the present IEE, the stakeholder analysis was carried out to identify relevant stakeholders on the basis of their ability to influence the Project or their vulnerability to be negatively impacted from it. This approach ensured that no relevant groups were excluded from the consultations, and appropriate engagement strategies were developed for each stakeholder.

During the stakeholder consultations carried out in the communities near the proposed site, the participants were first provided the salient information about the proposed Project.

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.

SECTION 8

ENVIRONMENT MANAGEMENT PLAN

8 ENVIRONMENT MANAGEMENT PLAN

8.1 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 specific objectives of the EMP are to:

- Define the responsibilities of the project proponents, contractors, and environmental monitors, and provide means of effectively communicating environmental and social issues among them
- Define the implementation mechanism for the mitigation measures identified during the present study.
- 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.

8.2 COMPONENT OF EMP

The EMP consists of the following:

- Institutional Arrangements
- Mitigation and Monitoring plan
- Grievance Redressal Mechanism
- Reports and Documentation
- Environmental and social trainings,
- Public disclosure requirements
- Budgetary estimates for EMP implementation.

All the components of EMP are discussed from Section 8.3 to 8.9.

8.3 INSTITUTIONAL ARRANGEMENT

MCC New Energy Company will establish an Environment & Social Management Cell (ESMC) at Corporate and Site level, headed by a Project Director to be responsible for day-today implementation of the Project. MCC New Energy Company 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).

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 MCC New Energy Company 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 MCC New Energy Company 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 coordinating field units 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 raising on environmental and social issues related to power transmission projects to the project/contract staff.

The duties of the Environmental and Social Unit at site level are to:

- Implement the environment policy guidelines and environmental good practices at the sites.
- Advise and coordinate the contractor(s) activity towards effective environment management.
- Implement environment 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.

The Framework of Environment and Social Management Cell are shown in **Figure 8.1** and Key responsibilities of ESMC are summarized in **Table 8.1.**

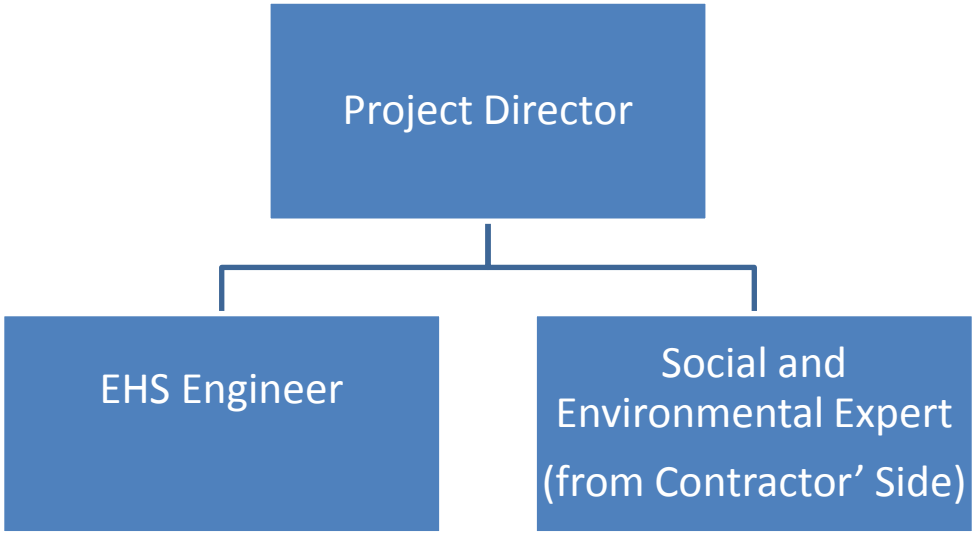

Figure 8.1: Framework of Environment and Social Management Cell (ESMC)

Table 8.1: Identification of Activities and Potential Impact (O & MPhase)

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

8.4 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.
- 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-III.**

8.5 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.

MCC New Energy Company 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 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.

8.6 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.

8.7 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 MCC New Energy Company 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.

8.8 PUBLIC DISCLOSURE REQUIREMENTS

MCC New Energy Company 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 MCC New Energy Company official website.

8.9 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-IV.**

SECTION 9

CONCLUSION AND RECOMMENDATION

9 CONCLUSION AND RECOMMENDATION

Overall environmental impacts of the project are manageable and can be managed cost effectively - Environmental impacts are likely to result from the proposed Power project. Careful mitigation and monitoring, specific selection criteria and review/assessment procedures have been specified to ensure that minimal impacts take place. The detailed design would ensure inclusion of any such environmental impacts that could not be specified or identified at this stage are taken into account and mitigated where necessary. Those impacts can be reduced through the use of mitigation measures such as correction in work practices at the construction sites, or through the careful selection of sites and access routes. Since proposed land is covered with shrubs, most of the shrubs will not be removed; however few shrubs may need to be removed to avoid any shadow impact on the solar panels.

- 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.
- There is negligible removal of trees/shrubs 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 MCC NEW ENERGY COMPANY 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 MCC NEW ENERGY COMPANY 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 MCC New Energy Company, no major adverse impacts are expected. There is no adverse impact on the migration of habitat, any natural existing land resources and effect in the regular life of people.

The environment and social impact associated with project is limited to the extent of construction phase and can be mitigated through a set of recommended measures and adequate provision for environment and social impacts which cover monitoring, measuring and mitigation.

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

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

Adequate provisions have been made for the environmental mitigation and monitoring of predicted impacts, along with their associated costs. Adverse impacts if noticed during implementation will be mitigated using appropriate design and management measures. The potential cumulative and residual impacts of the project as a whole indicate the project classifies as a category "B", in accordance with ADB's Safeguards Policy Statement 2009. The Project is not considered highly sensitive or complex. Mitigation measures related to 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.

Reference No: EPA/2016/02/25/IEE/157

ENVIRONMENTAL PROTECTION AGENCY

GOVERNMENT OF SINDH

Plot # ST-2/1, Sector 23, KIA, Karachi-74900
Ph: 5065950, 5065598, 5065637
5065532, 5065946, 5065621
epasindh@cyber.net.pk
Facsimile: 5065940

Date: 28-03-2016

SUBJECT:-**DECISION ON INITIAL ENVIRONMENTAL EXAMINATION (IEE).**

1.	**Name & Address of Proponent:**	Mr. Chuang Shaolin Shaolin Director M/s: MCC New Energy Company (Pk) Private Limited
2.	**Description of Project:**	Construction of 100 MW Solar Power Project
3.	**Location of Project:**	Deh Son Walhar,Talkuka Kotri, District Jamshro.
4.	**Date of Filing of IEE:**	25-02-2016

5. After careful review of the Initial Environmental Examination (IEE) report, the Environmental Protection Agency (EPA), Sindh accord its approval subject to the following conditions:

   a. The mitigation measures provided in the IEE report and implementation of Environmental Management Plan shall strictly be followed by the proponent to minimize or reduce the impacts on physical and biological environment. As for this, cost of EMP shall separate be allocated and be part of the tender document.

   b. The project proponent makes ensure to treat effluent generated from sewerage & waste water generated from the project activities and reduced its concentration at permissible level for compliance of National Environmental Quality Standards (NEQS) prior to discharge. However, the discharge should be planned away from environmental sensitive areas, with special attention to high water tables, vulnerable aquifers, and wetlands, community receptors, including water wells, water intakes and high value agriculture land.

   c. The gaseous emissions (SO_2, NOx, & CO) and particulate matters released from machinery shall conform/meet to the National/ Provincial Environmental Quality Standards (NEQS/SEQS) all the time; at no time, the discharge/emission levels shall go higher than stipulated standards of this office.

   d. The machinery used for construction or other project activities shall meet the NEQS/SEQS positively; however, proponent shall possess fitness certificate prior to use of the machinery equipment.

   e. The impact on Water, Air, Soil and noise shall be minimized by adopting adequate precautionary measures as stipulated in national and international guidelines (Pak-EPA, IFC, World Bank).

All the types of adversely affect of wind project on local environment shall be reduced by means of mitigation efforts that should be completed during the design, construction, and operation phase of wind warm by proponent in order to avoid damages to vulnerable ecological systems.

f. The project proponent shall bound to adopt effective mitigation measures with respect to environmental issues posed by wind turbines that includes wildlife safety, bio-safety disturbance, noise, visual pollution, electromagnetic inferences and local climate change.

g. The project proponent shall follow national and international guidelines with respect to wind energy such as OPIC & (IFC) during construction, operation & decommissioning of the project activities.

h. The Wind Energy induced environmental impacts on birds, bats, and other physico-chemical parameters i.e. temperature, ambient air, water, and noise quality should be minimized & monitored by independent Monitoring Consultant (IMC) having expertise in carrying out Environmental & Social Impact monitoring. In addition, the IMC will monitor the implementation of the Environmental Management Plan and commitments made in IEE report. And the monitoring reports of the same will be submitted to EPA on quarterly basis.

i. The vegetation of the disturbed project area should be replanted soon as after completion of construction work in order to overcome or reduced the impact of soil erosion.

j. The waste generated from project activity shall confirm to dispose as environment friendly manner as non-hazardous waste shall be disposed at designated and approved waste disposal site and hazardous waste shall be transferred/disposed off only in a manner as prescribed in Waste Management Rules 2014 of Sindh EPA

k. The Project proponent shall prepare on-site & off-site emergency plans as disaster risk management and other as per extent rules in this regard.

l. A complete Health, Safety and Environment (HSE) commissioning management system shall be developed as per national if available or international guidelines. For this purpose, HSE setup should be supervised by a designated HSE officer at the senior level with sufficient administrative and technical authority to perform the designated functions. And proponent shall make sure that the operating instructions and emergency actions are made available to every worker/labor at the site. Moreover, proponent shall place all required resources and take necessary safety measures to prevent any incident and accident to human during project activity.

m. The proponent shall ensure that no unfortunate incident(s) are caused due to construction and operation of project. The cost of damage to the environment, property and life of the people/workers shall lie on the proponent.

n. If project proponent is storing bulk diesel/ furnace oil then project proponent bound to obtain necessary approval from Department of Explosive.

o. The project proponent shall have secondary containment equivalent to 110% of storage capacity for safety measures and prevent from soil contamination. However, chemicals of any forms (solid,

liquid, gases) shall be handled by wearing personal protective equipments (PPEs) and care shall be taken to prevent any spillage.

p. The proponent shall ensure that emissions/effluents from project activity do not pose an unacceptable risk to human health or become nuisance to the neighborhood.

q. For all engineering designs, NFPA (National Fire Protection Authority) codes will be followed. Standard fire and smoke detection and protection devices such as alarms, sprinklers, fire hoses and hydrants will be provided at all critical locations.

r. This approval is accorded only for the construction of project activity and proponent shall submit separate EIA or IEE as required under EIA/IEE regulation 2014 o SEP ACT, for any enhancement or change in the design of project.

s. Under the CSR policy, community development scheme should be initiated after assessment of needs of community in terms of social assessment.

t. Proponent shall facilitate EPA Officer(s)/Official(s) as and when required for inspection of compliance status under provisions of Sindh Environmental Protection Act, 2014, rules and regulations framed there under and the conditions laid down in this approval.

u. The Department reserves the right to stipulate additional conditions, if found necessary and the company/ project proponent in a time bound manner will have to implement those conditions.

v. No violation of any regulations, rules, instruction and provision of SEP Act, 2014, shall be made and in case of any such violation of the rules/laws in the approval shall stand cancelled without any further notice.

6. All the environmental conditions of this approval shall be incorporated in the terms and conditions of tender document of the project for commitment and compliance.
7. The proponent shall be liable for compliance of SEP Act 2014 & EIA/IEE Regulations 2014, in force relating to conditions for approval, confirmation of compliance, entry, inspection and monitoring
8. This approval is valid only for construction phase of the project activities.
9. The proponent shall be liable for compliance of EIA/IEE Regulation 2014 of SEP ACT 2014, which direct for conditions for approval, confirmation of compliance, entry, inspection and monitoring.
10. This approval shall be treated as null and void if all or any of the conditions mentioned above, is are not complied with. This approval does not absolve the proponent of the duty to obtain any other approval or consent that may be required under any law in force.

Waris Ali Gabol
(Deputy Director Tech)

TECHNICAL FEASIBILITY STUDY

SINDH AT DEH SON WALHAR, TALUKA KOTRI, AND DISTRICT JAMSHORO – SINDH - PAKISTAN

FOR F1 SOLAR PK PRIVATE LTD.

MARCH 26, 2020

Contents

Glossary / List of Abbreviations

Acronym or keywords	Definition
SED	Sindh Energy Department
AC	Alternating Current
Corrected PV split from the combined feed-in	Share of energy fed in that is coming from the PV side, after curtailment due to energy feed-in from wind turbines and correction for data gaps
Capex	Capital Expenditure
CUF	Capacity Utilization Factor - the ratio, given as percentage, of the actual AC output from a solar plant over the year to the maximum output that would be generated if operated continuously at maximum capacity
DC	Direct Current
W.C.S.	Worst Case Scenario
EIA	Environmental Impact Assessment
EMP	Environmental Management Plan
EPC Contractor	Engineering, Procurement and Construction Contractor - the entity that will be contracted to design, buy the necessary materials, and construct the Plant
GHG	Greenhouse Gases
GHI	Global Horizontal Irradiation - the amount of irradiation falling on a horizontal plane over a period. Usually measured in kWh of energy falling on a square meter over a set amount of time (hourly, daily , monthly or annually), e.g. kWh/m2/yr
GII	Global Inclined Irradiation - the amount of irradiation falling on an inclined or tilted plane over a period of time Effective GIi is the amount of irradiation that falls on a plane that tracks the sun such as those used in single axis tracking PV systems
HV	High Voltage
IEE	Initial Environmental Examination
IFC	International Finance Corporation
ILO	International Labor Organization
IRR	Internal Rate of Return - the rate that results in the Net Present Value equal to zero
kV	Kilo-Volts (1 kV = 1000 Volts)
LCOE	Levelised Cost of Electricity
LID	Light Induced Degradation
LV	Low Voltage
MPPT	Maximum Power Point Tracker
MRA	Maintenance Reserve Account
MV	Medium Voltage

MVA	Mega-Volt-Amps , a measure of the capacity of a power line or transformer to carry real and reactive power
MWp	The nameplate capacity of PV modules on a site measured in Mega-Watt peak. Also, expressed as kWp or Wp
NPV	Net Present Value - a financial formula to calculate the potential return from an investment
O&M	Operations and Maintenance
Opex	Operational Expenditure
SEPA	Sindh Environmental Protection Agency
P50	A value which is based on uncertainties and probabilities, has a 50% chance of being exceeded. For example, the P50 yield number is the estimate for the yield produced and the probability of the actual yield being higher is 50% and lower is also 50%
P90	A value which, based on uncertainties and probabilities, has a 90% chance of being exceeded. For instance, the P90 yield number is the estimate for which the probability of the actual yield being higher is 90% and lower is 10%
POC	Point of Connection (to the electricity grid)
PR	Performance Ratio - a measure of how well the plant performs compared to an ideal case. This parameter given as a percentage indicates the ratio between the actual and theoretically possible energy outputs. If multiplied by the GIi, this ratio gives the P50 Specific Yield of a project
PV	Photovoltaic
R.O.W	Right of Way
RE	Renewable Energy
SEP	Stakeholder Engagement Plan
SLD	Single Line Diagram
Specific yield	A measure of the energy produced by the plant over a year divided by its nominal installed capacity which allows for comparison of the performance of different sized plants Usually measured in kWh/ yr. of energy produced per kWp of PV installed
VSAT	Very Small Aperture Terminal

Issue and Revision Record

Revision	Date	Originator	Checker	Approver	Status
A	26/03/2020	AA, CB, JM, BO, JP, FT, AC, MA, MK	CS, AA	CS	1st Draft

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i. Project Overview and Back Ground

F1 Solar PK (Private) Limited is a special purpose vehicle (SPV) set up to develop, build, own and operate a 93.76 MW AC ~ 100 MW DC Solar Power Plant in Sindh at Deh Son Walhar, Taluka Kotri, and District Jamshoro. The PV solar plant will contribute to the national development by providing self-sufficiency in power and reducing dependence on fossil fuels. F1 Solar PK (Private) Limited is fully incorporated with Securities & Exchange Commission of Pakistan. The SPV is owned by Germany based ib vogt GmbH (ib vogt) in majority and their Partner Pakistan Testing Service (PTS) in minority.

ibvogt was established in 2002 and is specialized in the development, design & engineering, financing, construction, operation & maintenance and asset management of solar power plants worldwide. The company provides high-quality turnkey solar power plant solutions, designed and engineered in Germany to end investors internationally.

Pakistan Testing Service (PTS) is an Islamabad based developer of PV solar projects for end investors. The company successfully developed a project portfolio of approx. 160MW.

In 2018, a project of 100MWp with valid LOI (issued in August 2015) was presented to ibvogt for acquisition by the Chinese company MCC Tongsin Resources Ltd. Ibvogt, after an internal due diligence process, acquired the project development rights while following the process established by Directorate of Alternative Energy, Sindh Energy Department, Government of Sindh.

The Directorate of Alternative Energy issued the No Objection Certificate (NOC) for transfer of project development rights on 31st of May 2019 and acknowledged “F1 Solar PK (Private) Ltd” as the project’s SPV on 31st of October 2019.

In order to proceed with the necessary project development activities and submission of revised feasibility study the Directorate of Alternative Energy issued an LOI extension on 11th of February 2020. The LOI’s validity is extended to 13th of September 2020. The first feasibility study draft needs submission by 31st of July 2020 as per standard LOI timelines.

ibvogt is working on the Feasibility study incl. Topographical Survey, Geo Tech survey, Environmental Survey and Grid interconnection survey of the site. The objectives of the said Feasibility Study is to assess and structured the following items:

- Project Overview; complete understanding of the solar power project;
- Site appraisal geotechnical investigation;
- Planning policy statement;
- Desktop based Environmental and Social Impact Assessment (IEE attached as Annex – I);
- Design and Access Statement;
- Grid Interconnection;
- Energy Yield Assessments of solar PV system on P50 basis;
- Economic analysis including total project cost estimations for the construction and operation of the plant along with various sensitivities;

1.1 Site and Works overview

Key details for the project are shown in Table 1 and the location of the proposed site is indicated in Fig 1

S.No.	Entry	Details
1	Site Name	Jamshoro Solar Farm Site
2	Site Coordinates	P1= Lat 25°22'57.42"N, Long 68° 8'21.72" P2= Lat 25°22'41.70"N, Long 68° 7'50.04"E P3= Lat 25°21'43.86"N, Long 68° 8'24.30"E P4= Lat 25°22'0.12"N, Long 68° 8'55.74"E
3	Altitude	80 m (Highest recorded value) 52 m (Lowest recorded value)
4	Proposed AC and DC capacity	93.76 MW AC ~ 62.2 MW DC
5	Global irradiation levels	2271 KWh / m^2 (Solar GIS)

Table 1 showing the site coordinates, altitude, capacity and GHI value

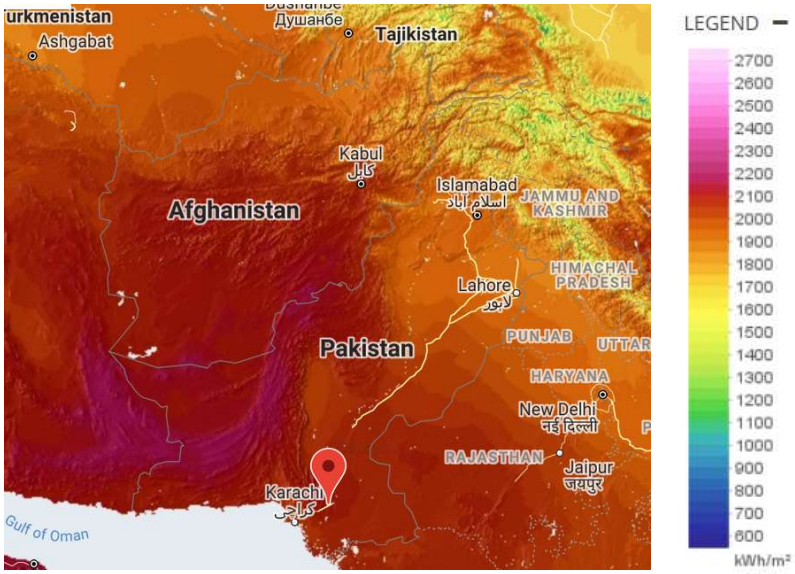


Figure 1 showing GHI value for the site

Global horizontal irradiation map for Pakistan can be seen in Figure 1 with the location of the proposed site. (ESMAP, Solar GIS).

The proposed layout is for a ground mounted single axis tracker system using Bankable Tier 1 monocrystalline modules and string inverters. A drawing of the proposed layout is shown in Annexure A.

An indicative timeline for the Project is shown in Annexure B. Contractors will be required to comply with a prearranged schedule of works and complete the construction and installation of equipment by the required deadline. We recommend that permits, equipment, infrastructure logistics and grid application will be secured for the Project prior to commencement of works.

1.2 Pakistan Power Market

Electricity is life line of any economy and most vital instrument of socioeconomic development of a country. Electricity is pivotal in running machinery in factories and industrial units, for lighting our cities and powering our vehicles. The challenge of ensuring electricity access for industries and providing increased access to the poor parts of the population is the key issue for any government.

There has been an enormous increase in the demand of energy because of industrial development and population growth, in comparison to enhancement in energy production. Supply of energy is, therefore, far less than the actual demand, resultantly crisis has emerged.

Pakistan's energy infrastructure is not well developed; rather it is underdeveloped and not properly managed. Currently the country is facing severe energy crisis. Moreover, rapid demand growth, transmission losses due to outdated infrastructure, power theft, and seasonal reductions in the availability of hydropower have worsened the situation. Consequently, the demand exceeds supply and hence load-shedding is a common phenomenon through power shutdown.

1.3 Electricity sector structure

Pakistan power sector constitutes of four major entities, Water and Power Development Authority (WAPDA), Karachi Electric Supply Corporation (KESC), Independent Power Producers (IPPs), Pakistan Atomic Energy Commission (PAEC).

Two vertically integrated public entities, i.e. WAPDA, which serves entire country except economical capital – Karachi and KESC that solely facilitates Karachi as well as its surroundings.

Under 1997 "The Regulation of Generation, Transmission and Distribution of Electric Power Act" National Electric Power Regulatory Authority (NEPRA) was formed; with a challenging charter to operate as an independent regulator and to devise a transparent, economically dynamic, competitive power sector in Pakistan. The National Electric Power Regulatory Authority ('NEPRA") is an independent regulator setup for the regulation of Pakistan' s power sector to balance the interests of consumers and power sector companies. NEPRA develops the regulatory regime and future market design for the power sector. All generation transmission and distribution companies are now licensees of NEPRA and matters related to tariffs, licensing, safety, grid codes, consumer interest are regulated by NEPRA.

WPDA Power wing was further transformed into four sub tier entities GENCOs (Generation Companies), Eleven DISCOs (Distribution Companies), one NTDC (National Transmission & Dispatch Company) and KESC (Karachi Electric Supply Corporation) later named K-Electric after privatization. Pakistan Atomic Energy Commission was than established for generation of electricity from Nuclear Power. Private Power infrastructure board was established to magnetize the investment from private sector through a one window operation. To explore the opportunities in the field of renewable energy Alternative Energy Development Board was recently established with aim of generation of electricity through alternative resource. Provinces after the empowerment from Council of Common Interest can generate their own electricity and each province has their own power development boards including AJK.

Central Power Purchase Agency ("CPPA"), a public-sector agency has recently become active for the centralized purchase of power from all existing and upcoming private and public sector power producers. All public-sector agencies/companies are administered/overseen by the Ministry of Water & Power, Govt of Pakistan.

1.4 Situational Analysis

The overall power generation capacity of Pakistan at the end of 2018-19 was 35,521 Mega Watt (MW) on the NTDC system and 2,854 MW on K-Electric. Against this installed capacity, the power generation was 122,497 GWh, which represents 44 per cent average capacity utilization. Seasonal variation in hydropower generation, de-rated capacity of the public-sector generating units and failure of timely supply of fuels to the IPPs are main causes of low-capacity utilization.

S.NO	Peak demand during 2020-21 (MW)	Installed Generation Capacity 2019 (MW)	Surplus (MW)	Short fall due to 19.4% losses (MW)
1	29325	35521	6891	695

Table 2 showing peak demand and generation during 2019 (source: NTDC)

The situational analysis for year 2019 shows that Country has now surplus generation but still due to weak transmission system there are lot of line losses and Country still faces load shedding especially in rural areas where power Generation projects are not located closer to the existing grid. To improve the situation National Transmission and Dispatch Company is supporting the new renewable energy generation projects near the load centers and to the National Grid. So that line losses can be reduced. Proposed solar project is also located near to the and exiting grid and it's less than 0.5km radius of the Jamshoro Industrial grid making it closer to load center.

1.5 Current Statistics

Installed Capacity (MW)

Installed Capacity (MW)						
Description	**2013-14**	**2014-15**	**2015-16**	**2016-17**	**2017-18**	**2018-19**
Hydel						
Wapda Hydel	6902	6902	6902	6902	8341	9387
IPPs Hydel	195	195	195	195	342	382
Thermal						
GENCOs with PEPCO	5762	5622	5477	5477	5627	5497
KE Own	2422	1875	2295	2295	2267	2295
IPPs						
IPPs connected with PEPCO	8408	8426	8411	12322	14883	16911
IPPs connected with KE	228	352	349	339	443	489
Nuclear						
CHANUPP (PAEC)	665	665	665	1005	1345	1345

KANUPP (PAEC)	137	75	75	75	137	70
Renewable						
Solar	0	100	400	400	400	400
Wind	106	256	306	736	985	1235
Bagasse	24	70	146	281	306	364
Total PEPCO	22062	22236	22502	27318	32229	35521
Total KE	2787	2302	2719	2709	2847	2854
Total Installed Capacity	24849	24538	25221	30027	35076	38375
Yearly Addition	1217	-311	683	4806	5049	3299

Table 3 showing generation from different sources up till 2019 (source: NTDC)

1.6 Energy Mix

Most of the power generated from Pakistan is coming from two main sources: Thermal and Hydro. The installed generation capacity by June 2017 and energy mix is as follows:

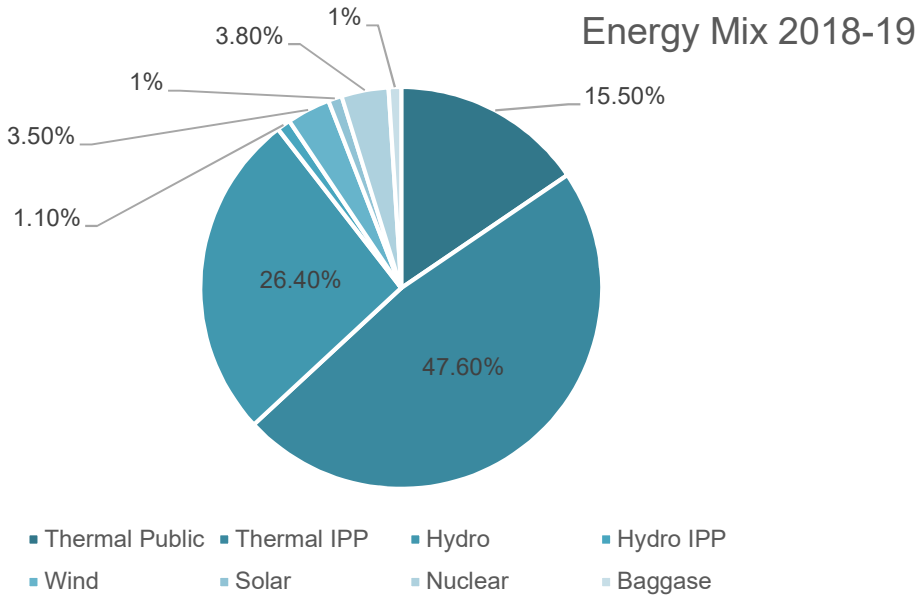


Figure 2 showing current energy mix of Pakistan (source: NTDC)

1.7 Pakistan Power Pakistan - Key Challenges

Pakistan's power sector is currently afflicted by several challenges.

1.7.1 Energy Mix

Due to poor energy mix, most of the country generation is coming from thermal fuel sources including furnace oil and high speed diesel, which results in expensive generation of 12 USD cents / KWhr on average.

1.7.2 Transmission and Distribution infrastructure

High losses, in range of 19.4% is because of weak transmission and distribution infrastructure. The inefficiencies and high cost of generation are resulting in high levels of subsidies and circular debt. This also include loses due to theft as well.

1.7.3 Electricity shortfall due to losses

Due to high energy losses, still country faces load shedding problem and taking transmission losses into account, still electricity shortfall of 695 MW.

1.7.4 Installed and Planned Power Projects up to 2018-2019

Sr. No.	Names of projects Agency	Fuel	Location	Installed capacity (MW)
1	Quaid-e-Azam Solar Park PPDB (Phase-1)	Solar	Lal Sohnra (Cholistan), Punjab	**100**
2	FWEL-I AEDB	Wind	Jhampir/Gharo/Bhambore, Sindh	**150**
3	Nandipur (Remaining Unit-CC) GENCO	RFO	Gujranwala, Punjab	**425**
	Total generation addition in 2014-15			**675**
4	Sapphire Wind Power Plant AEDB	Wind	Jhampir/Gharo/Bhambore, Sindh	**50**
5	CHASNUPP-III PAEC	Nuclear	Chashma, KPK	**340**
6	Other Wind Power Plants AEDB	Wind	Jhampir/Gharo/Bhambore, Sindh	**330**
7	Quaid-e-Azam Solar Park PPDB (Phase-2)	Solar	Lal Sohnra (Cholistan), Punjab	**300**
	Total generation addition in 2015-16			**1,020**
8	Other Wind Power Plants AEDB	Wind	Jhampir/Gharo/Bhambore, Sindh	**1,120**
9	Neelum Jhelum Hydel WAPDA	Hydel	Nauseri/Muzaffarabad, AJK	**969**
10	CHASHNUPP-IV PAEC	Nucl	Chashma, KPK	**340**
11	Tarbela 4th Ext. Project WAPDA	Hydel	Tarbela, KPK	**1,410**
12	Patrind HPP PPIB	Hydel	Kunhar River, KPK/AJK	**147**
13	LNG Based Plants (Phase-I) PPIB	LNG	Bhikki and Baloki, Punjab	**2,400**
14	Quaid-e-Azam Solar Park PPDB (Phase-3)	Solar	Lal Sohnra (Cholistan), Punjab	**600**

	Total generation addition in 2016-17			**6,986**
15	Keyal Khwar WAPDA	Hydel	Dasu District, KPK	**122**
16	Coal Plant at Sahiwal PPDB	Coal	Sahiwal, Punjab	**1,320**
17	Port Qasim Power Plant PPIB	Coal	Port Qasim Karachi, Sindh	**1,320**
18	Engro Thar Coal (unit-1) PPIB	Coal	Thar, Sindh	**330**
19	Nooriabad Gas Plant GoS	Gas	Nooriabad ,Sindh	**100**
20	Engro Thar Coal (unit-2) PPIB	Coal	Thar, Sindh	**330**
21	LNG Based Plants (Phase-II) PPIB	LNG	Haveli Bahadur Shah (Jhang), Punjab	**1,200**
22	Coal Plant at Salt Range PPDB	Coal	Salt Range, Punjab	**300**
23	Tarbela 5th Ext. Project WAPDA	Hydel	Tarbela, KPK	**1,400**
24	S TCEB S R L	Coal	Thar, Sindh	**1,320**
	Total generation addition in 2017-18			**7,742**
25	Golen Gol HPP WAPDA	Hydel	Chitral, KPK	**106**
26	HUB Power Company Ltd. PPIB	Coal	HUB, Baluchistan	**1,320**
27	Siddiqsons Limited TCEB	Coal	Port Qasim, Sindh	**350**
28	Lucky Electric Power TCEB Company Ltd.	Coal	Port Qasim, Sindh	**660**
29	Grange Holding PPIB	Coal	Arifwala, Punjab	**163**
30	Gulpur Poonch river PPIB	Hydel	Poonch River/Gulpur, AJK	**100**
	Total generation addition in 2018-19			**2,699**
	Total addition during the Plan period			**19,122**

Table 4 showing installed and planned capacity up till 2018 - 2019 (source: NTDC).

2. Site Appraisal

Directorate of Alternative Energy (DoE), in Sindh Energy Department Govt. of Sindh awarded the LOI to ibvogt GmbH for setting up of 93 MW AC ~ 100MW AC solar farm in Jamshoro Sindh. ibvogt GmbH together with its local partner PTS visited the solar farm site on multiple occasions and carried out site appraisal against following factors:

1. Location
2. Access
3. Proximity to Grid
4. Terrain
5. Geo tech
6. Flood Risk
7. Shading
8. Irradiation levels
9. Land use
10. Landscape & Visual Impact
11. Availability of utilities (Gas, Water & Electricity)
12. Any National or local planning designation
13. Environmental Impact
14. Land Cost
15. Legal ownership any court litigation

After site surveys and desktop assessment, Jamshoro site considered as a feasible option from financial and technical perspective. Solar farm site further appraised while going through following steps:

- Preliminary technical and financial assessment for pre-feasibility during Due diligence stage
- Pre-Feasibility
- Site visit

2.1 Preliminary technical and financial assessment

ibvogt as a lead developer carried out an in house technical and financial assessment for Jamshoro site. The project development cost component assessed as per NEPRA guidelines. NEPRA only allows certain per MW development cost as a tariff component. It was made sure that due to cost of land the overall project development cost should not go beyond NEPRA threshold. All the numbers were put in the financial model and a suitable but competitive tariff was identified. Also our local Grid Consult Arco Energy performed a Desktop based assessment (DBA). The DBA showed that, the project will be connected by making an In/Out on 132KV Single circuit b/w PAF Jamshoro Old Grid Station by a Feed Length of 7 km of Lynx Conductor.

2.1.1 Pre-Feasibility

A pre-feasibility technical and financial assessment was then carried out by Lead developer ib Vogt to for in house strategic meeting and following outcomes were shared with Board.

Summary

- The Solar System appears to be viable and economically attractive,
- The optimal system sizing is expected – depending on several factors (NEPRA Grid Interconnection guidelines, IRR or NPV maximization)
- At a PPA with a tariff of $ 4,94 c/kWh an IRR for such system would be expected of ~ >15% (range) assuming "normal" costs in the region
- The optimal technology choice is likely to be "Single Axis Tracker"
- There is strong potential to increase the IRR through (a) Total Cost and (b) Financial structuring
- As a further potential, installing short term battery storage to minimize short term fluctuation driven curtailments could be very beneficial and increase the overall project sizing – probably a "Phase 2".
- Information regarding the above is supplied below, together with technical team thoughts on the relevant planning assumptions
- It is recommended that a detailed Feasibility Study should be undertaken to deepen, verify and optimize potentials in the Project

2.2 Site Visit

After the submission of pre-feasibility work, a site visit was then carried out to gather the primary data from the site.

2.2.1 Site Location

The proposed project site is located almost 14 km away from the main Jamshoro city center in South West direction. The propose project site is 80m above sea level.

Fig 3 showing the location of Jamshoro Solar Farm site

2.2.2 Weather Data Meteonorm

Weather data for the Jamshoro Solar farm site is collected from the two data set sources Meteonorm and Solar GIS. Both data sets were analyzed and data with lower expected bias value was selected for the detailed technical analysis.

2.2.3 Average Temperature Data Jamshoro(Meteonorm)

The max average annual ambient air temperature at 2m height recorded at the site is 27^{0}C and 33.3^{0}C for month of July. High temperatures, can affect the efficiency of solar cells. Hence solar panels with permitted module temperature between -40 ^{o}C to +85 ^{o}C will be used for the JamshoroSolar farm site.

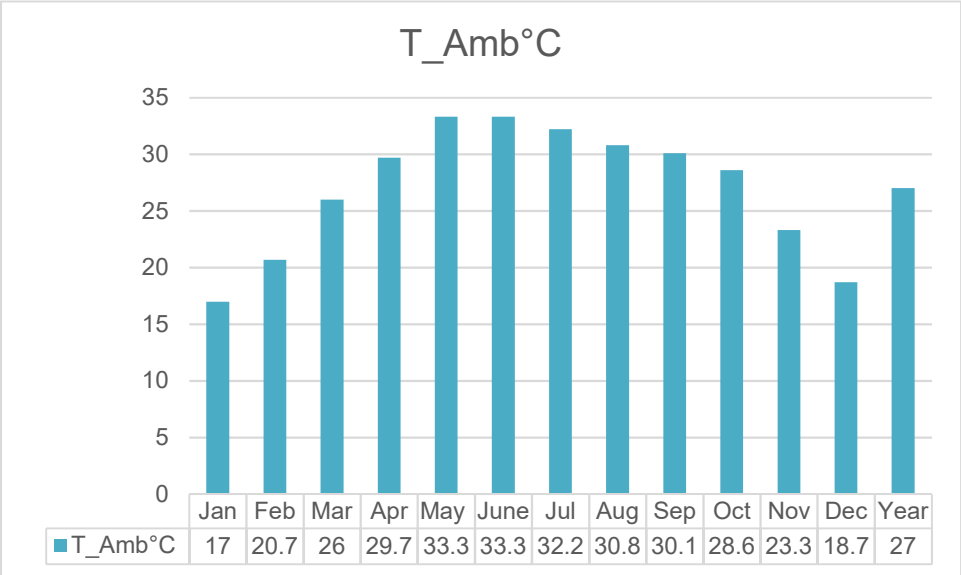


Fig 4 showing min, max monthly ambient air temperature at 2m height

2.2.4 Average Temperature Data Jamshoro

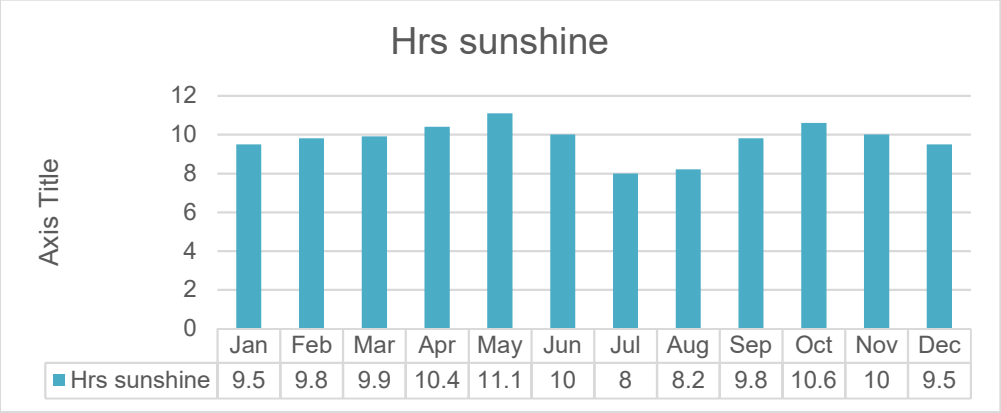


Fig 5 sowing sunshine hours at the Jamshoro site

2.2.5 Average Rainfall

Weather at Jamshoro site is usually dry and it only rains heavily during the wet season of Monson. The following graph shows the high values for rain and days from June to September.

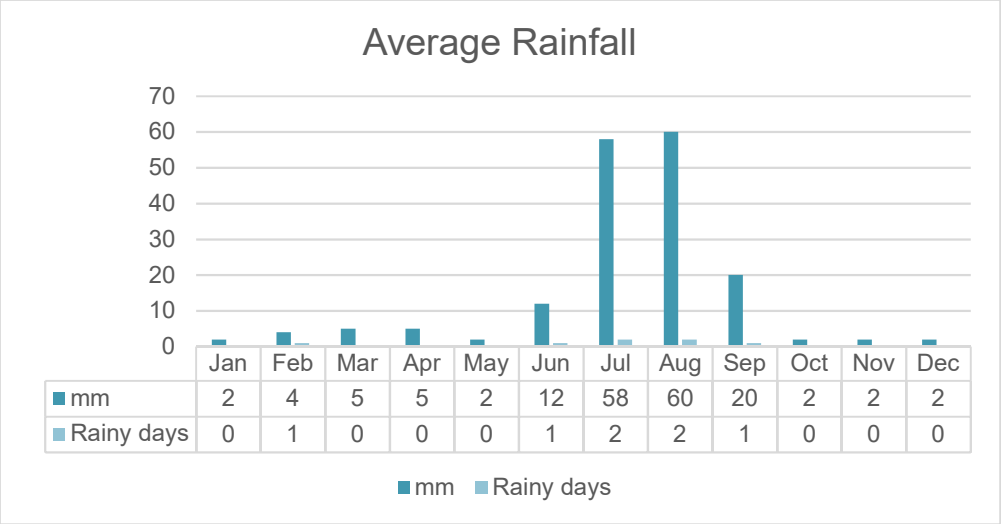


Fig 6 showing precipitation graph in Jamshoro

2.2.6 Solar irradiation (Meteonorm)

Jamshoro solar farm site is in Southern area of Pakistan and blessed with annual Global Horizontal Irradiation value of 1909 KWhr/^{2}m, making it suitable site for a solar farm development.

	GlobHor kWh/m².mth	***DiffHor kWh/m².mth***	***T_Amb °C***	***WindVel m/s***
Jan	126.8	41.9	17	2.1
Feb	128.8	55.7	20.7	2.3
Mar	170.9	75.9	26	2.5
Apr	182.7	88.4	29.7	3.1
May	198	102	33.3	4.2
June	201.2	107.5	33.3	4.7
Jul	171.9	107.5	32.2	4.8
Aug	163.2	103.7	30.8	4.4
Sep	172.1	78.6	30.1	3.8
Oct	154.7	67.1	28.6	2.2
Nov	127	49.5	23.3	1.6
Dec	111.9	47.1	18.7	1.9
Year	**1909.2**	**925**	**27**	**3.1**

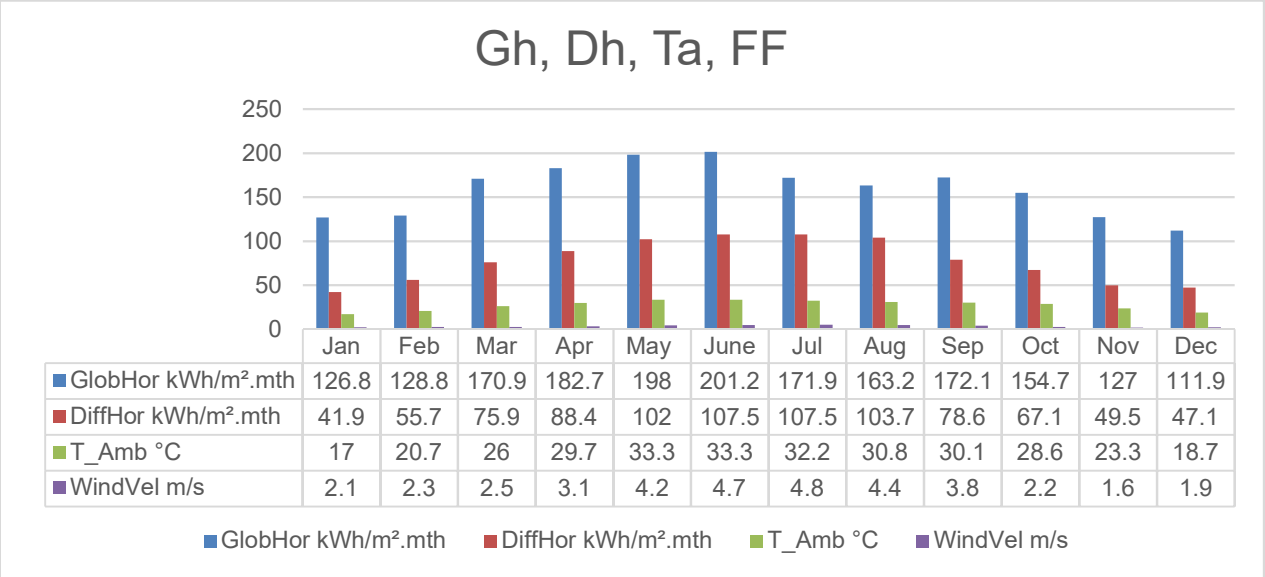
Table 5 showing irradiation levels at Jamshoro site

Gh: Global horizontal radiation ("GHI")

Dh: Mean irradiance of diffuse radiation horizontal

Ta: Air temperature (2 m above ground)

FF: Wind speed (FFE, FFN longitudinal and latitudinal part of the wind speed)



	Jan	Feb	Mar	Apr	May	June	Jul	Aug	Sep	Oct	Nov	Dec
GlobHor kWh/m².mth	126.8	128.8	170.9	182.7	198	201.2	171.9	163.2	172.1	154.7	127	111.9
DiffHor kWh/m².mth	41.9	55.7	75.9	88.4	102	107.5	107.5	103.7	78.6	67.1	49.5	47.1
T_Amb °C	17	20.7	26	29.7	33.3	33.3	32.2	30.8	30.1	28.6	23.3	18.7
WindVel m/s	2.1	2.3	2.5	3.1	4.2	4.7	4.8	4.4	3.8	2.2	1.6	1.9

Fig 7 showing GHI, DH Ta and FF irradiation levels at site

2.2.7 Solar irradiation (Solar GIS)

The weather data from Solar GIS was also analyzed, and yield assessment was carried on the basis on in house software interpolation and previous experience.

Month	*GHId*	*GHIm*	*Diffd*	*Diffm*	*DNId*	*DNIm*	*T24*
Jan	4.35	135	1.73	54	4.92	153	18.0
Feb	5.25	147	1.96	55	5.46	153	21.5
Mar	6.31	196	2.38	74	5.70	177	26.8
Apr	7.04	211	2.87	86	5.58	167	31.4
May	7.28	226	3.22	100	5.21	162	34.3
Jun	6.81	204	3.38	101	4.29	129	35.2
Jul	5.83	181	3.48	108	2.86	89	33.6
Aug	5.85	181	3.17	98	3.41	106	32.6
Sep	6.05	182	2.64	79	4.68	140	32.2
Oct	5.62	174	2.12	66	5.55	172	29.9
Nov	4.56	137	1.90	57	4.81	144	24.2
Dec	4.02	125	1.68	52	4.55	141	19.4
Year	**5.75**	**2099**	**2.55**	**930**	**4.75**	**1733**	**28.3**

Table 6 showing irradiation levels at Jamshoro Site

GHId = Average daily sum of global horizontal irradiation [kWh/m2]

GHIm = Average monthly (yearly) sum of global horizontal irradiation [kWh/m2]

Diffd = Average daily sum of diffuse horizontal irradiation [kWh/m2]

Diffm = Average monthly (yearly) sum of diffuse horizontal irradiation [kWh/m2]

DNId = Average daily sum of direct normal irradiation [kWh/m2]

DNIm = Average monthly (yearly) sum of direct normal irradiation [kWh/m2]

T24 = Average diurnal (24-hour) air temperature [°C]

2.2.8 Global Horizontal Irradiance (GHI) – Solar GIS

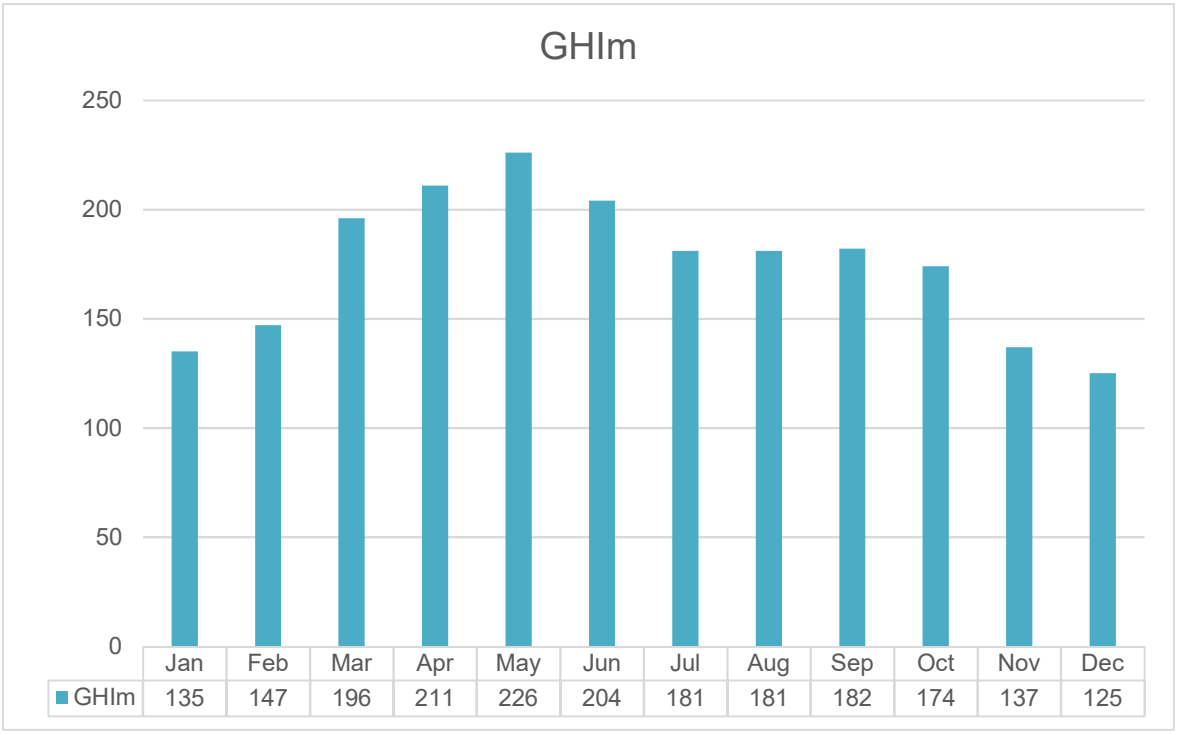


Fig 8 showing GHI levels at Jamshoro Site

2.2.9 Diffused Horizontal Irradiation (DHI) – Jamshoro GIS

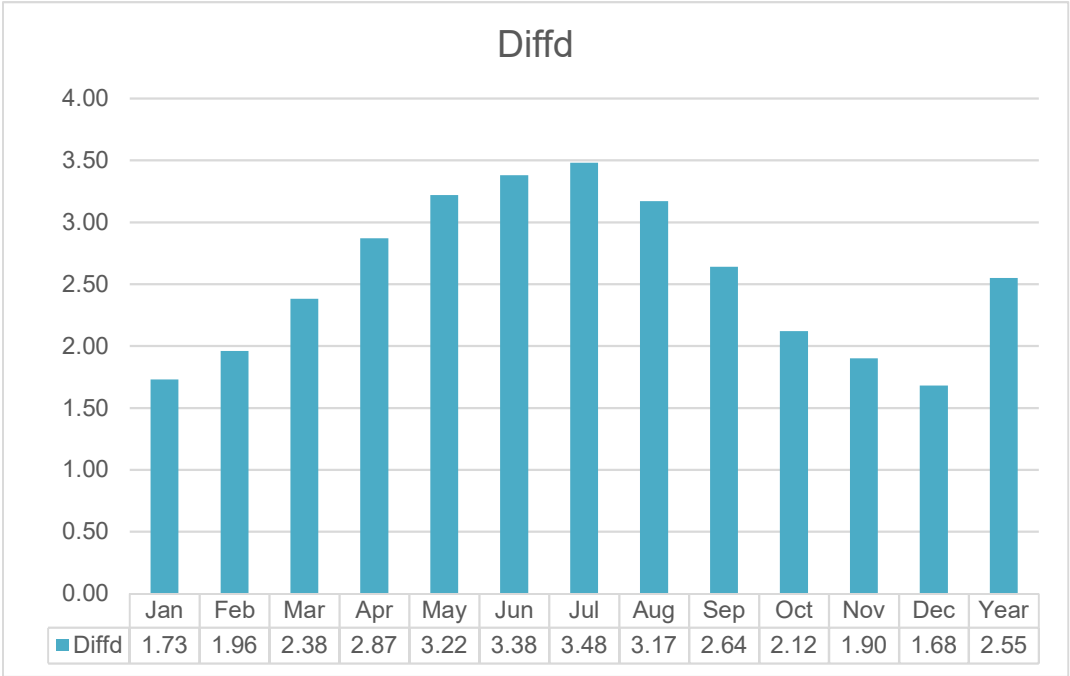


Fig 9 showing DHI levels at Jamshoro site

2.2.10 Average diurnal (24 hour) air temperature at 2 m) – Solar GIS

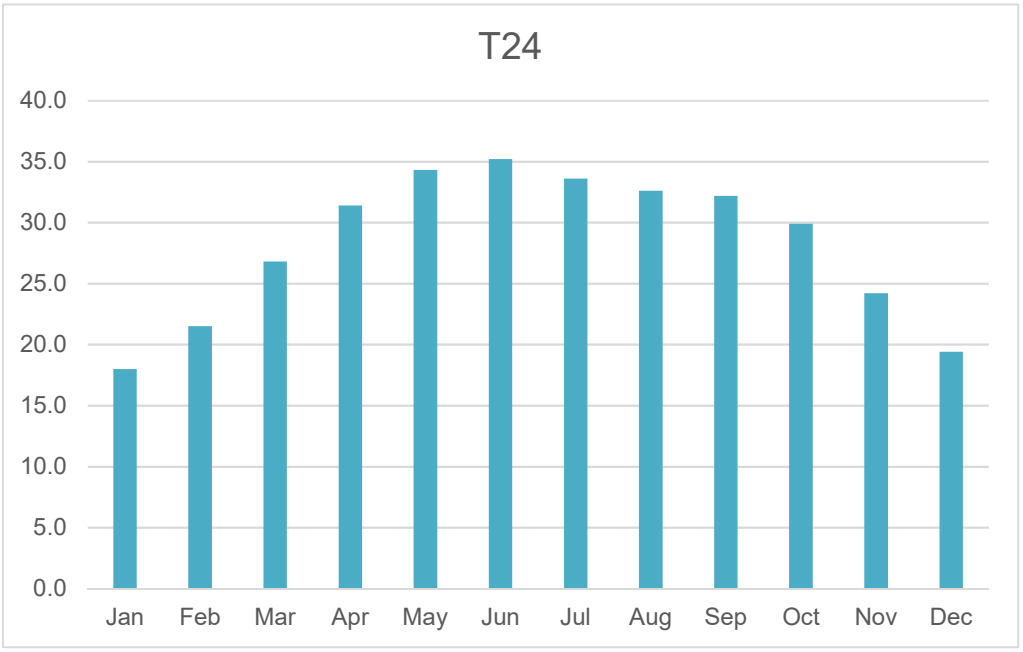


Fig 10 showing Average diurnal (24 hour) air temperature at 2 m

2.2.11 Site Access

Jamshoro solar farm site is located on the Hyderabad Karachi Motorway M-9. The site can be accessed directly from the Motorway M-9. A triple surface treatment road will be constructed, which will be used later during the operation and maintenance stage.

2.2.12 Road types

Hyderabad Karachi Motorway M-9 is the main artery and primary road through which site will be accessed.

S.No.	Road Type	Name
1	Primary	M-9
2	Secondary	Access Road

Makran Coastal Highway is a multiple carriageway road for one-way traffic. The road width is sufficient to cater the heavy traffic vehicles.

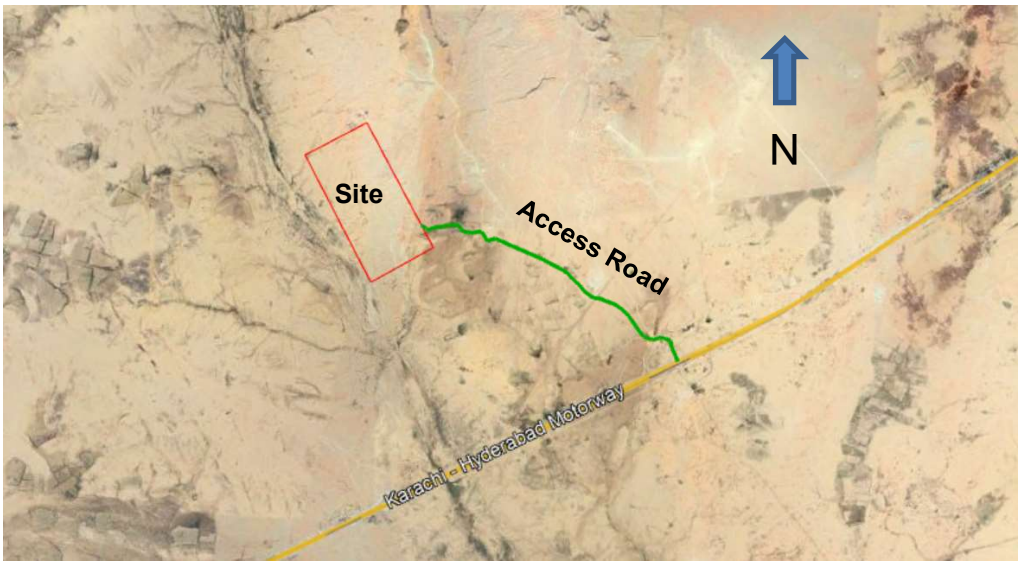


Fig 11 showing connectivity of the site through M9

2.2.13 Site boundary

Before ibvogt Gmbh site visit, Land Revenue Department Govt. of Sindh already did the identification of the red line site boundary for solar project. The first session of site visit was a desktop assessment and second session comprised of:

1. Viewing solar farm site from a high surveillance point
2. Walking on the site

2.2.14 First Session

A desktop assessment (DSA) was carried out by ibvogt technical team and site was checked against all the National and local planning designations. The DSA showed that site does not lie in areas of outstanding natural beauty, green belt, National Park or located near to a site of special scientific interest. Also the site is not classified as prime agricultural land and no crop can be cultivated on the land. As the site is part of the Bare area and deciduous shrub cover in country landscape mapping, hence most of use surrounding solar farm is desolated or of low agricultural activity. Jamshorosolar farm is also located in rural area and the project will support the rural economy. An economic analysis was carried out for the project, which showed that the solar project will create more than 300-800 jobs during the construction and 50-100 permanent jobs during operation of the solar project. Also project will have positive impact on the local construction activity as most of the raw material during the construction will be purchased from the local market. Overall project will contribute towards the growth of the rural economy.

Fig 12 showing landscaping characterization of Pakistan and location of Jamshoro solar farm. Proposed site is Characterized as Bare Areas & Deciduous Shrub Cover, in Landscape characterization map of the country.

2.2.15 Second Session:

The second session comprised of the site visit and started in collaboration with the local Patwari (Revenue Department official). During the visit whole of the site is viewed from a high surveillance point. From that point whole site was viewed and it was noticed that site is generally flat and comprises of some undulating parcels.

Fig 13 showing the area which are relatively flat

A detailed reconnaissance survey was then carried out. Site usually has relatively flat topography and almost no vegetation cover on the top. Topsoil shows that site is suitable for ramming of profiles but a detailed Geo Tech study would be required for detailed design of foundations.

Fig 14 showing areas with undulating terrain

The site has relatively undulating terrain towards the northern boundary of the site and during construction initial grubbing along with relatively light earth work would be required, for site leveling.

As the topsoil of the site is loose, hence after levelling initial compaction would also be required, which will affect the civil works cost of the project. Comparatively higher civil costs would be expected, for which an estimated number should be kept in the civil work costs.

Fig 15 showing the proposed redline boundary for detailed Geotech study

2.3 Surrounding Land use

The site itself has power generation use and surrounded by Bare Areas, and deciduous shrub cover as per landscape characterization map of the Country. A small industry is located within 5 km radius of the site toward North West corner of site boundary.

A swale is also passing near to western boundary of the site. The swale will work for the site as, a natural drainage option during the event of the rain. Few numbers of Agricultural fields are also present towards the North West boundary of the site.

M9 motorway is also present within 5km radius of the site and along the M9 motorway two small lay bays are also present which used for refreshment purpose for drivers travelling on the Karachi – Hyderabad Motorway.

Proposed site do not have any residential use within 5KM radius; hence, the solar development will have zero social impact. Considering the poor environmental quality of the proposed land, the environmental impact is also negligible.

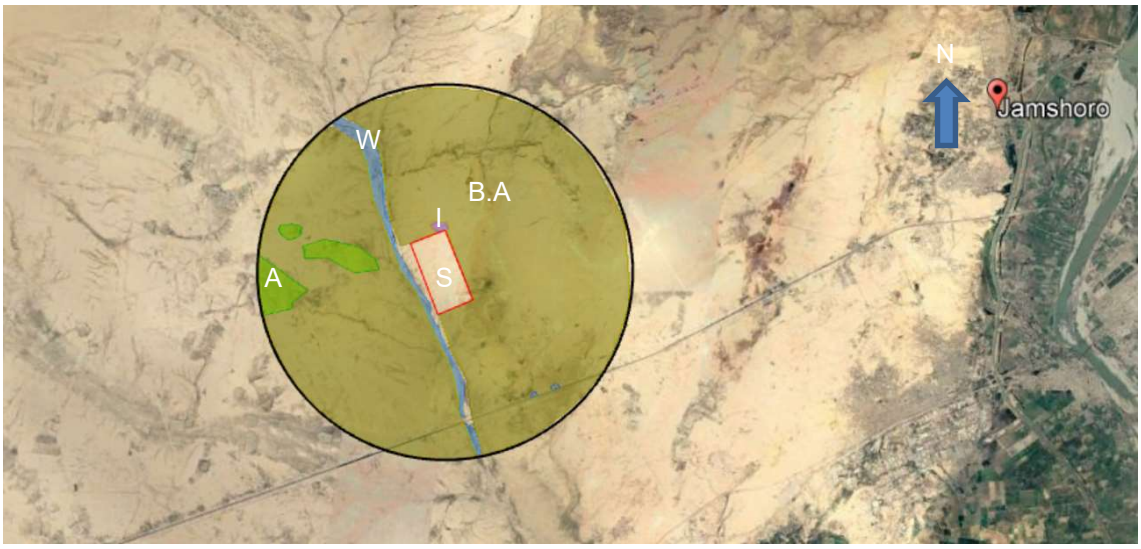


Figure 16 showing the major land uses around the site in 5KM radius

B.A	= Bare Areas, and deciduous shrub cover as per Country Land Characterization Map
I	= Industrial Use
W	= Swale
A	= Agricultural Use

Site is also not located in the area of outstanding natural beauty, and do not have National or local planning designation making it ideal for solar farm development.

2.4 Existing Land use

The site does not have any distinctive land use. In Country's Landscape Characterization Map, the land is Characterized as Bare Land and deciduous shrub cover which shows land doesn't have any quality use and makes it suitable for a clean energy generation project.

2.5 Topography

The topography of the site is predominantly flat which makes it suitable for development of solar farm development. The site generally slopes from North to South and very gradual slope from east to west.

A grade analysis has been carried out at points of highest level difference to check the gradient of the slope in redline boundary of the site for solar farm.

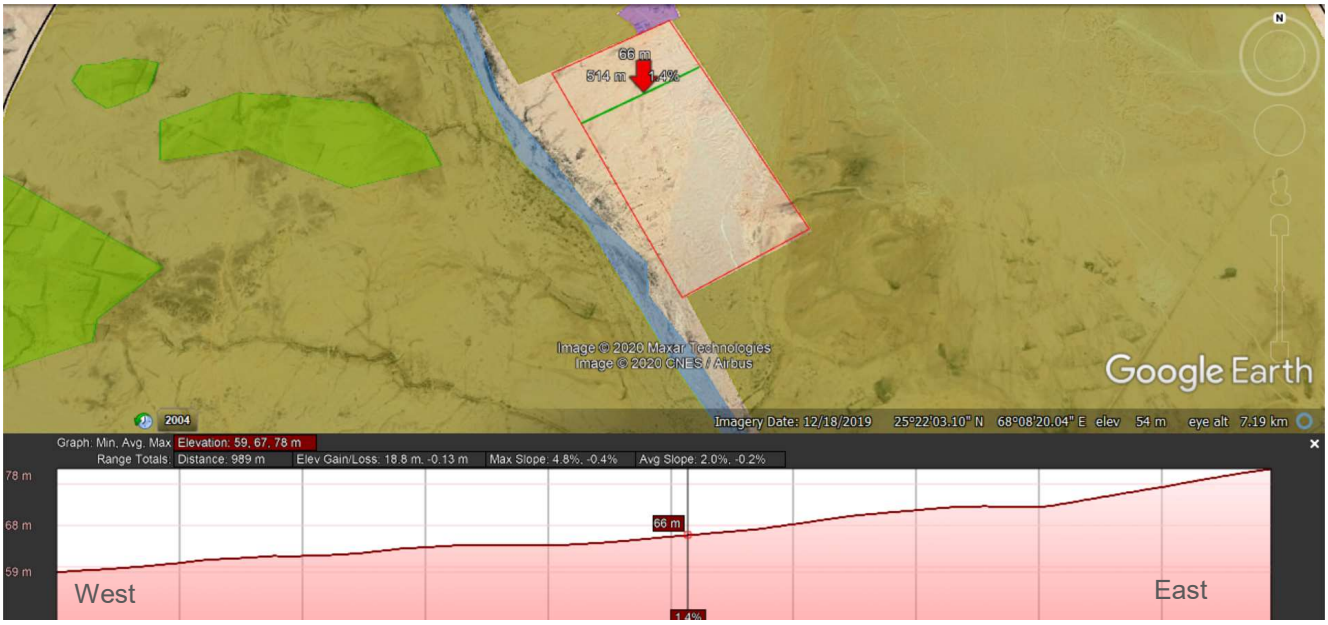


Figure 17 showing the section through site and gradual fall of terrain toward west, average slope 2%

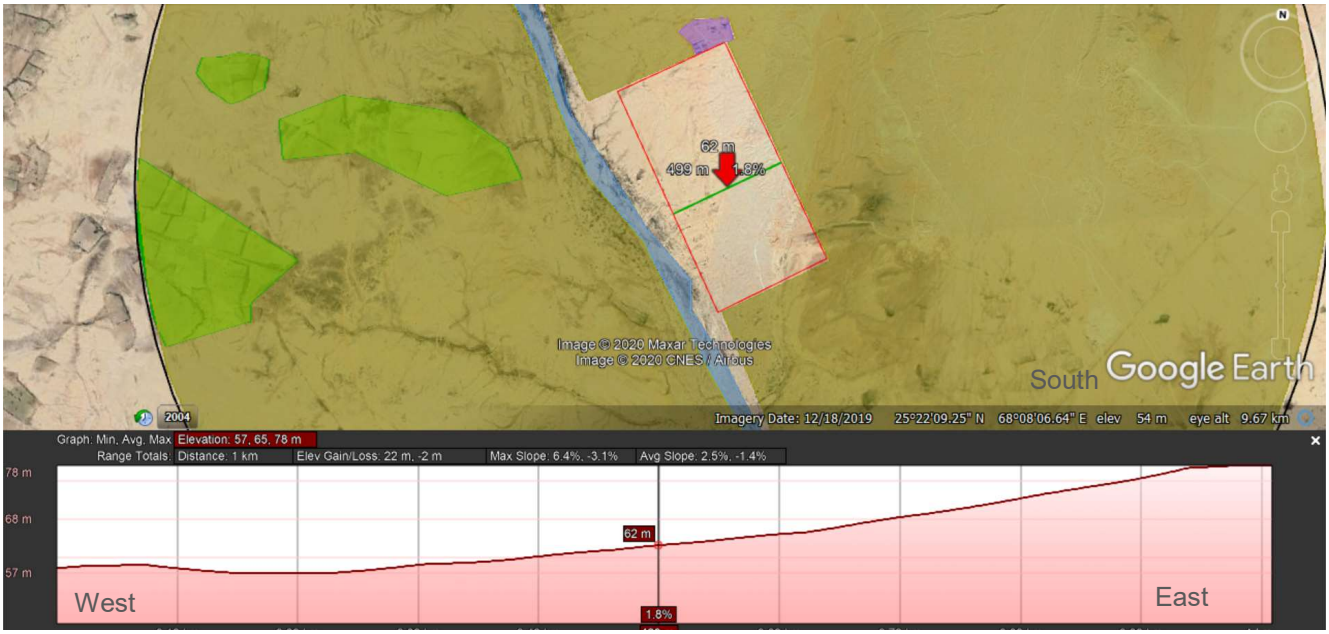


Figure 18 showing the section through the site and showing gradual fall of terrain towards west with average slope of 2.5%.

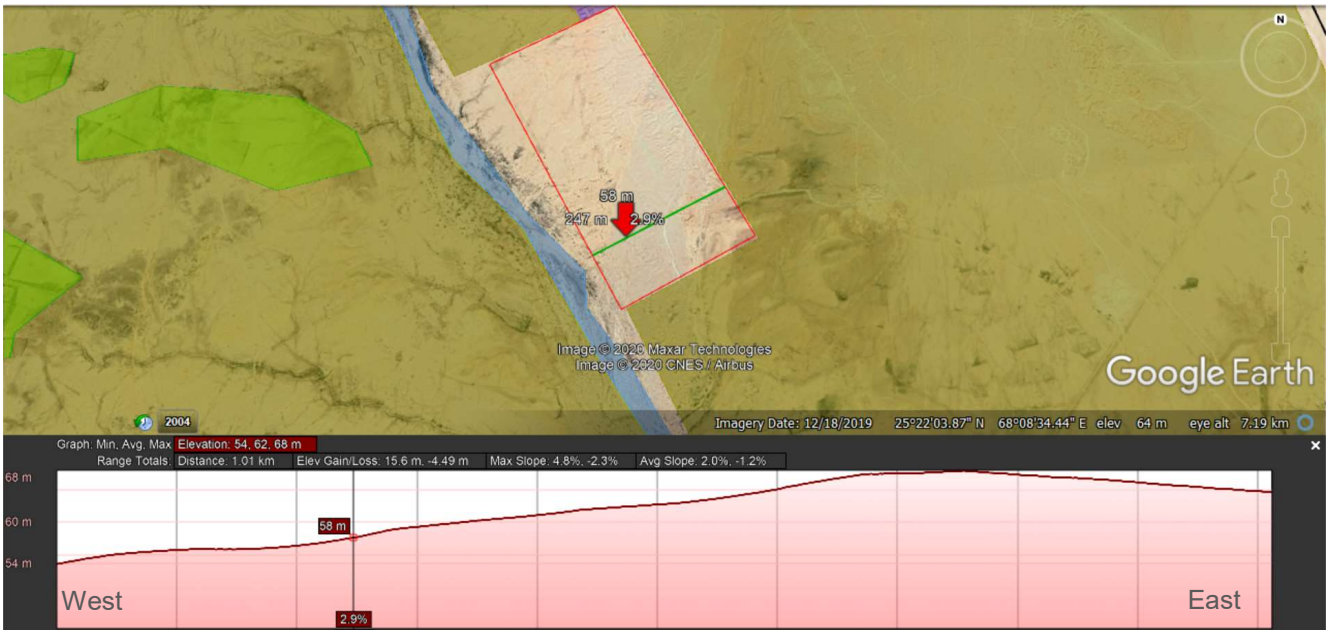


Figure 19 showing section through the site and average slope of 2%. As the trackers will be installed on the site hence the section shows that reverse slope phenomenon will take when solar panels will be facing east.

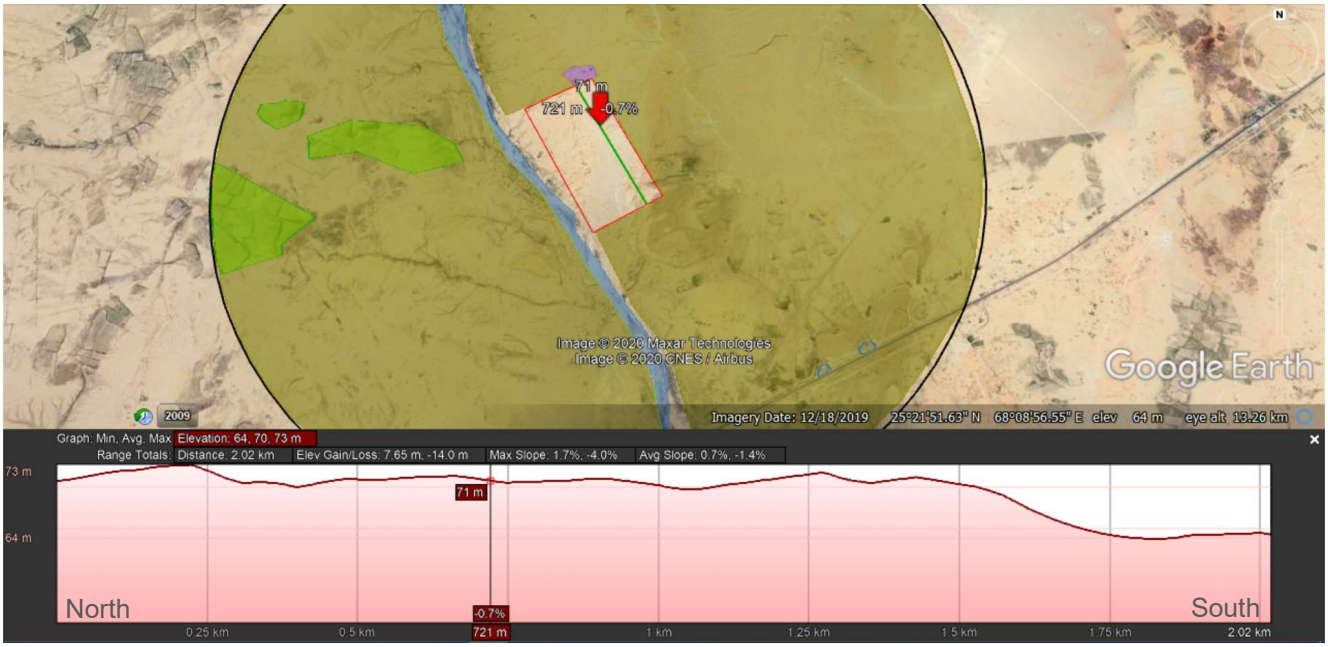


Figure 20 showing section through the site from north to south and undulating terrain that will require earthwork. Average slope through the section is 0.7%.

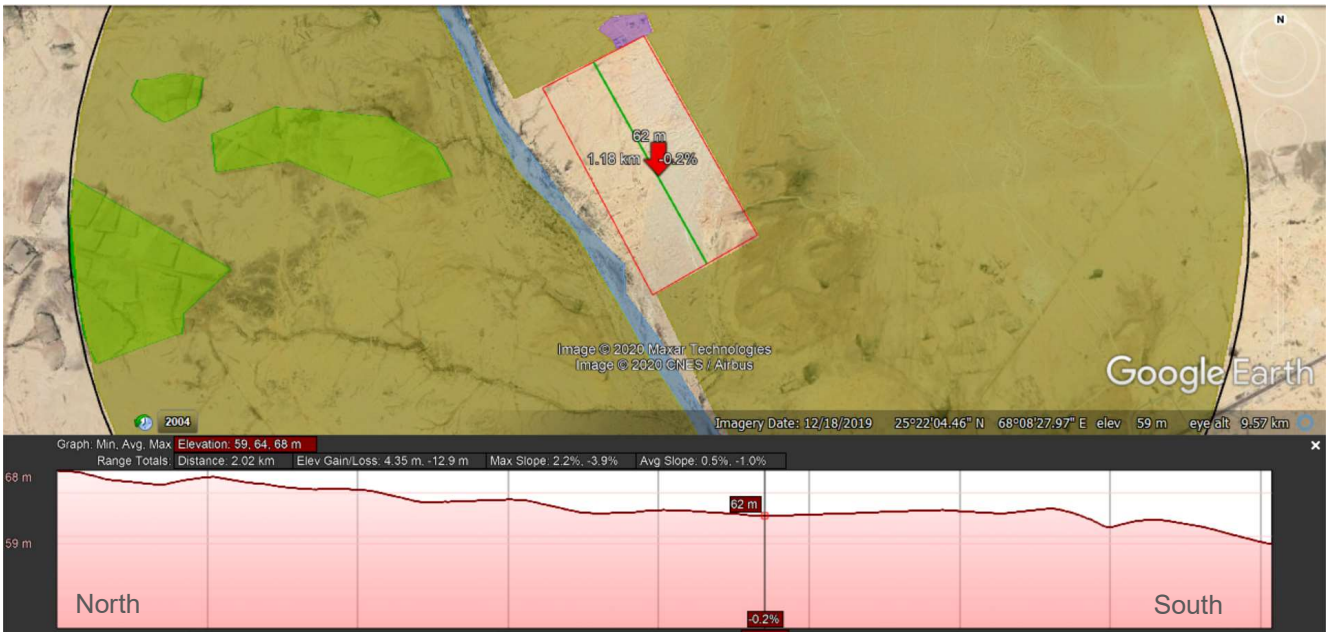


Figure 21 showing section through the site, predominantly flat and gradual drop in terrain towards southern side of the boundary – average slope 0.5%

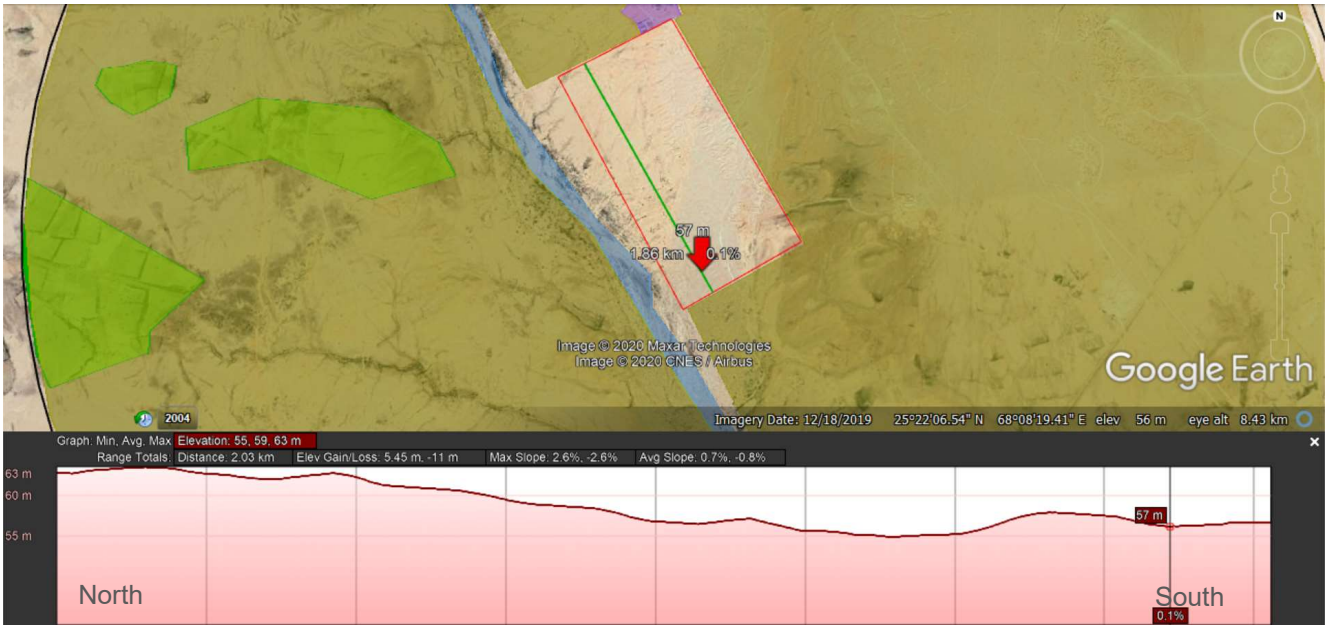


Figure 22 showing section through the site, very gradual undulation – average slope 0.7%

2.6 Flood risk

The site has its natural drainage pattern and quite few natural Nullahs / swale /rain water drains are passing through site. Incorporating the natural drainage pattern of the site into the design will reduce the risk of flooding on the site.

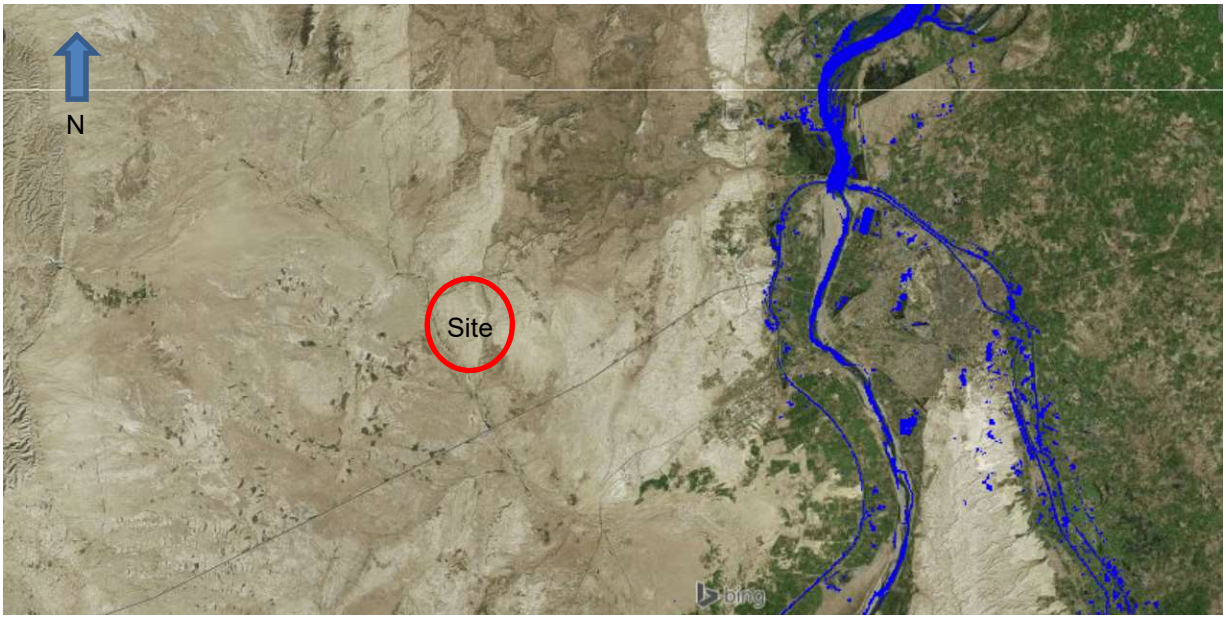


Fig 23 showing flood risk map shows Jamshoro solar farm site is not located in a Flood Plain

Currently site is free from a flood risk and lies out the flood plain of Jamshoro Sindh.

The National Disaster Management flook risk map shows that site has risk of flash flooding and is located closer to the exisitng natural drains. Small natural water channels already present on the site are best suited as drainage channels during the event of rain.

Due to undulation, there is a potential of onsite ponding and the phenomenon noticed frequently during monsoon season. As the solar farm development, usually do not have any adverse impact on the surrounding, but sometimes the angle of solar panels can increase the velocity of surface water runoff and can cause flooding somewhere else. Hence, a separate flood risk assessment may be commissioned before construction.

Natural drainage pattern of the site shows that most of the time the surface water runoff will be moving towards south and west along the natural slopes of the site.

The flood extent of 2010-2018 also shows that site is free from any river flooding and located out the flood plains of Sindh.

2.7 Shading

Shading is one phenomenon, which can affect the efficiency of the solar panel. Only 10% area of the panel in shade can result in 50% loss in the efficiency of the solar panel. 500KV pylons passing through the site and small trees are the prominent heighted features, which can cause shading of the solar panels. A buffer zone will be kept around the 500KV pylons, to avoid the shading of the solar panels. The site topography has been considered flat, during the design, and still to avoid the impact of the shading on to generation, the solar panels with fitted by pass diode will be used for the installation.

Figure 24 showing 500KV pylons and trees on the site as heighted features.

The other form of shading that can affect the power generation is from solar panels themselves. For large scale, solar farms, solar panels are usually arranged in two in portrait or four in landscape at an optimum tilt angle, usually 15-25 degrees depends on the angle of sun. Usually height of the solar arrays ranges between 1.5 – 2.5 m. Single Axis trackers will be used hence the array will rotate 60 degrees to the horizontal plane either way (east or west) and tilt angle for solar array will vary from 0-60 degrees depending on sun angle.

Sufficient land is available for the solar farm generation. Hence the shading distance between the arrays will be maxed out, to avoid any form of shading from the solar arrays.

2.8 Existing features

Lot of small shrubs and bushes are present on the site. 500KV pylons, tracks, Trees and natural drians are the main existing features on the site. No distinct flora and fauna have been noticed on the site.

2.9 Utility connections

Electricity and gas are easily available on the site. Due to high water table, a fresh water tube well can be quarried. Same water will be used for cleaning of panels during O&M stage of the project.

2.10 Wind Direction and Speed

The predominant wind direction is Western and South West. The average wind speed is 6.2 m/s. The max wind speed recorded in the area is 9 m/s. (Weather Data file can be seen as Annexure E)

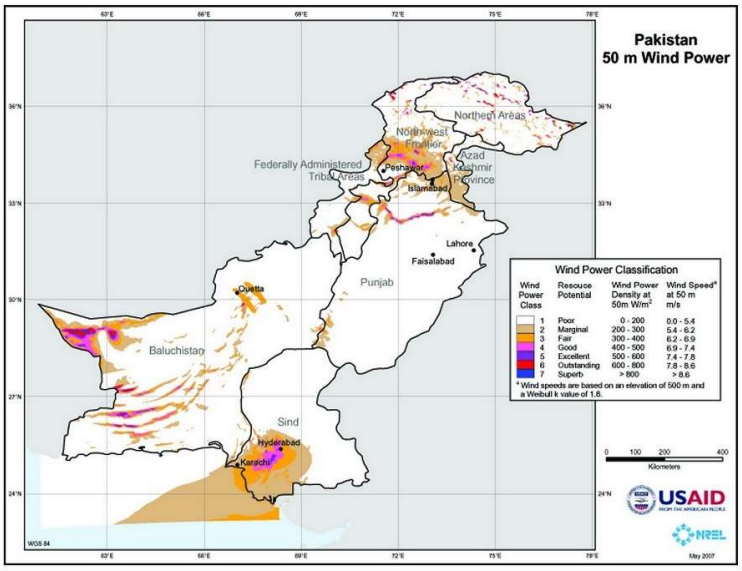


Figure 25 showing wind resource available in the area.

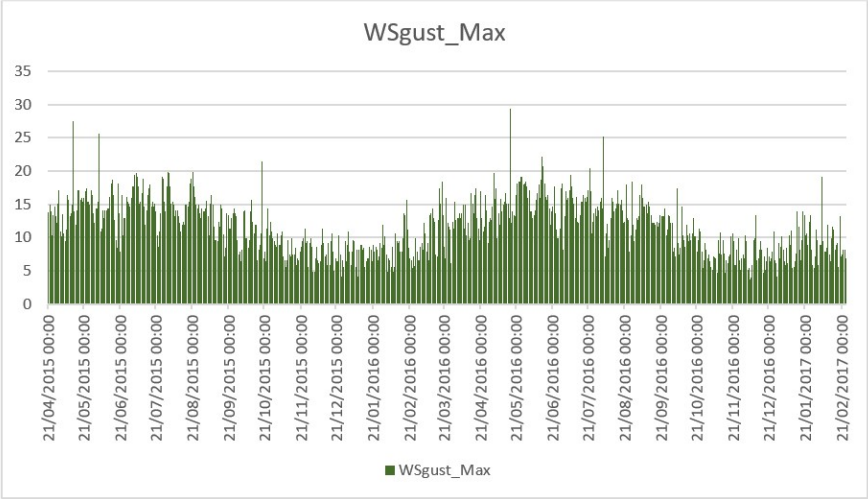


Figure 26 showing actual Wind Gust data of the site for year 2015, 2016 & 2017. Max Wind Gust speed recorded in these years is 29 m/s.

The mounting structure used for the site is designed in a way to withhold the wind speed of 47 m/s and above – detailed data sheet of Mounting structure also attached as Annexure F.

US AID Pakistan Wind Resource Map also shows that site is located in Jamshoro region and wind resource is Fair in the area where Jamshorosolar farm is located.

2.11 Legal status of site

Govt. of Sindh revenue department, after approval from the Competent Authority allocated the land in Jamshoro for development of Solar Farm, after the issuance of LOI from the Sindh Energy Department. The lease order has already been issued by Land Revenue Department, Govt. of Sindh and Sindh Energy Department has already written a letter to Member Revenue Board for its renewal.

2.12 Way leave issues

The project will be connected by making an In/Out on 132KV Single circuit b/w PAF Jamshoro Old Grid Station by a Feed Length of 7 km of Lynx Conductor. The construction of 7km 132KV line is HESCO scope of work and any wayleave issue will be dealt by the HESCO.

2.13 Underground cables and pipeline

The desktop assessment shows that site don't have any underground cables or gas pipes. The local utility will be consulted before the start of the construction to make sure, that project civil work will not cause any harm to the existing infrastructure. Proposed solar farm site is owned by Govt. of Sindh, hence during the site visit it was shared by the Land Patwari that there are no underground oil or gas pipes passing through the site. Most of the existing features have been demarcated on the topographical survey.

2.14 Fiber optic cable

For monitoring purpose SCADA communication system will be installed in the control room. All the PV MW blocks will be connected with CR via underground fiber optic cable (F.O.C). No existing underground fiber cable encountered.

2.15 Environmental Impact Assessment

As per Sindh Environmental Protection Agency regulations, the solar farm sites below 100MW will not require any EIA and will only be liable to submit an Initial Environmental Examination report.

Initial desktop assessment shows that, there will be no impact on the flora & fauna of the area since there is no established grazing land, national parks, protected wild life zones or bird sanctuary present near the solar farm. The site has also been examined from Noise, Shadow and Visualization Impact Angle. The results show that there would be no adverse impact of Noise, Shadow and visualization on nearby dwellings. The land is also free from resettlement issues since it is a holding of Govt. of Sindh Revenue Department and now under use of F1 Solar PK Pvt Ltd.

The desktop based land use assessment also showed that there wasn't any prime use of the land and there isn't any special planning or environmental designation recorded on the site after 2008 till to date. As per Sindh EPA, IEE would be required for the project.

2.16 DNO connection

The proposed site location has been discussed and analysed with respect to power evacuation and grid Interconnectivity point of view. The Jamshoro area lies in Hyderabad Electricity Supply Company (HESCO). The proposed site is located almost 18km away from Old Jamshoro 132/11 KV grid and almost 25km from PAF 132/11 KV grid. The project will be connected by making an In/Out on 132KV Single circuit b/w PAF Jamshoro Old Grid Station by a Feed Length of 7 km of Lynx Conductor.

The proposed interconnection scheme has been tested for steady state, short circuit and transient stability conditions through detailed technical studies after the commissioning of Solar Power Plant.

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

From line capacity point of view, transmission lines have enough capacity to carry this power. In-fact the thermal stress on transmission line will be reduced because this 100MW plant which will give support to active and reactive power. Hence the frequency and voltage profile will be improved.

3. Planning Policy Statement

This chapter provides a brief outline of the planning policy information applicable to the project with emphasis on renewable energy policy and climate change. The current Government have attached substantial importance to the continued development of renewable energy sources and their renewable energy policy sets the context for the determination of planning applications. The policies outlined in this statement clearly indicate that considerable planning weight should be attributed to these policies.

The Renewable Energy Policy 2006 revised in 2009 provides the support for the development of RE projects in Pakistan.

3.1 International Policy

Climate change became a prominent issue in the 1980s and in response to this the United Nations adopted a resolution on the 'Protection of global climate for present and future generations of mankind'.

The United Nations Framework Convention on Climate Change (UNFCC 1992), the Kyoto Protocol (1997) and 2015 Paris Accord committed parties to individual, legally binding targets to limit or reduce their greenhouse gas emissions. One hundred ninety two (192) Countries signed 2015 Paris Accord and Pakistan is its signatory.

The Stern Review warned, *"Delaying action, even by a decade or two, will take us into dangerous territory. We must not let this window of opportunity close".* The review highlights the importance of acting now to reduce carbon emissions. In the short term renewable energy is one of the main options for reducing carbon emissions.

The 4th Assessment Report of the IPCC (Intergovernmental Panel on Climate Change) raised the possibility of the Earth's temperature rising well above the ceiling quoted in earlier accounts and giving rise to severe consequences such as the collapse of the Greenland ice sheet and disruption of the Gulf Stream Ocean current.

A 'roadmap' towards a new climate deal in which developed and developing countries are legally bound to reduce their carbon emissions was the agreement born out of the United Nations Climate Change Conference 2011, Durban. The terms of the agreement are to be drawn up by 2015 and come into effect by 2020.

3.2 European Policy

The European Climate and Energy Package12 (2007) aims to further improve energy security and reduce carbon emissions. The package sets out the following climate and energy targets that are to be met by 2020:

- A reduction in EU greenhouse gas emissions of at least 20% below 1990 levels;
- 20% of EU consumption to come from renewable resources;
- 20% reduction in primary energy use compared with projected levels, to be achieved by improving energy efficiency".

These targets are known as the 20-20 targets. EU leaders have agreed to increase Europe's emissions reduction target to 30% if a global climate agreement can be achieved. To achieve the EU renewable energy, target each member state has agreed to an individual target.

3.3 Asia Pacific Renewable Energy Targets

Burgeoning energy demand, limited fossil fuel reserves, and global warming concerns have forced countries in the Asia-Pacific region to increase the share of renewable energy in their energy mix. The region has made significant investment in renewable energy projects in recent years, and this is expected to continue in future. Many countries have adopted policy instruments such as Feed-in Tariffs (FiTs), Renewable Portfolio Standards (RPS), soft loans and tax incentives to promote renewable energy. Most of the government measures that have been introduced have received a positive response and have played a vital role in the development of the renewable energy industry.

Investment in renewable energy projects increased following the introduction of the Kyoto Protocol in 1997. This protocol sets binding obligations for industrialized countries to reduce greenhouse gas emissions by 5% against 1990 levels by 2012 (the first commitment period) and by 18% against 1990 levels by 2020 (the second commitment period).

Australia, Japan and New Zealand have signed the Kyoto Protocol, thereby committing to the reduction of carbon emissions. India and China, as participants in the Copenhagen Accord in 2009, pledged to work towards respective binding carbon intensity reduction targets of 20–25% and 40–45% by 2020, in comparison with 2005 levels.

China is rapidly becoming a major player in the global renewable energy industry. In recent years, the country has developed its wind turbine and solar Photovoltaic (PV) manufacturing industries. The government has shown commitment to renewable energy through the introduction of a series of new laws and financial support measures.

India and Australia have also implemented several support measures for the development of renewable energy; the efficiency with which these measures are implemented will determine future growth in both countries. The new programs related to solar power development announced in India are expected to significantly increase the share of solar power in the renewable energy portfolio. The Japanese government has shown commitment to renewables through the introduction of a FiT for renewable energy. It also announced plans to entirely rebuild its energy policy following the Fukushima nuclear disaster in March 2011. The policy now recommends gradually reducing dependence upon nuclear power while enhancing the share of renewable energy and efficient fossil-fuel power generation.

Thailand, which has announced several measures to support the growth of its renewable industry, is aiming for renewable energy to account for a 25% of overall power within the next 10 years. In 2019 Govt. of Pakistan has identified RE Targets, which aims to generate 25% of energy from RE projects by 2025 and 30% by 2030 and have got a policy frame work in place to support the RE projects in Pakistan.

3.4 National RE Policy 2006

Pakistan has a tremendous renewable energy potential. Ministry of Water and Power in 2006 published RE Policy which encourages the deployment of wind, solar, hydro and biomass projects. The policy provides the detailed process and guidelines for development of RE project in Pakistan. Salient feature of 2006 RE policy are as follow:

i. It invites investment from the private sector for following categories of proposals: a. Independent power projects, or IPPs (for sale of power to the grid only) b. Captive cum grid spillover power projects. (i.e., for self-use and sale to utility) c. Captive power projects (i.e., for self or dedicated use) d. Isolated grid power projects (i.e., small, stand-alone)
ii. Except for Category (a) above, these projects will not require any LOI, LOS, or IA from the Government.
iii. Electricity purchase by NTDC/CPPA from qualifying renewable energy-based generation projects has been made mandatory.
iv. It permits an investor to generate electricity based on renewable resources at one location and receive an equivalent amount for own use elsewhere on the grid at the investor's own cost of generation plus transmission charges (wheeling).
v. It allows net metering and billing so that a producer can sell surplus electricity at one time and receive electricity from the grid at another time and settle accounts on net basis. This will directly benefit the economics of small scale, dispersed generation and optimize capacity utilization of installed systems.
vi. It delicenses and deregulates small scale power production through renewable resources (up to 5 MW for hydro and 1 MW for net metered sales) to reduce the transaction costs for such investments. This will be particularly beneficial for micro, mini and small hydro as well as solar-based electricity production.
vii. It lays down simplified and transparent principles of tariff determination.
viii. In insulates the investor from resource variability risk, which is allocated to the power purchaser.
ix. It facilitates projects to obtain carbon credits for avoided greenhouse gas emissions, helping improve financial returns and reducing per unit costs for the purchaser.

Table 7 showing salient features of RE Policy 2006

These guidelines are in line with the Government's open door policy for inviting private investment into the country." Projects with Govt. PPA are developed under same RE Policy.

The brief of development process is as follows:

S.NO.	O&M	Typical Allowance (Days)
1	Submission of proposal on raw site by sponsors	-
2	Review of proposal and qualification of sponsors by AEDB/Provincial/AJK Agency	30
3	Posting of Bank Guarantee by sponsors	15
4	Issuance of Letter of Intent (LoI) by AEDB/Provincial/AJK Agency	7
5	Initial time allowed to carry out feasibility study and term of the LoI.	Based on schedule submitted by IPP, subject to maximum of 18 months
6	Tariff negotiations with power purchaser and approval of tariff by NEPRA (the time can be significantly reduced if up-front tariff is accepted by IPP)	90
7	Submission of Performance Guarantee by sponsors upon approval of tariff by NEPRA	15
8	Issuance of LoS by AEDB/Provincial/AJK Agency	7
9	Financial close	365

Table 8 project development process as per policy 2006

Note:

LOI to proposed solar farm development was awarded by Sindh Energy Department, Govt. of Sindh. Hence project will be developed under Policy for Development of Renewable Energy for Power Generation 2006 ("Policy"). LOI extension copy attached here as Annexure L.

In 2019 Govt. of Pakistan has identified RE Targets, which aims to generate 25% of energy from RE projects by 2025 and 30% by 2030 and currently working on 2019 RE Policy for development of renewable energy projects in Pakistan.

4. Desktop based Environmental and Social Impact Assessment

Sindh Environmental Protection Act 2014 (SEPA 2014) requires the proponents of every development project in the country to submit either an Initial Environmental Examination (IEE) or Environmental Impact Assessment(EIA) to the concerned environmental protection agency. As per regulation all the developments that require IEE or EIA are categorized into two types Schedule I and Schedule II developments. The energy project (hydro generation) above 50MW require an EIA and energy project (hydro generation) below 50MW will require an IEE. As per Schedule I development, an Initial Environmental Examination (IEE) will need to be carried out to demonstrate that the impact on the environment and local communities is acceptable and that the Project complies with national environmental laws and regulations. The proposed solar plant will require an IEE which shall be carried out by an environment expert and the IEE study approval shall become part of this Feasibility Study as Annexure I.

If the Project require at any stage, international financing than it will need to demonstrate compliance with the requirements of International Financing Institutions, such as Development Agencies and Banks. This is generally achieved by following the International Finance Corporation's (IFC) Performance Standards on Social and Environmental Sustainability, and Industry Sector Guidelines. The standards relate to various elements of social and environmental assessment and management, summarized as follows:

Performance Standard 1· Assessment and Management of Environmental and Social Risks and Impacts

Performance Standard 2 Labor and Working Conditions

Performance Standard 3 Resource Efficiency and Pollution Prevention

Performance Standard 4 Community Health, Safety, and Security

Performance Standard 5 Land Acquisition and Involuntary Resettlement

Performance Standard 6 Biodiversity Conservation and Sustainable Management of Living Natural Resources

Performance Standard 7 Indigenous Peoples

Performance Standard 8 Cultural Heritage

The IFC Performance Standards are reinforced by the Equator Principles (EPs), a credit risk management framework for determining, assessing and managing environmental and social risk in Project Finance transactions. As Lenders for this type of project are generally Equator

Principles Financial Institutions (EPFIs). It is likely that adherence to these Principles will be required.

A gap analysis between the IEE produced for the Project and compliance with the IFC Standards and EPs would identify additional issues that should be addressed to reduce risk to the project and to help safeguard the project against any environmental and social uncertainties. This analysis will produce an Environmental and Social Action Plan (ESAP). Listing actions are required to meet the various standards.

These actions would form part of a Condition Precedent issued by the lender and can be addressed as financing proceeds. Thus, incorporating these standards is unlikely to result in delays to the project or prohibitive costs.

The principal impacts of a solar development are dictated by the specific nature of the site, and usually limited to the following key impacts and issues:

- landscape and visual impact
- Ecological impact
- Hydrological impact
- change in land use
- construction impacts
- employment opportunities

4.1 Environment

Solar farm development is temporary development in nature, and has minimal impact on surrounding. The solar panels are passive in nature and do not generate any harmful emissions. Almost 0.3m high from the front and 4.5m high from the back, make the vegetation grow well and sheep grazing is easily possible. Solar farm generates electricity by using the solar irradiations and don't require fossil fuel for most of its operation, which makes it zero carbon development. In addition, the production of electricity from a renewable source will make a significant contribution to reductions in Greenhouse Gases (GHG) emissions over the lifetime of the Project. The solar farm will have energy generating capacity of approximately 100 MW and will generate enough low carbon renewable electricity to meet the demands of more than 62748 homes a year.

Solar Project Generation in MWhr = 2202*100 = 220,200

Combined Margin Emission Factor $_{grid, CM, y}$ = 0.6343 tCO_{2e}/MWh.

Carbon Emissions savings = Solar Project Generation X Combined Margin Emission Factor $_{grid, CM, y}$

= 220200 MWhr X 0.6343 tCO_{2e} / MWh

= 139,672.86 tCO_{2e}

The principal environmental and social aspects identified as part of our early observations are outlined below for the proposed project site, with a brief statement regarding possible mitigations that have been identified at this early stage.

4.2 Ecological Impact

The proposed solar farm site is not a prime agricultural land and don't have any record of threatened flora and fauna. Not a single endangered tree species has been found over the site, only the Native bushes are present on distant locations.

The site has mainly perforated rocky strata at and below the surface, which is not suitable for a quality green cover.

4.2.1 Flora

The flora of the area is governed by the type of soil and the amount of moisture available. As it is an open uninhabited area, so no particular flora is present. Only some bushes are present at the project site. The project site itself is a barren land but the natural vegetation around the site is comprised of few scattered bushes and trees.

4.2.2 Fauna

The wildlife in the area has been affected by colonization of the area and many wild life species have either diminished or vanished. Most of the domestic fauna are in the vicinity of the Project Site. Terrestrial fauna of the area includes cats, jackals and dogs. Domestic animals like cow, buffalo, goats, sheep, donkey and horses are also found. The bird community, found in the area, includes variety of residential birds such as sparrows, crows, parrots etc. Small squirrels, rats and snakes are also found in the area.

4.3 Cultural Heritage

The site is in Jamshoro Sindh and mostly has desolated land use in the surrounding. The site doesn't have any other historic building in the surrounding. Hence site setting will not be affected by the development of solar farm and history of land use of the site shows that site is free from any kind of archeological findings. The desktop assessment clearly demonstrates that the solar farm will not have any cultural or heritage impact.

4.4 Landscape and Visual

The site and surrounding area are characterized by an overall flat topography, with no elevated areas in the vicinity to give significant views of the development. The closest settlement to the proposed site is a residential area in southeast direction of the Jamshoro power plant. The closest settlement near to the solar site is located almost 10 km away from the site in southeast direction, called Khuda Ki Basti. Being located away from the site, residential area is located at low elevation and because of distance from solar plant, it is highly likely that residents will overlook the site. The undulating nature of the topography will screen the site from any potential views. As the only residence located near the site is in the

southeast direction, and due to topography the site will be naturally screened, hence there will not be any Glint and Glare impacts. The landscape character of the area is not outstanding and has been designated as Bare Area and deciduous shrub cover in Landscape Characterization Map of the Country. Hence development of solar farm will not deteriorate the surrounding environment and landscape. With proper landscaping plan, the existing character of the area can be strengthened.

4.5 Site Land Use

Prior to development of solar farm, the site was predominantly of infertile character without having any quality agricultural activity. The development of solar farm will not result in the change of use, as site existing use is desolated land. Thus, there will be no loss of existing agricultural land or displacement of any users of the land. The installation of the solar power plant would provide income from a site which was previously unused and non-productive.

4.6 Hydrology and Water Use

The major surface water source in the area is nearby Kotri Barrage. The primary source of water provided at site is through tankers. Water is obtained from tube wells, canals and underground sources. For the proposed site, contract with local supplier is already in place. However, for drinking purpose, filtrated water is used through filtration plant.

The major sources of the groundwater in the area are hand pumps, pressure pumps and tube wells. The main source of drinking water in the area is groundwater, which is pumped through hand pumps, pressure pumps and tube wells. The ground water recharge will not be affected, as only 40% of the site area will be covered with solar panels and mounting structure will not cause any stoppage of water during any event of recharge.

4.7 Transport and Access

Jamshoro solar farm site is located on the Hyderabad Karachi Motorway M-9. The site can be accessed directly from the Motorway M-9. A triple surface treatment road will be constructed, which will be used later during the operation and maintenance stage.

Hyderabad Karachi Motorway M-9 is the main artery and primary road through which site will be accessed.

S.No.	Road Type	Name
1	Primary	M-9
2	Secondary	Access Road

Makran Coastal Highway is a multiple carriageway road for one-way traffic. The road width is sufficient to cater the heavy traffic vehicles.

The current development of solar farm will only generate the traffic during the construction period which will last for six months' maximum. During the operation, the only small LTVs will be carrying out the maintenance jobs. After construction HTVs will visit the site in case

of replacement of major part / equipment like inverter, which usually happens for once during whole project life.

4.8 Waste Management

To reduce the waste generated from the construction of the development there will be waste recycling and re-using initiatives in place. Four waste containers will be on site; one for the recycling of paper and cardboard, and the other for the recycling of wood. Several containers will be needed during the installation to store panels as they are constructed. Earthwork materials arising from the construction process will be stored and re-used on site. It should be noted these quantities will be minimal. This will avoid the need to import and export material. To minimize damage to soil structure all top and sub soil will be handled and stored carefully. It should be noted these quantities will be minimal. Site office waste will be collected in separate bins to allow for recycling. Recycling bins will allow for cans, bottle and paper. Paint spray cans, used for surveying, will be logged when issued so that it can be ensured all are disposed of properly. Wastewater from the portable toilets and washing facilities will be discharged into sealed containment systems and disposed of by licensed contractors.

4.9 Social

The solar project should also place emphasis on Corporate Social Responsibility. Targets and commitments should be made with regards to issues such as local spend for both the construction and the operation phases, as well as commitment to a community trust, targeting further priority issues such as education or training projects.

The land on the proposed site is not currently occupied by any tenant farmers and, being located within the existing power plant security perimeter, is not in unofficial use by any of the local population. No physical or economic displacement will therefore result from the development.

4.10 Environmental and Social Management

4.10.1 Impact Assessment

Solar PV plants are currently classified in Schedule I of Sindh Environmental Protection Act 2014. The development of the proposed Project is very unlikely to cause any negative effect on the surrounding environment and as the Project falls within the Schedule I for which only the IEE is required as part of the planning and approval process.

The IEE provides a description of the environmental and social setting of the development, an assessment of potential impacts and recommendations for mitigation measures.

4.10.2 Environmental Management Plan

Although it is expected that the Project will be established using local/foreign financing mix, and it is recommended to comply with IFC Performance Standards, which are considered

industry best practice and demonstrate ongoing and responsive management of all potential social and environmental impacts throughout, both construction and operational phases, in line with the principles already established at ibvogt other power plant. A key requirement in this regard is the provision of an Environmental Management Plan (EMP). The EMP for the solar project is set out in Section 6 of the IEE, describing mitigation and management measures for the development and allocating responsibilities for the measures proposed.

4.10.3 Stakeholder Engagement Plan

Stakeholder engagement is an essential element of a robust environmental and social assessment and is a key lender requirement, e.g. Principle 5 Stakeholder Engagement, of the Equator Principles, and IFC Good Practice Handbook for Stakeholder Engagement. The general stakeholder process is as follows:

- To identify people or communities that are or could be affected by the project, as well as other interested parties
- To ensure that such stakeholders are appropriately engaged on environmental and social issues that could potentially affect them through a process of information disclosure and meaningful consultation
- To maintain a constructive relationship with stakeholders on an ongoing basis through meaningful engagement during project implementation

5. Design and Access Statement

The Design and Access Statement will describe the various design elements of the proposed development in terms of use, amount, layout, scale, and appearance. It has demonstrated that the proposal has been designed in accordance with industry best practice and with the principle of good design in mind.

From the site visit it can be assumed that the soil is rammable although the presences of stones may hinder these works. A thorough geotechnical study has been carried out which shows that ramming of profiles is possible, which makes the site feasible for development of solar farms.

5.1 Introduction

This Design and Access Statement (DAS) has been prepared by ibvogt GmbH to assess the feasibility for the proposed solar farm with an installed capacity of 93.7 MW AC ~ 100 MW DC at the Jamshoro site in Sindh, Pakistan and forms an integral part of the feasibility study. The solar farm is intended to operate as Grid connected generation facility which will sell electricity to National Grid through an EPA. Specifically, ibvogt intends to develop a solar power plant located on the premises owned by the project SPV.

During the preparation of this DAS, ibvogt has leveraged decades of expertise in designing, constructing, operating and maintaining utility-scale solar power plants across the globe. Several key experts within the ibvogt team were involved in the design process to develop the best and most optimal outcome for JamshoroSolar Farm.

This DAS encompasses the design factors, issues and decisions that should be considered for any solar farm, including the design layout, type and number of components, positioning, soil and material attributes, etc.

It should be noted that this DAS should be read in conjunction with both the accompanying Planning Policy Statement, which establishes the plans for the design of the application proposal, and the supporting environmental report, which considers any potential impacts on ecology, landscape and aesthetics, transport and flood risk, among others.

5.2 Site Location

The proposed solar farm site is located in District Jamshoro, of Sindh Province Pakistan. Jamshoro city is the capital of Jamshoro District.Jamshoro district was split from Dadu district in December 2004. It consists of four Talukas Sehwan, Manjhand, Kotri and Thano Bola Khan. The Project is located in Taluka Kotri. The district borders Dadu district to the north. To the east, the Indus separates it from Nawab Shah, Matyari and Hyderabad districts. Thatta district lies to the south, and Karachi district to the southwest. To the west, the Kheerthar Range separates it from the Sindh and Lasbela district of Sindh. The total geographical area of the district is 11,517 square

kilometers. It is about 220 kilometers from north to south and about 100 kilometerswide from east to west.

Fig 27 showing location of Jamshoro solar farm

5.3 Transport and Site Access

Jamshoro solar farm site is located on the Hyderabad Karachi Motorway M-9. The site can be accessed directly from the Motorway M-9. A triple surface treatment road will be constructed, which will be used later during the operation and maintenance stage.

Hyderabad Karachi Motorway M-9 is the main artery and primary road through which site will be accessed.

S.No.	Road Type	Name
1	Primary	M-9
2	Secondary	Access Road

Karachi-Hyderabad Motorway is very busy road however wide enough for movement of heavy vehicles and traffic.

This route is more direct and most of the foreign equipment will be brought to the site through Karachi International port.

Transportation Study attached as Annexure A to the Feasibility Study. Provides in depth information about movement of HTV's from Port Qasim to project site.

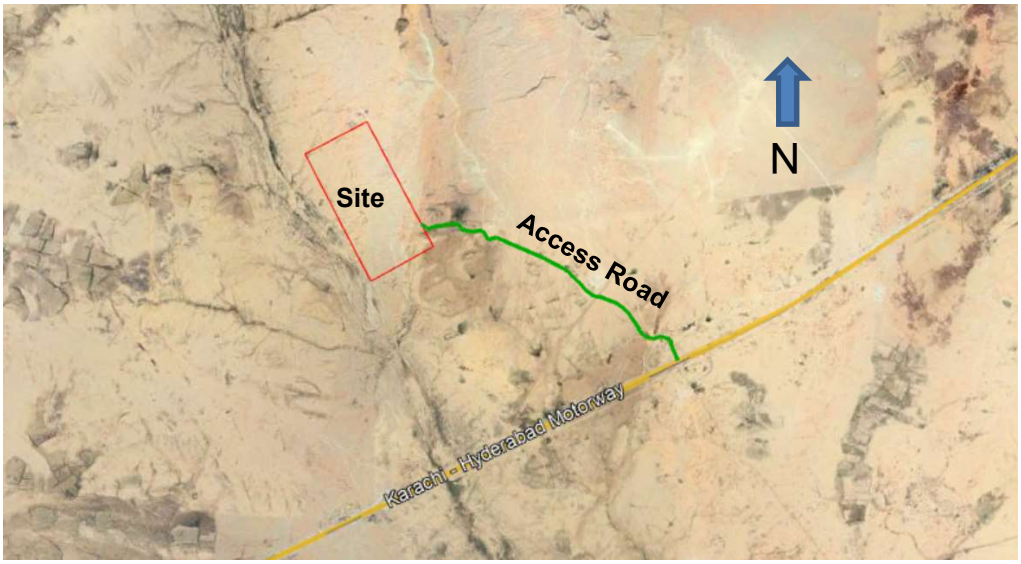


Fig 28 showing connectivity of the site with Karachi-Hyderabad Motorway.

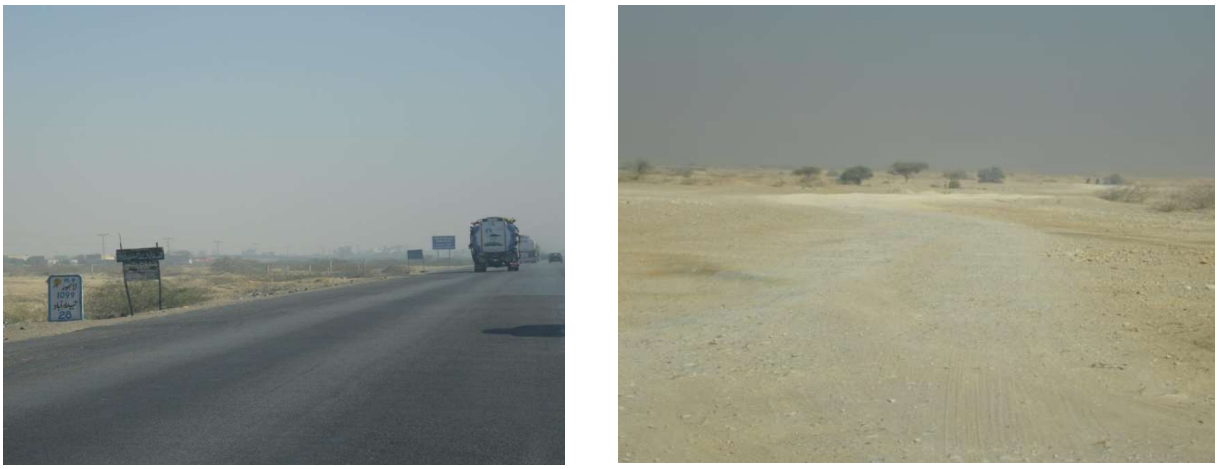


Fig 29 showing the existing M9 motorway and access road to the site.

5.4 Proposed Development and Design Principles

With every solar farm project development, ibvogt follows a proven methodology to render the best design solutions. Extensive experience has made these design approaches and processes more effective and efficient over the years. As Per the methodology, the development and design principles are based on:

- Physical opportunities and constraints the site provides;
- Material and labor needs of the development itself;
- Policy context relevant to the development of the site, and;
- Technical input and criteria from local consultants.

In addition, from its extensive track record, ibvogt is committed to established international standards and norms applicable in the industry, including IEC as well as local standards. For example, some notable IEC standards in the past have included “IEC 61557: Photovoltaic (PV) module safety qualification” and “IEC 62446: Grid connected photovoltaic systems - Minimum requirements for system documentation, commissioning tests and inspection.”

The key considerations and constraints as well as opportunities are outlined below.

Key Considerations and Constraints

The design must consider:

- Any potential archeological assets, wildlife habitats, precious resources or minerals at the site. The input provided by Environmental Consultants confirms that the site is not home to any protected wildlife or trees and is not subject to minerals or mining rights, archaeology finding, any local or national designation as a national park or areas of any special scientific interest, nor any special ecological features.

- Physical characteristics of the site, such as the field boundary, slopes, etc. Following the site visit and GIS analysis, the topography of the land at the site seems to be relatively flat with minimal, gradual sloping, which are not enough to significantly affect the tilting and positioning of the modules.

- Shading form nearby Trees and heighted feature. Solar power plants are prone to higher risk of losses due to shading, which can be mitigated or completely avoided through careful planning and design. Following a thorough analysis and software simulation, the engineering team at ibvogt has determined an optimal placement of the racks at sufficient distances away from every tree to avoid shading effects.

Figure 30 showing the 500KV pylon and trees that can cause shading

- Module soiling and cleaning. Given the dusty and windy climate of the site, soiling and cleaning of the modules requires an in-depth analysis. From projects developed

in the Middle Eastern deserts, ibvogt already has experience in soiling and cleaning marginal cost and benefit calculations, where the actual and monetary values of the yield reduction due to soiling and infrequent cleaning are compared to cost of cleaning the modules. Module cleaning, whether manual or using robots, also requires water, which is a scarce resource in the area. But Jamshoro solar farm site will require a tube well on the site and its water will be used for cleaning of panels. The salinity of water is low which means there will be no salt deposits on the solar panels after cleaning.

- Ramming, drilling or blasting of the ground. The site comprises mostly of plain land with no major variations in elevation, while small area of undulation was also encountered due to presence of sand dunes. Preliminary Geo – tech study of the site was carried out and 12 boreholes were drilling as part of geo tech investigation. Deposits of highly weathered and fractured limestone inter bedded with layer of shale were found in all the boreholes drilled at the site. Rock core samples were collected from these deposits. State of compactness according to unconfined compressive strength has been determined as 'weak' limestone in accordance with BS 5930. The unconfined compressive strength of the limestone encountered at the site ranges from 5.30 MPa to 16.38 MPa. Groundwater table was not encountered up to the explored depth of 10 meters below the existing ground level in any of the boreholes drilled at site. Keeping in view the subsoil conditions prevailing at the site and the loads expected to be transferred to the foundations, shallow foundations including isolated and mat foundations are recommended as the foundation system. It should be noted that the area of the project site is large and this preliminary investigation is only for the feasibility stage study.

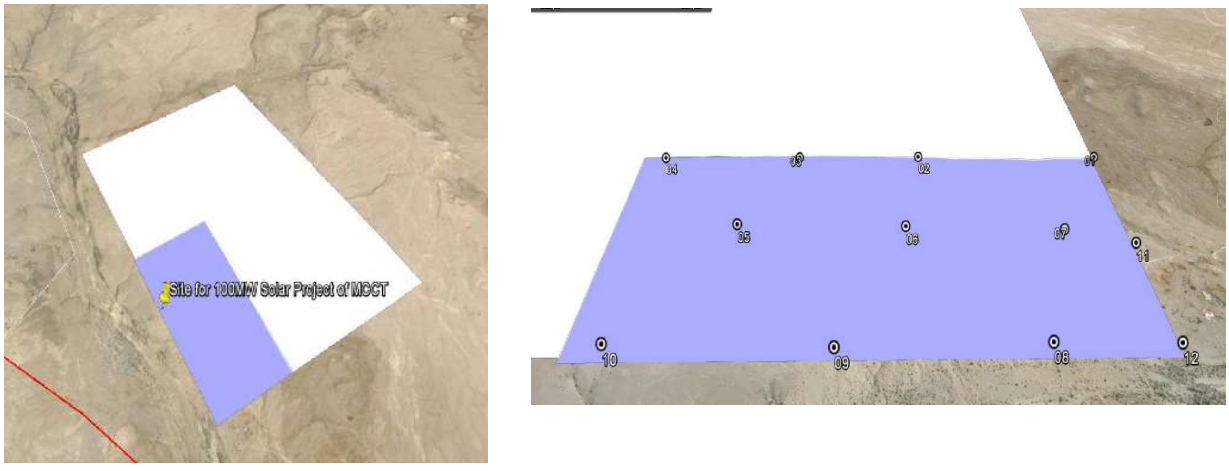


Figure 31 showing Geo Tech, test location points.

The Jamshoro area is situated in seismic Zone 2-A as per building Code of Pakistan (Seismic Provisions -2007). This corresponds to peak Horizontal Acceleration of 0.08 to 0.16 g, which shows that seismic activity in the area is moderate (Seismic Hazard Map attached as Annexure H). Groundwater level was not encountered in any pit or LPT. Details of the test summary is appended to this report Attached as Annex H.

5.5 Opportunities

On a broader level, the solar farm present advantages and opportunities for positive impact, namely:

- Contribution to national renewable energy and climate change targets;
- The delivery of renewable energy at a local level;
- A positive contribution to the economic development and diversification of the area;
- Use of underutilized barren land;
- Sunlight intensity levels - the site is well located geographically for relatively high solar irradiation and flat terrain that is free of any buildings or mountain ranges that could cause shadowing;
- Relatively good road access from the east, as mentioned above;
- The site is not historically protected or environmentally sensitive, as described within the EIA Regulations;
- Area requirements - the site provides enough land to accommodate a 93.7 MW AC~100MW Dc solar farm, and;
- The site is available for the entire lifetime of the proposed scheme (designed operational life span is 25 years).

5.6 Design Solution

As evidenced by the company's extensive portfolio of solar power plants, ibvogt's vast EPC and O&M track record serves as a robust indicator of the success and reliability of the design solutions and the comprehensive in-house expertise of the project development teams. This section elaborates on some of the design solutions mentioned previously and addresses important site requirements and local characteristics, specifically with respect to the proposed use of the site; amount, scale and appearance of components; site layout; location; materials requirements; and site access.

5.6.1 Proposed Use

As mentioned, the proposed development is for a ground-mounted solar farm. To ensure an optimally operating solar farm and maximize yield and earnings, ibvogt offers its EPC and O&M expertise to design, build and operate the solar farm as per proposed site layout. The solar farm will have energy generating capacity of approximately 93.7 MW AC ~ 100 MW DC and will generate enough low carbon renewable electricity to meet the demands of more than 62748 homes a year. The Carbon emissions saving calculations has been carried out and are as follows:

Solar Project Generation in MWhr = 2202*100 = 220,200

Combined Margin Emission Factor $_{grid, CM, y}$ = 0.6343 tCO_{2e}/MWh.

Carbon Emissions savings = Solar Project Generation X Combined Margin Emission Factor $_{grid, CM, y}$

= 220200 MWhr X 0.6343 tCO_{2e} / MWh

= 139,672.86 tCO_{2e}

= 85298.3805 tCO_{2e}

The solar farm is proposed for a standard operational lifetime (approximately 25 years), after which the associated equipment can be removed from the site and the land would be restored to its original condition.

Amount, Scale and Appearance of Components

The attributes of key components are as follows:

- **Modules:** out of the top technologies and brands, monocrystalline bifacial panels have been selected to generate a combined AC capacity of 93.7 MW. An important point is availability, which can determine the success and speed of the project during construction. As an established leader in the industry, ibvogt has prominent relationships with top module manufacturers, facilitating the procurement process.

- **Module Dimensions:** The dimensions of the selected panel would be in the range of 1.99 m x 0.99m x 0.40m. As part of an optimal arrangement that minimizes near shading, the mounted height of the panels should be no higher than 3 m above ground level and, at the lower end, at least 600 mm above ground level. The glass coated panels are coated to maximize daylight absorption, and thus minimize glare potential.

Mounting Frames:

The solar panels will be oriented towards east and west on metal mounting rack frames by using Sun tracking technology. Each rack is designed with 2 panels in portrait arrangement and 26 modules in table. To capture maximum direct irradiation, the mounting frames will adjust its angle of between 0-60 degrees from the horizontal. Rest the solar array will be able move 60 degrees from horizontal either way, east or west. Posts and beams of the supporting structure are made from galvanized steel or aluminum. The design is based on a detailed structural calculation tool developed in-house by ibvogt.

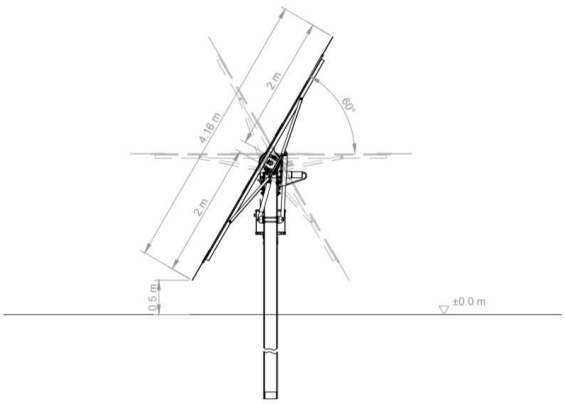


Figure 32 showing side elevation of mounting structure for Single Axis trackers

- **Module Tilt**: in past projects, ibvogt has conducted in-depth analyses on projects across the globe on the applicability of fixed tilt, seasonal tilt and tracking systems. Building upon this extensive track record, ibvogt has compared the financial and technical implications based on a preliminary analysis for each of the approaches for

the solar farm site. Due to drop in the equipment prices and will higher yield output, Single – Axis tracker is the best solution for markets with low Feed in Tariff. The module Tilt usually varies between the 15-30 Degrees in different regions depending on angle of the sun. For Jamshoro development the tilt angle will be adjusted automatically between 0-60 degrees depending of sun angle.

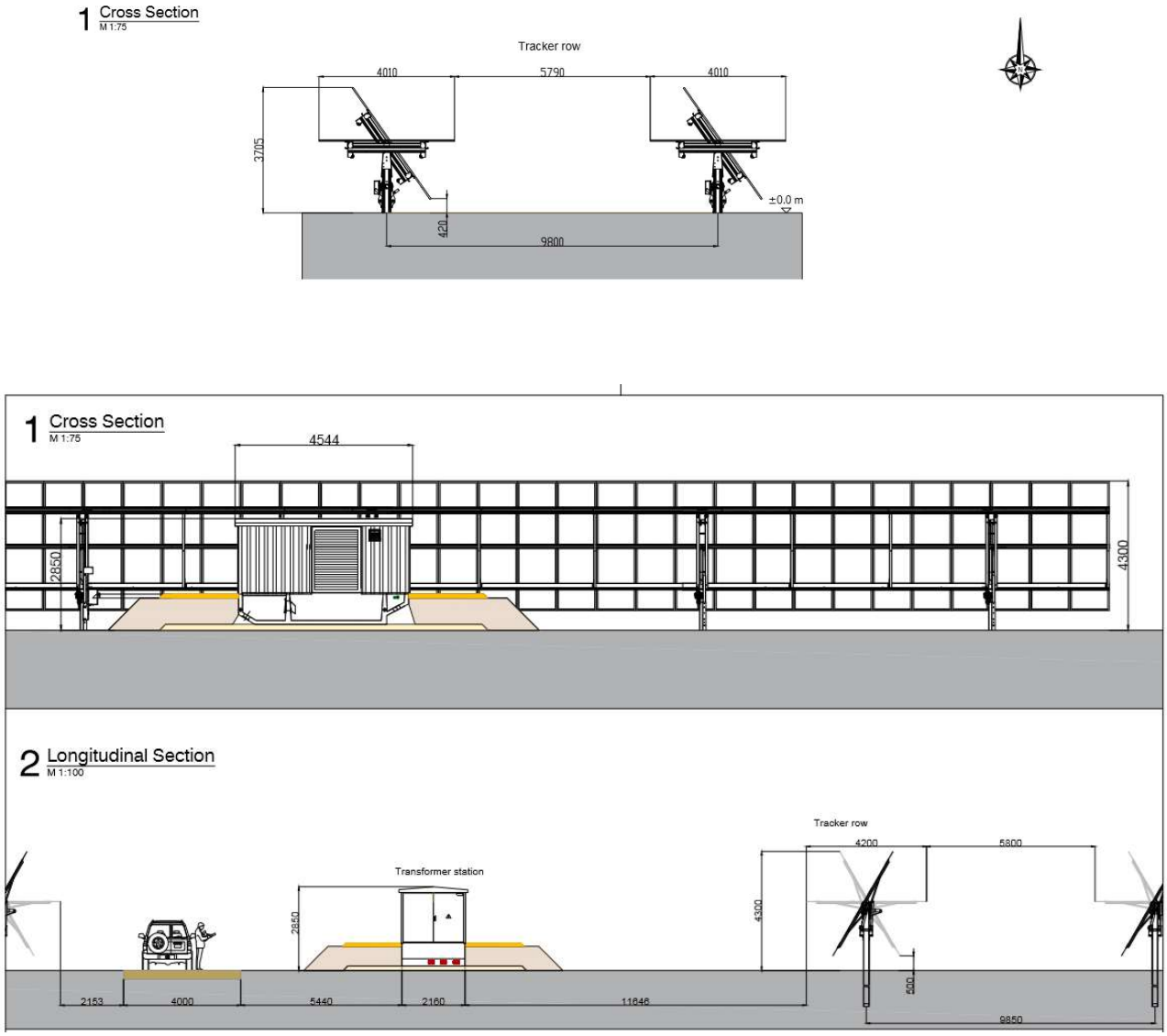


Figure 33 showing generic, side elevation of solar array and rear elevation of solar array

- **Mounting Piles**: as the main supporting structure for the modules, piles serve a very important role and must be fixed properly. Piles can be driven but, ramming depth should base on a more detailed analysis of the soil at the site. The mounting frame piles are typically driven approximately 1.5 m into the ground and, contrary to other developments, no concrete foundations are required. At the end of their operational life, when the site is decommissioned, the piles are simply removed from the ground, leaving negligible ground disturbance.

- **MV / Customer Substations (Inverter/Transformer)**: the solar panels generate DC (direct current) electricity and require an inverter to convert DC into AC (alternating current) for injection into the grid. The proposed solar farm will use string inverters like most standard solar farms and details can be found in the example datasheet provided in Annexure C.
- As per the Plant SLD, the PV plant will consist of 586 inverters having 160kVA capacity each with following 0.8/0.8/22kV and 22/132kV transformer, to accumulate all available power from PV panels to 22kV bus bar and 132kV bus bar respectively. A XLPE insulated 400mm^2 AL cable will be used to connect the output of 0.8/0.8/22kV transformer to main 22kV bus bar to avoid losses. Each inverter of model SUN2000-185KTL-H1 make Huawei is connected with approx. 200 strings, each string having 26 modules. Further information on typical inverter/transformer stations, such as internal mechanisms, performance and material, can be found in the example datasheet provided in Annexure C.

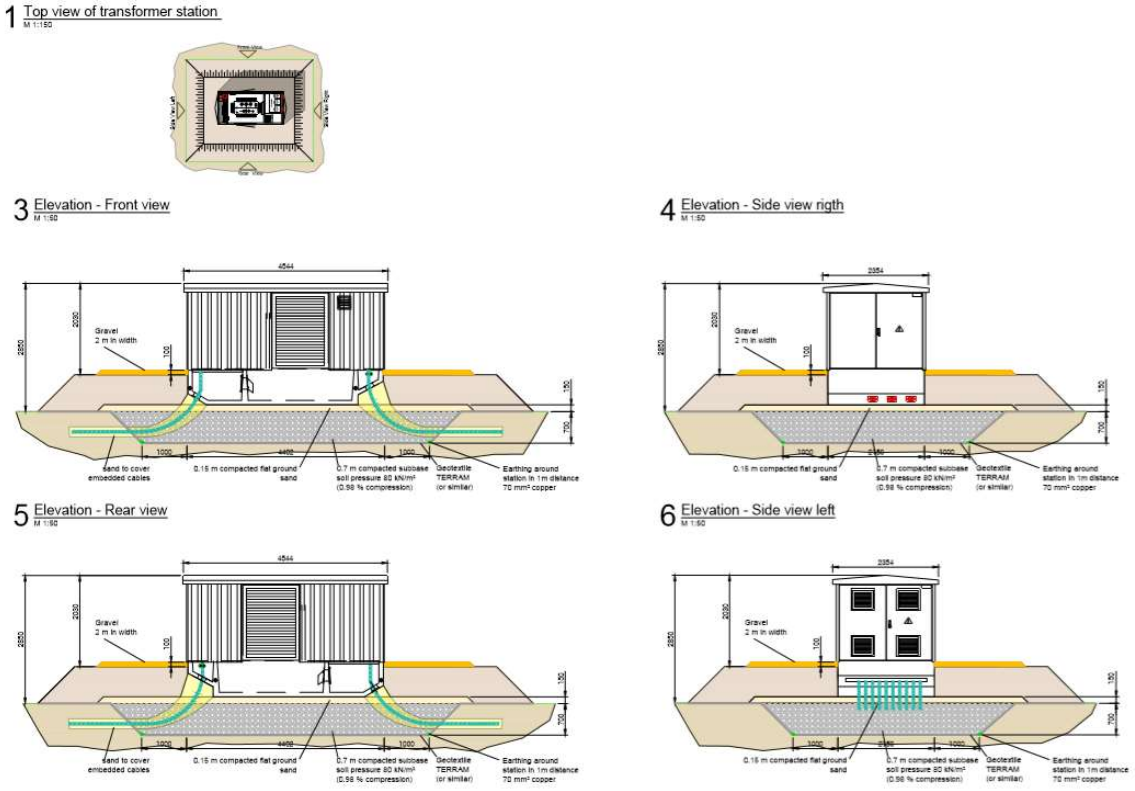


Figure 34 showing typical transformer station

- **Substation (DSO)**: a substation is required on every solar farm site as it is the point of connection from where the electricity flows into the grid network via the connection cable. The substation houses the switchgear which acts as a safety mechanism to protect the solar farm from any fault in the grid and vice versa. It automatically disconnects the electrical circuits if there is a fault in the system. Appropriate earthing

and lightning protection systems will be developed during the engineering phase of the project. Solar farm will be conencted to National Grid through a 132KV connection with N-1 contigency. More details of Grid interconection has been discussed in Chapter 6 of the feasibility study.

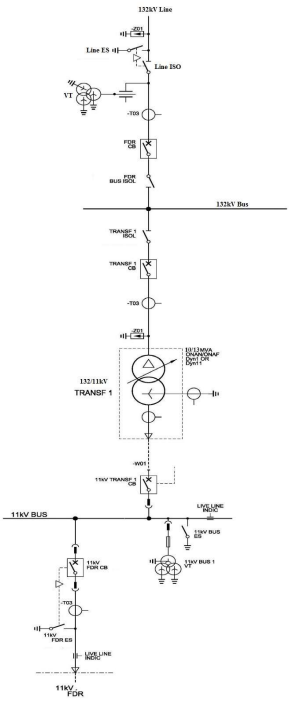


Figure 35 showing SLD of 132KV grid station

- **Communications Pole:** a communications pole will be installed on site so that the solar farm can be remotely monitored by technical operations and maintenance staff. Additional provisions, such as a very small aperture terminal (VSAT) system, tele protection and communication through a Digital Power Line Carrier (DPLC) system, can be included.

- **Spares Building**: a small storage/spares building will be installed to allow the safe storage of spare parts required from time to time as well as other maintenance equipment.

- **Perimeter Fence**: a perimeter fence must be installed to prevent wild or large animals from entering the site and damaging the panels and equipment. Additionally, it is required for security purposes to prevent vandalism and unauthorized access as well as for health and safety reasons to ensure no unauthorized personnel can access the onsite equipment.

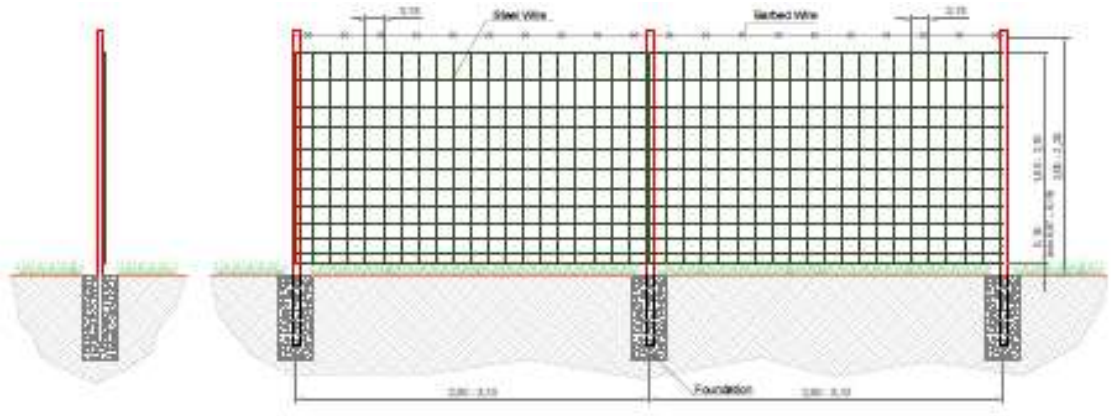


Figure 36 showing typical fence drawing

- **Security Cameras**: to monitor the site and prevent any unauthorized access motion sensor CCTV cameras will be installed along the site boundary. The CCIV cameras will be mounted on poles approximately 4 m in height. Additionally, although the

cameras use infrared technology, lighting will be required according to WTG specifications.

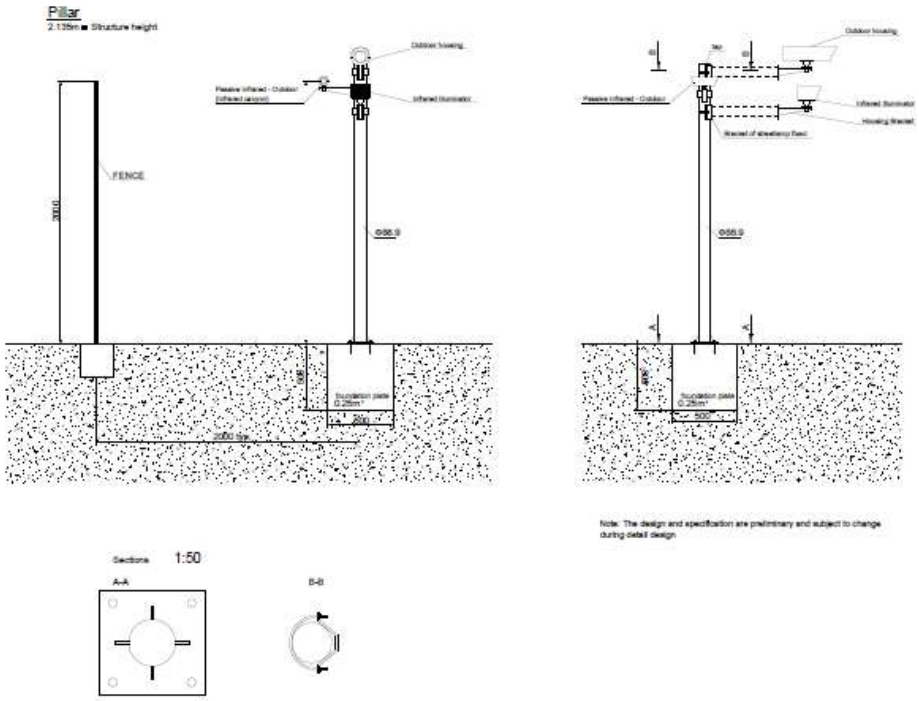


Figure 37 showing typical security camera drawing

- **Temporary Construction Compound**: a temporary construction compound or area is proposed towards the south-western end of the site. This will enable ease of access for construction staff and provide a suitable location for loading and unloading of construction materials. This area will be in temporary use whilst the solar farm is being constructed.

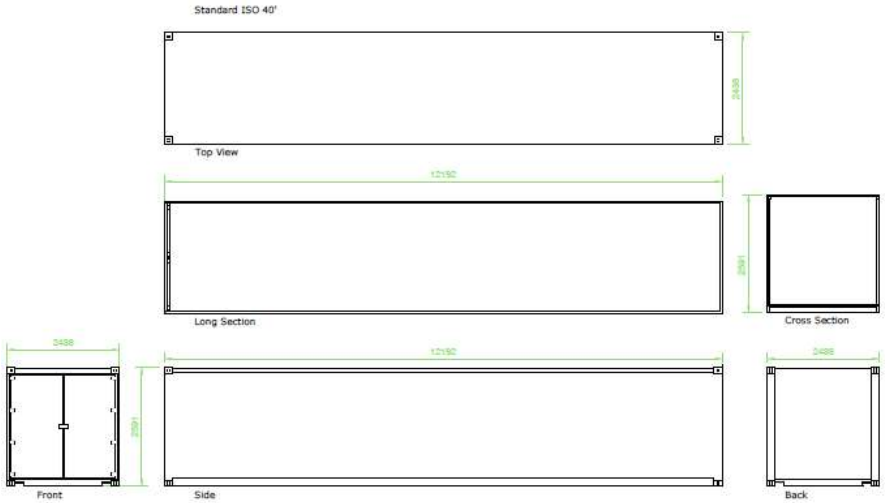


Figure 38 showing typical ISO 40' container

- **Access and Site Tracks**: The development will be connected to the public road network via the existing access road. Existing access tracks on site will be used during construction and operation with some additional sand and gravel tracks installed off the existing access tracks to allow easy access for construction, operation and maintenance.

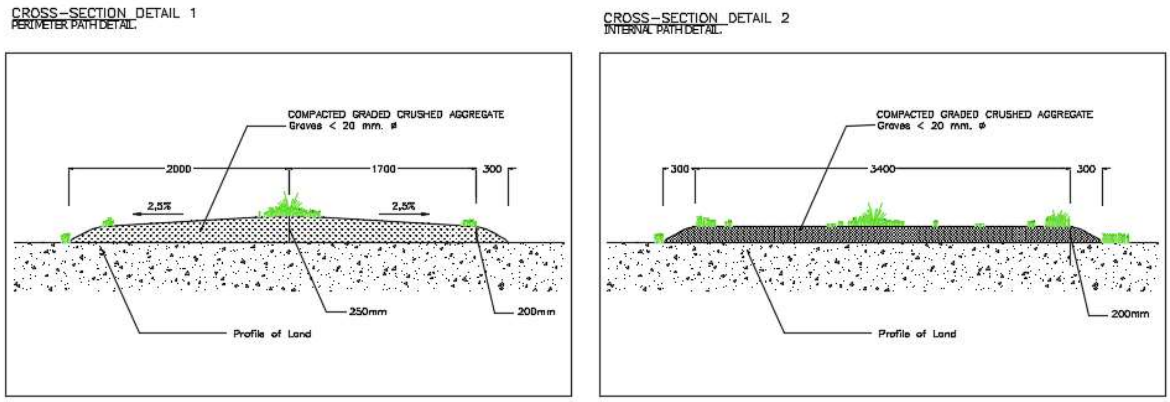


Figure 39 showing typical section of access and site tracks

5.6.2 Layout

During the design period, the layout of any solar farm is extremely important to ensure the most efficient use of the land available and prevent any unnecessary impacts on the landscape. It is also important to ensure that no shading occurs on the solar arrays so that they can produce as much electricity as possible from the daylight they receive. The proposed layout has been prepared by ibvogt's in-house technical team and has taken account of all features on site, such as wind turbines and overhead lines. More details are presented in the section on "Yield Assessment".

The total area of the site is 202.4 hectares / 500 Acres. Almost 40% of this area will be covered with the proposed solar panels. The remainder of the site will remain as steppe apart from some sand and gravel tracks that will be laid on site as shown on the site layout. The layout in high-resolution can be found in Annexure A.

Figure 40 showing PV solar farm layout plan

5.6.3 Location

The location of the proposed solar farm has been influenced by several factors. The most important being the need to find a suitable location to support the maximum irradiation potential of the sun. Accordingly, a clear view south, south-facing or a flat site with minimal shadowing are usually considered ideal locations. An available point of connection to the electricity distribution network is also of prime importance, while also satisfying other technical and planning criteria for solar farms.

5.6.4 Construction Access

The site will be accessed from the road as shown on the accompanying Site Layout. A new gate entrance will be installed. The area already consists of a firm surface suitable for vehicles entering the site. The site access point has the benefit of being located along a straight stretch of road ensuring excellent sight visibility. During the operational period of the proposed solar farm, low levels of traffic will be generated from the following activities;

- Operations and maintenance staff will visit the site a couple of times a month in a transit van or a 4 x 4 type vehicle;
- Visits per year to clean the panels, which will involve trucking in water.

Occasional tours of the solar farm may be facilitated for educational purposes once it is fully operational. Decommissioning of the site will broadly reflect the same traffic levels experienced during the construction period.

5.7 Construction Phase

A maximum of up to 300-800 construction workers are anticipated to be on site during peak times during the construction period. A temporary construction compound will be provided on the site. This will also act as a storage area, parking for contractors and turning for heavy-duty vehicles. A comprehensive construction plan will be prepared before the start of construction. Typically, the construction plan would last up to 48 weeks in total, limited to specific hours by planning condition with limited working at weekends.

The first stage comprising preparation and installation works will take around six months. On completion, there would be a further month of testing and commissioning prior to the development becoming operational. A typical sequence of construction works is as follows:

- Field survey/setting out
- Preliminary earth works
- Onsite trenching and cable laying
- Piling to support framework
- Erection of support framework
- Panel Installation
- Electrical Installation
- Construction of transformer buildings
- Connection of inverters
- Security fencing
- Security installation/communication system
- Site remedial works and completion
- Off-site trenching and cabling
- Testing and commissioning

Traffic to the site following the completion of the development will be on an intermittent basis, and should not influence the conditions of local roads and lanes. Movement of dust during construction will be mitigated via regular module cleaning, as necessary.

6. Grid Connection

6.1 Current Installation

The 132kV PAF and Jamshoro-old Grid Station are located in Hyderabad, Sindh. The PAF grid station is currently equipped with one 20/26MVA (ONAN/ONAF) power Transformer and Jamshoro-old grid station (G/S) is currently equipped with two 20/26MVA (ONAN/ONAF) power Transformer. The general single line diagram of similar grid station is also shown in the figure 41. HESCO is solely responsible for maintenance, extension, augmentation and up-gradation of subject grid station. Currently, the 132kV PAF grid station is having 1x132kV T/L to Jamshoro-old G/S and Nooriabad G/S. Further, the 132kV Jamshoro-old are having 1x132kV T/L to PAF G/S, Gulshan-e-Shahbaz G/S, Kotri Site-2 G/S & Nooriabad G/S, 2x132kV T/L's to Jamshoro-New & Hyderabad Bypass. An initial survey was carried out to determine capacity of 132kV PAF-Jamshoro-old Transmission line and for interconnection of 100MW solar power plant site that is located at a distance of approx. 25km away from PAF grid station and 18km away from Jamshoro-old grid station.

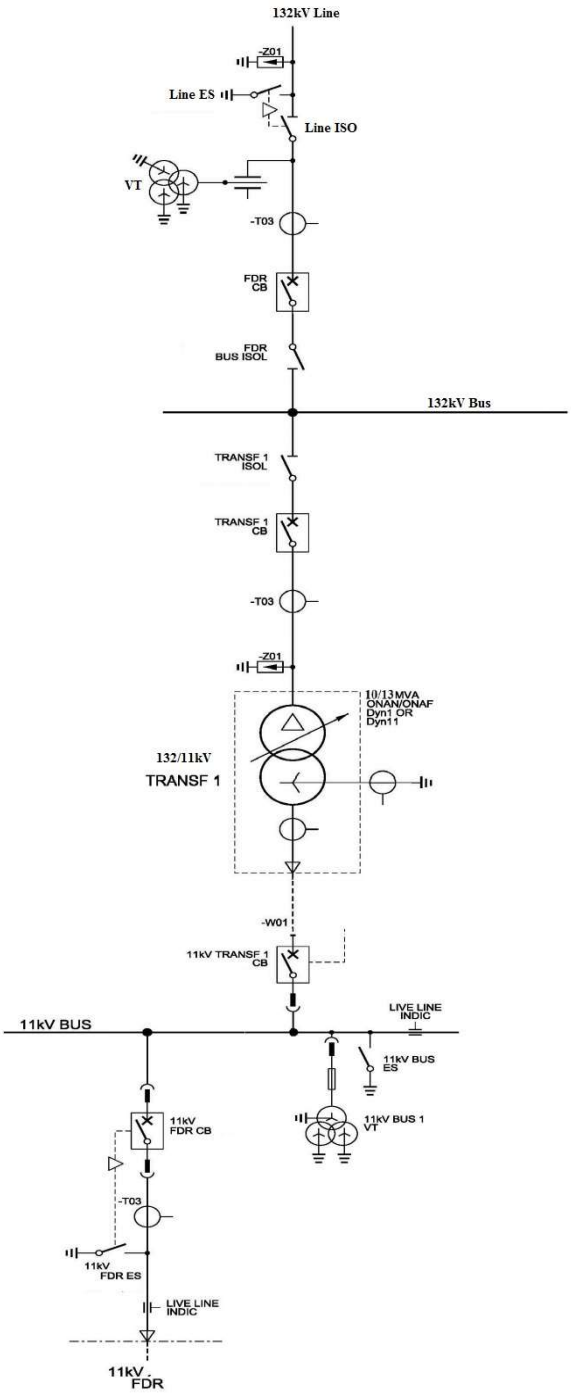


Figure 41 – SLD of 132kV Grid Station.

6.2 PV plant MV system

As per the Plant SLD, the PV plant will consist of 586 inverters having 160kVA capacity each with following 0.8/0.8/22kV and 22/132kV transformer, to accumulate all available power from PV panels to 22kV bus bar and 132kV bus bar respectively. A XLPE insulated 400mm^2 AL cable will be used to connect the output of 0.8/0.8/22kV transformer to main 22kV bus bar to avoid losses. Each inverter of model SUN2000-185KTL-H1 make Huawei is connected with approx. 20 strings, each string having 26 modules. Each module is having a capability of peak power is 400W$_p$. Furthermore, the 0.8/0.8/22kV, 5700kVA transformer is connected with different No. of inverters e.g. 30/32/36. The arrangement scheme of the inverter/transformer is:

- 05x03 Nos. 0.8/0.8/22kV, 5700kVA transformers are connected in series through cable with 22kV bus bar.
- 01x02 Nos. 0.8/0.8/22kV, 5700kVA transformers are connected in series through cable with 22kV bus bar.

From 22kV bus bar all available power will be accumulated to 132kV bus bar with three transformers of 55MVA each.

The detailed block level modeling is shown in figure 42 below.

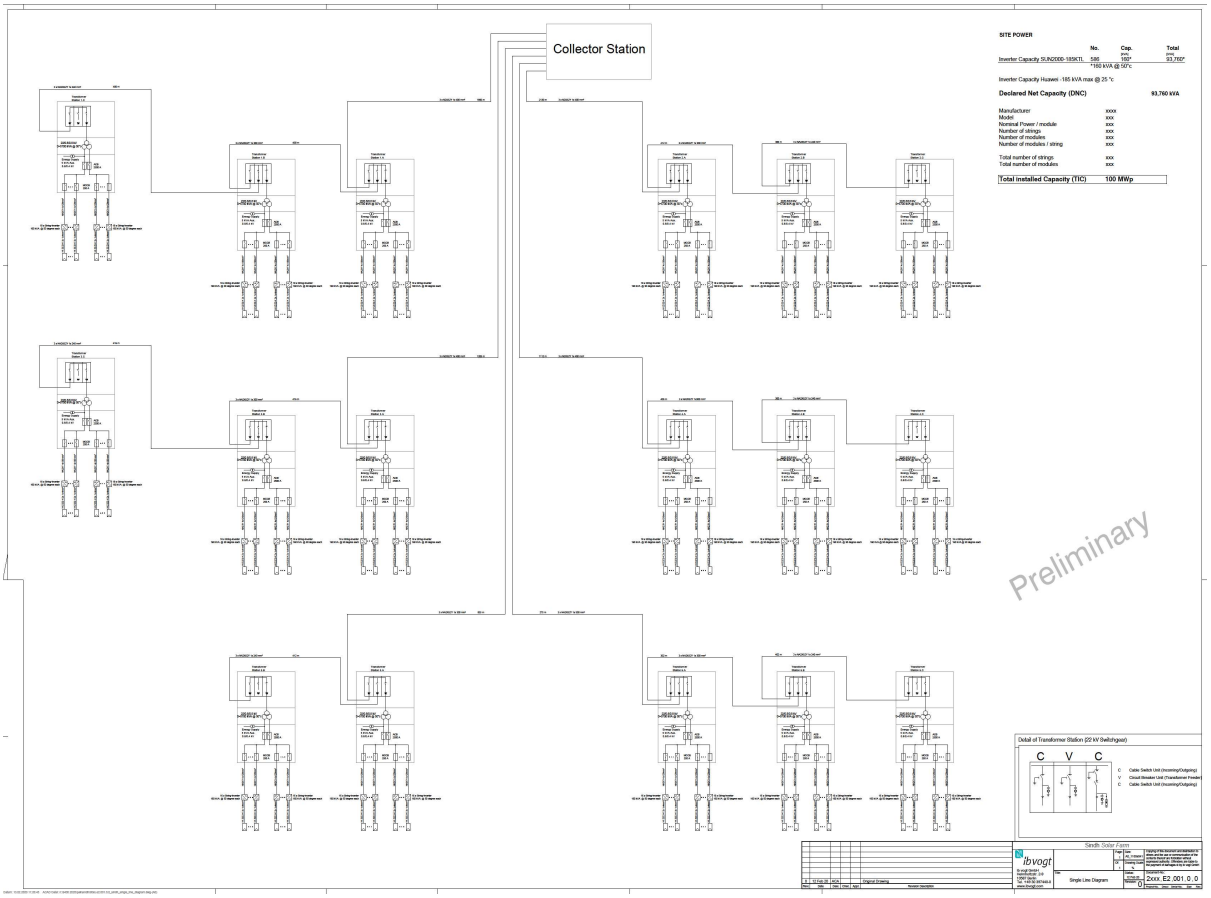


Figure 42 – Single Line Diagram (SLD) for 100MW Solar Power Plant

The maximum gross installed DC power is 100MW$_p$. The net power (AC) will be 93,760kW, whereas the auxiliary load will be 44kW approx. As according to CPPA Renewable guidelines if power that is to be evacuated is greater than 12.5MW then interconnection would be at 132kV voltage level.

Furthermore, the PV panels are also equipped with single axis tracker having a range of +/- 60.3° to track maximum available power from sun. the detailed layout plan of PV panels with single axis tracker is shown in figure 43.

Figure 43 – Module Array Layout Tracker

6.3 Grid connection of solar plant

During the site visit, only one suitable, economical possibility of interconnection was discussed. From an engineering perspective, the possible interconnection is described below:

- The 132kV bus 100MW PV plant will be connected by making an In/Out on 132kV Single Circuit between PAF-Jamshoro-Old grid station with a feed length of 7km of Lynx Conductor.
- In N-1, one (01 No.) conductor will serve the purpose to ensure reliability of power from 100MW solar power plant.

With interconnection of subject power plant, the key considerations must be:

- That MVAR compensation if needed, to meet grid code requirement then Reactor bank will be installed.
- That the Quality of power not to be compromised means very much less THD level. Therefore, a detailed load flow, PQ capability and dynamic study would be conducted.
- That the interconnection arrangement must adhere to the local norms and standards.

Furthermore, the stringing of 132kV transmission lines on Lynx conductor is not so much expensive. The general topology along with protection scheme, interconnection of 100MW solar plant with existing 132kV PAF-Jamshoro-Old grid station is hereby shown in figure 44.

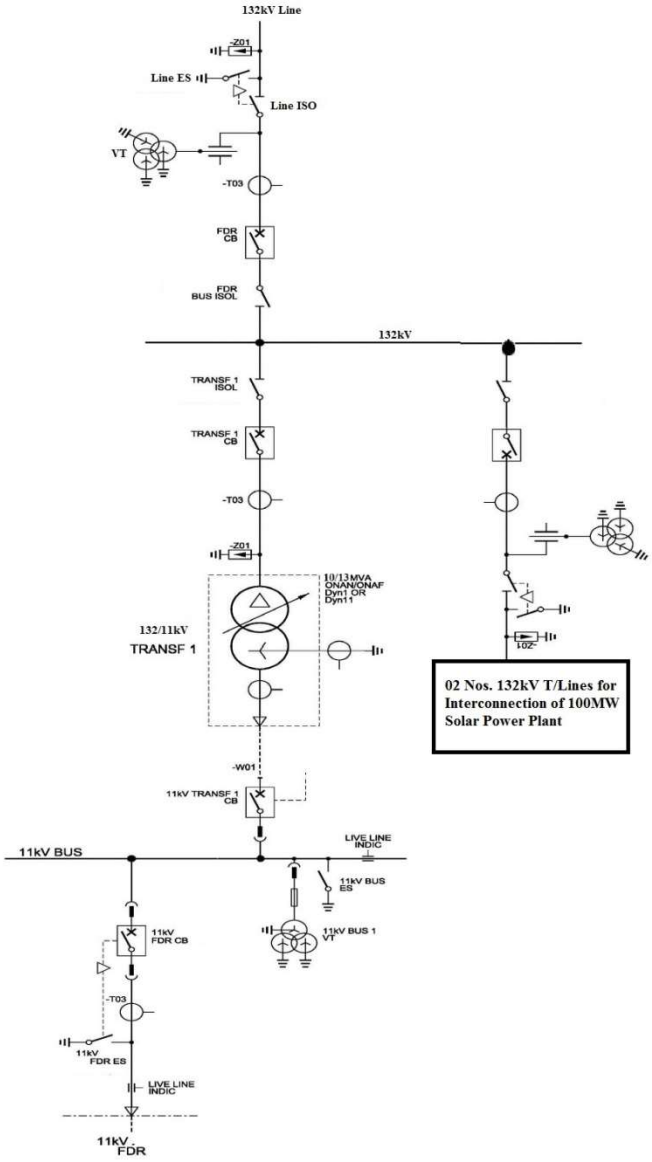


Figure 44 – General Interconnection Topology of 100MW Solar Power Plant with 132kV PAF-Jamshoro-Old Grid Stations through 01 No. each 132kV T/L.

7. Energy Yield Assessment

A solar cell is the smallest semiconductor element within a PV module to perform the immediate conversion of sunlight into electrical energy by the photovoltaic effect. Depending on the employed technology, the degree of efficiency amounts up to 18%-20%. This value seems to be quite low, but the free supply of primary energy (solar radiation) and the corresponding absence of power dissipation in the conventional sense should be taken into consideration. By using appropriate technology, such as inverters, the direct current generated by the solar modules is converted into alternating current that can be fed into the public power supply.

The conversion into alternating current implicates losses depending on the PV system configuration, the choice of components and to a minor degree on the local site conditions. If these losses are identified and evaluated, the system operation quality – the performance ratio (PR) – can be ascertained.

The PR is stated as percent and describes the relationship between the actual and theoretical energy outputs of the Solar farm considering module efficiency.

PR = energy yield / (unshaded annual irradiation on array surface * module efficiency as per STC)

$$PR = 100 \times \left[\frac{E_{AC}}{E_{Irradiation} \times A_{Array} \times \eta_{STC}}\right]$$

E_{AC} = energy coming from the inverter in kWh

$E_{Irradiation}$ = unshaded irradiation at module level in kWh

A_{Array} = total surface of all solar modules in m²

η_{STC} = module efficiency at STC

The module efficiency, in contrast to the cell efficiency, considers the gross module surface and can be calculated as follows:

$$\eta_{STC} = \left[\frac{P_{Module}}{A_{Module} \times 1000}\right]$$

7.1 System Operation Quality / Performance Ratio

A fundamental step in understanding this important quality criterion is the explanation of the typical loss factors affecting the energy yield with different weights. In every simulation step, all described aspects have an hourly impact on the overall result.

7.2 Irradiation gain by inclination of modules

In non-equatorial zones, the degree of irradiation at module level can be improved by the inclination of modules southwards (northern hemisphere) or northwards (southern hemisphere) against the horizontal. When reaching a normal module inclination angle of 25-30 degrees, the irradiation gain can amount up to 13-15% in temperate zones. It is expressed by the surface factor F(A) ~ 1,13 – 1,15. The inclination angle causes an additional irradiation because the ground reflects the light onto the modules. This reflection on different soil types is expressed by the Albedo Factor. There are empirical values for different soil surfaces. For example, the solar reflectance of grassland and cropland is about 20%. The effect on the energy yield is relatively low but, even so, is considered in the yield simulations. The product of irradiated amount of energy at module level and module efficiency (not cell efficiency, which is higher) is the basis for the initial value for the PR calculation and is defined to be 100%.

7.3 Description of types of technical losses:

7.3.1 Technical losses because of shading

If there are objects in the immediate environment of the planned solar farm causing shading of the solar generator, these shadings can be considered and simulated previously within a shading analysis. A distinction is made between “horizon shading” and “nearby shading”.

Horizon shading causes a shading effect which has a permanent impact on the entire generator field. The simulation considers this effect by adjusting the horizon line. Objects that are in a large distance to the modules, e.g. mountain ranges, are typical horizon shadings. Such shadings always affect a larger module field, i.e. an array. The relatively flat terrain at and around the Jamshorosite allows for minimal consideration of horizon shading effects.

Nearby shading has a temporally and spatially impact only on some parts of the generator field. Other parts of the plant remain unaffected. Objects at close distance to the modules act as cast shadows, e.g. power poles, trees but also row shading in large rack mounted solar fields. The potential shading from existing 500KV Pylons at the site was accounted for in the design.

Depending on the site conditions, these aspects are considered in the yield simulation.

7.3.2 Technical losses because of dirt

Dirt on the modules also causes shading effects which can change over time and seasonally. This shading impact on the energy yield depends for example on the surrounding landscape, cultivation and precipitation. The impact can only be appraised and is based on experience values. Consequently, the uncertainty is high.

Then again, the degree of this shading effect is quite low and amounts to 1-2% under normal conditions. The Jamshoro site is characterized by a relatively dusty and windy environment

creating higher than normal soiling conditions. Thus, the shading effect from soiling would potentially reach higher percentage amounts.

7.3.3 Technical losses because of part-load operation

The intensity of irradiation in solar plants changes during the year. The conversion into electricity does not happen linearly to the changing irradiation conditions.

7.3.4 Technical losses because of temperature fluctuation

Ambient temperature and degree of irradiation have an influence on the cell temperature and so affect the energy conversion process. As per the defined STC value of 25° C, the electrical power output decreases with higher cell temperature and increases with lower cell temperature. The module model shows this characteristic by means of temperature coefficients for current and voltage. The temperature ranges at the Jamshoro site would need to be accounted for.

7.3.5 Technical losses because of reflection

Inclined irradiation causes reflection of sunlight at the glass and cell surface. Although this is a small effect, it is considered by an empirically determined factor: IAM (Incidence Angle Modifier). By default, the factor is set to 0.05. With the latest anti-reflective coating, a more realistic factor of 0.04 is used as current industry standards.

7.3.6 Technical losses because of fluctuations in module performance

Due to production reasons, the module performances are subject to slight fluctuations (see data sheet„ module performance “). Because of the different manufacturing technologies, the module wiring to module strings causes the so-called mismatch effect. Further information can be found for an example module data sheet in Appendix D.

7.3.7 Technical losses because of weathering and degradation

Changes in the energy yield because of weathering are not considered in the simulation. Performance guarantees of the manufacturer and different practical results diverge a lot. Former long-term study findings cannot be applied easily to modules produced with today’s manufacturing processes and product features. But it is assumed that today’s processes and technologies lead to a higher module quality. The consideration of a correction value for weathering / degradation is recommended for the overall result. To varying degrees depending on the method used and frequency, cleaning of the modules may contribute to the overall degradation of the modules over time.

7.3.8 Technical losses because of cable losses

The whole wiring of the solar farm is subjected to cable losses due to the natural resistance of conductors - the so-called ohmic resistance. Due to small-scaled plant design and cable dimensioning for maximum performance, losses normally amount to 1-2%.

7.3.9 Technical losses because of DC/AC inversion

The conversion of direct current into grid compatible alternating current entails inevitable losses. The conversion losses of the inverters vary according to the chosen inverter type e.g. central inverters, sting inverters, etc.

7.3.10 Technical losses because of transformation (transformer losses)

Transformer losses depend simultaneously on several parameters and thus, unfortunately, cannot be simulated with precision. For this reason, depending on transformer quality, the performance ratio and the yields include a blanket value.

7.3.11 Technical losses because of self-consumption

Inverters (operation, fans, heating, etc.), monitoring and security systems as well as communication systems consume power. During energy production, the necessary power is reducing the current output of the Solar farm.

7.3.12 Technical losses because of Light-Induced Degradation (LID)

LID or also called initial degradation is a potential slight power drop during the first few days under solar radiation that can affect some solar cells. Manufacturers of crystalline modules do not always consider potential LID effects in the power specifications on the identification plate. If a manufacturer fails to take initial degradation into account in their power classification this value is used to regard this effect within the simulation.

7.4 Configuration of the PV Generator and Irradiation

Within the solar farm, the solar modules are connected to strings. Most of these strings are collected in DC distribution boxes and generator junction boxes, where they are connected to the inverter. The result is a cascading structure.

7.5 Solar module

Standard 72 cell bifacial modules with a rated nominal power of 400Wp are used in the design. The maximum open circuit voltage of the modules is at 1500V. Considering the minimum temperatures at the site, 26 modules are connected in series to form a PV string.

7.6 Inverters

The solar farm is equipped with 185 KVA string inverter systems, and with a nominal active power of 185 kWac. A Data sheet of Huawei Inverters can be seen as appendix C.

7.7 Mounting Structure

The plant design corresponds to a single axis tracking system. The titled axis is set at 0° whereas the rotation of the mounting structure is limited between 0° to 60° either way east or west.

This provided for a balance between the irradiation received on the module plane and row shading losses.

7.8 Technical losses considered for the energy yield simulation:

7.8.1 Technical losses because of shading

Shadings leading to losses due to nearby shading result from the planned installation of modules which is by means of racks arranged in rows. Distance between the rows is kept at 8m. This will lead to a shading angle of 9.7° in summer where the module tilt is 10°and during the winter at a module tilt of 30° the shading angle is 23.8°. By comparison, the lowest position of the midday sun during one year (northern hemisphere December 21st – winter solstice) is at 41.4°. Further shading results from external objects; for the site 132 KV pose external shading on the module array. For the 3D model, all possible positions of the trees were considered. The plant was simulated as 3D model in the simulation program (see Figure 45). Furthermore, the simulation calculated the annual shading ratio. This intermediate result was then factored into the actual yield simulation.

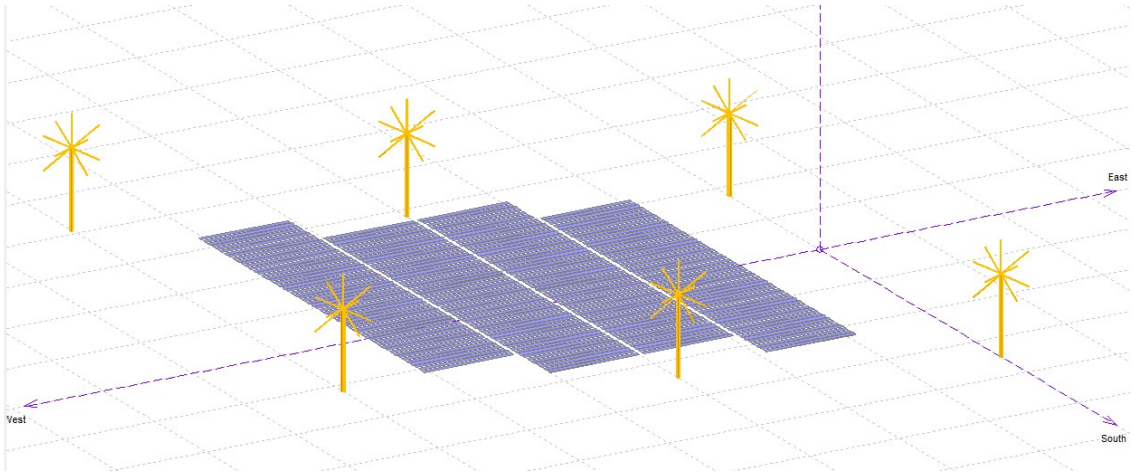


Fig 45 showing 3D Model and shading analysis carried out due to pylnons

The simulation was performed with PVSyst version 6.72, an application developed by the University of Geneva and PVsyst SA, Switzerland. The complete output of the simulation for the PV side can be found in Annexure E. The source data of the simulation is based on simulated half hourly data.

7.8.2 Technical losses because of dirt

Based on the company's extensive portfolio of plants, both those that reached the preliminary design stage and those fully constructed, ib vogt has developed a range for

typical percentage losses due to dirt for certain climates. In this case, energy yield losses because of dirt on the modules were set at the higher end at 2.0% of the energy generation based on the scope of O&M, considering the prolonged dry seasons and low rainfall at the site, and scheduled module cleaning according to current operation and maintenance industry standards.

7.8.3 Technical losses because of fluctuations in module performance

Calculation models according to industry standards were applied for the modules. The current industry standard performance variation is typically at 0/+3%. To consider the gain of the positive sorting of modules the parameter 'module quality' was set to -0.5%. Losses due to mismatch effects are assumed to amount of 0.2% considering a low deviation of V_{MPP} and I_{MPP}. Accordingly the LID losses were set at 0.8%.

7.8.4 Technical losses because of cable losses

According to the proposed design specifications, the ohmic losses of the DC installations are set to 1.5% under STC conditions. The cable losses on the AC side were set at 1.0% under STC conditions. Further information on cable losses can be found in the simulation output in Appendix E.

7.8.5 Technical losses because of DC/AC inversion

Industry standard central inverters are chosen for the design and accordingly represented in the energy yield simulation. The operating characteristics of the inverter as for yield optimization by efficient MPP tracking could not be displayed in the simulation. The DC/AC ratio is 1.23. This ratio falls in line with many of the successfully operating solar farms across the globe, including solar farms commissioned by ibvogt. Short periods with overload are possible.

7.8.6 Technical losses because of transformation (transformer losses)

Losses of external transformers were set at with 0.1% for iron losses and 1.0% for resistive/inductive losses according to the widely-used industry standard equipment.

7.9 Irradiation conditions

For the simulation irradiation data from the provider SolarGIS for the years 1999 – 2018 at a resolution of 30 minutes was used. SolarGIS provides irradiation data based on calculations from satellite images. The spatial resolution is 1.5 arc-minutes (about 3 km right below the satellite at 0° N, 0° E).

The following figures shows Global Horizontal Irradiation, Diffused Horizontal Irradiation and Initial Diurnal air temperature at 2m height at Jamshorosolar farm site.

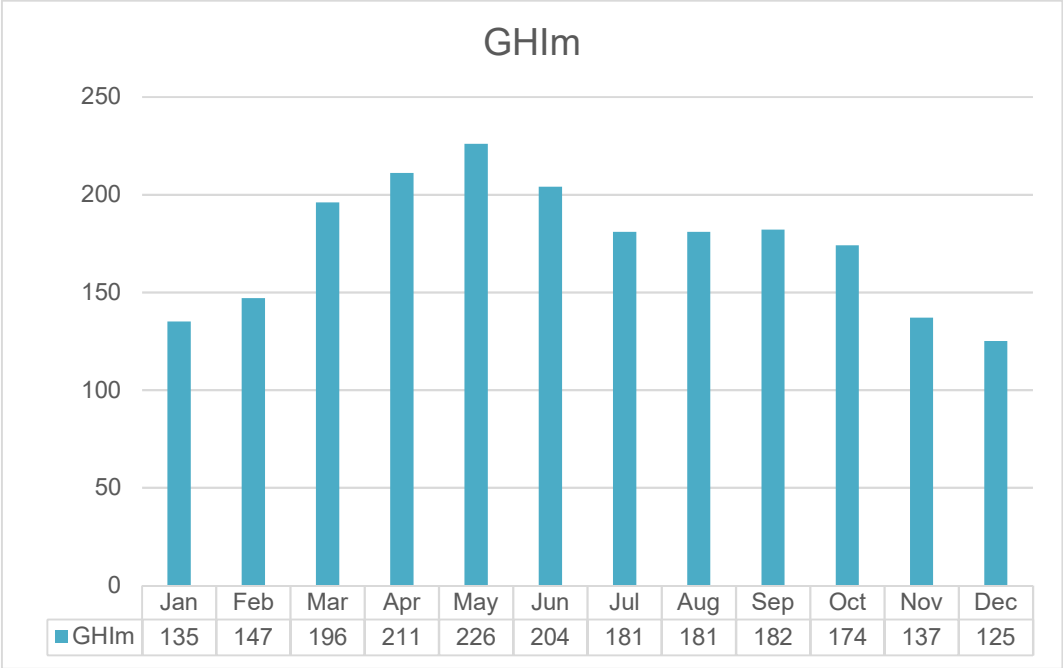


Fig 46 showing GHI values for Jamshoro solar farm site

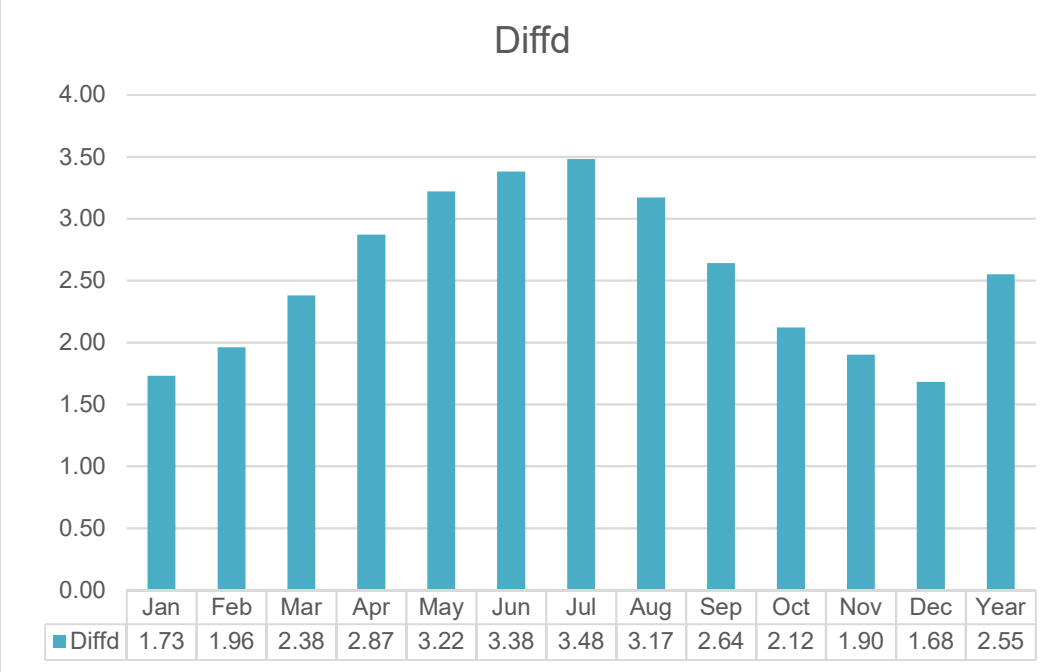


Fig 47 showing diffused horizontal irradiation values for Jamshoro solar farm site

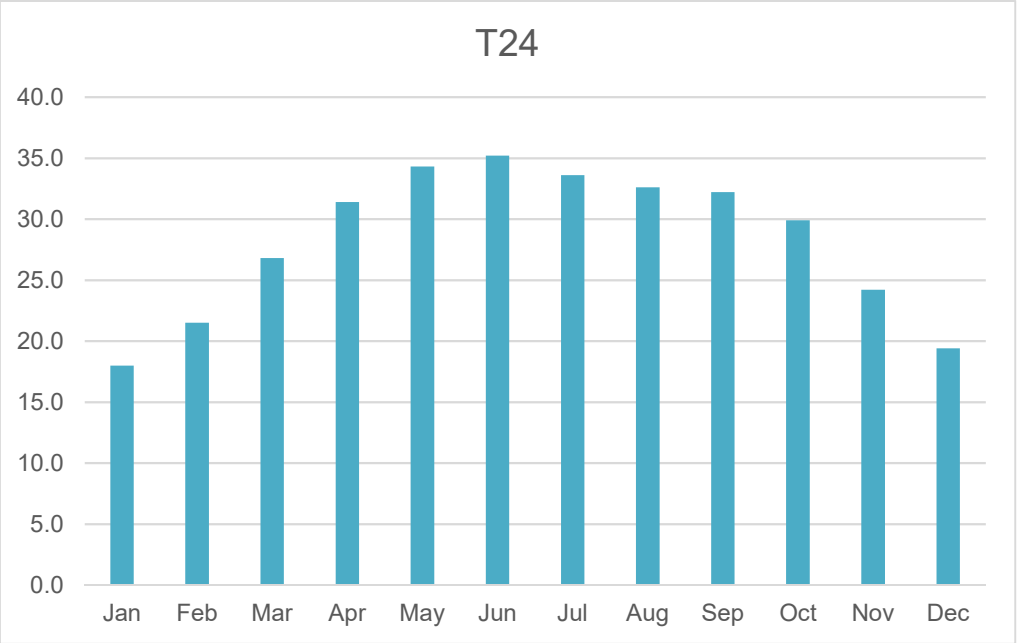


Fig 48 showing average diurnal air temperature at 2m

7.10 Energy Yield Prediction Results

The energy yield assessment was carried out using standard market software acceptable for 3rd party assessment. For yield assessment ibvogt engineers evaluate all possible solutions for system design using fixed tilt, seasonal tilt and single axis trackers.

All the specific yields were put into financial model to evaluate project feasibility and most feasible solution was than finalized for Jamshorosolar farm project.

7.10.1 Fix Tilt System

As mentioned above, the energy yield calculation was performed using the software PVSyst 6.72.

To simulate the daily irradiation at Jamshoro site, the percentage of diffuse radiation must be identified as per the Liu-Jordan correlations model. Then, the percentages of direct and diffuse radiation are applied to the inclination and adjustment of the solar generator as per the calculation model of Perez.

The hourly / daily variation in irradiance is based on a statistical method using daily values. This method traces back to the data evaluation of numerous weather stations worldwide. These results in a surface-factor applied for the variation in irradiance (irradiation on the horizontal or on the inclined module surface).

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Grid-Connected System: Main results

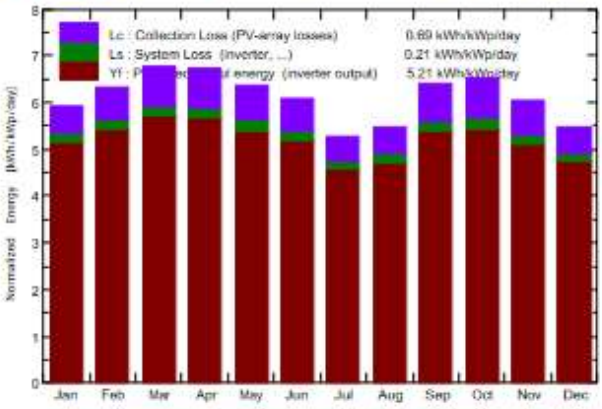
Project : **PAK_Sindh**

Simulation variant : **Fixedtilt_0°Az_bifacial_30°_old**

Main system parameters				
PV Field Orientation	System type	**Unlimited sheds**		
	Sheds disposition, tilt	30°	azimuth	0°
PV modules	Model	RSM144-6-400BMDG	Pnom	400 Wp
PV Array	Nb. of modules	5200	Pnom total	**2080 kWp**
Inverter	Model	SUN2000-185KTL-H0-Draft	Pnom	185 kW ac
Inverter pack	Nb. of units	10.0	Pnom total	**1850 kW ac**
User's needs	Unlimited load (grid)			

Main simulation results				
System Production	**Produced Energy**	**3954 MWh/year**	Specific prod.	1901 kWh/kWp/year
	Performance Ratio PR	85.28 %		

Normalized productions (per installed kWp): Nominal power 2080 kWp



Performance Ratio PR

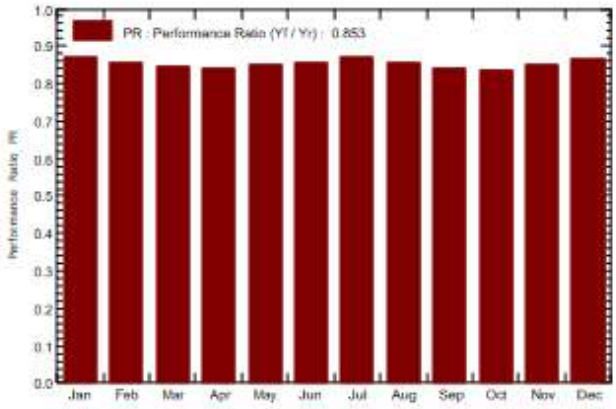


Figure 49 showing yield assessment of solar farm site for fixed tilt system

Fixedtilt_0°Az_bifacial_30°_old
Balances and main results

	GlobHor kWh/m²	DiffHor kWh/m²	T_Amb °C	GlobInc kWh/m²	GlobEff kWh/m²	EArray MWh	E_Grid MWh	PR
January	132.4	46.5	17.90	183.6	173.3	345.4	332.1	0.870
February	141.2	53.0	21.20	177.1	167.0	329.2	316.4	0.859
March	186.2	70.9	26.10	209.2	196.7	382.9	367.9	0.845
April	201.5	81.9	30.00	202.1	189.4	368.1	353.5	0.841
May	217.2	94.9	32.90	197.6	184.4	362.9	348.9	0.849
June	206.5	100.0	33.30	181.9	169.4	337.1	324.5	0.858
July	183.3	104.6	32.10	163.7	152.0	307.4	296.2	0.870
August	177.4	97.7	30.90	170.4	158.6	315.5	303.7	0.857
September	179.3	75.9	30.40	191.6	179.6	349.0	335.5	0.842
October	167.2	63.4	28.90	201.9	190.2	364.9	350.5	0.835
November	134.1	51.0	24.00	180.7	170.3	332.1	319.4	0.850
December	120.6	48.0	19.29	169.3	159.5	317.6	305.6	0.868
Year	2046.9	887.8	27.28	2229.1	2090.3	4112.0	3954.1	0.853

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

Table 9 showing balances and main results of yield assessment for fixed tilt system

Annual Specific Yield for fixed tilt: 1901 kWh/kWp

Performance Ratio: 85.28%

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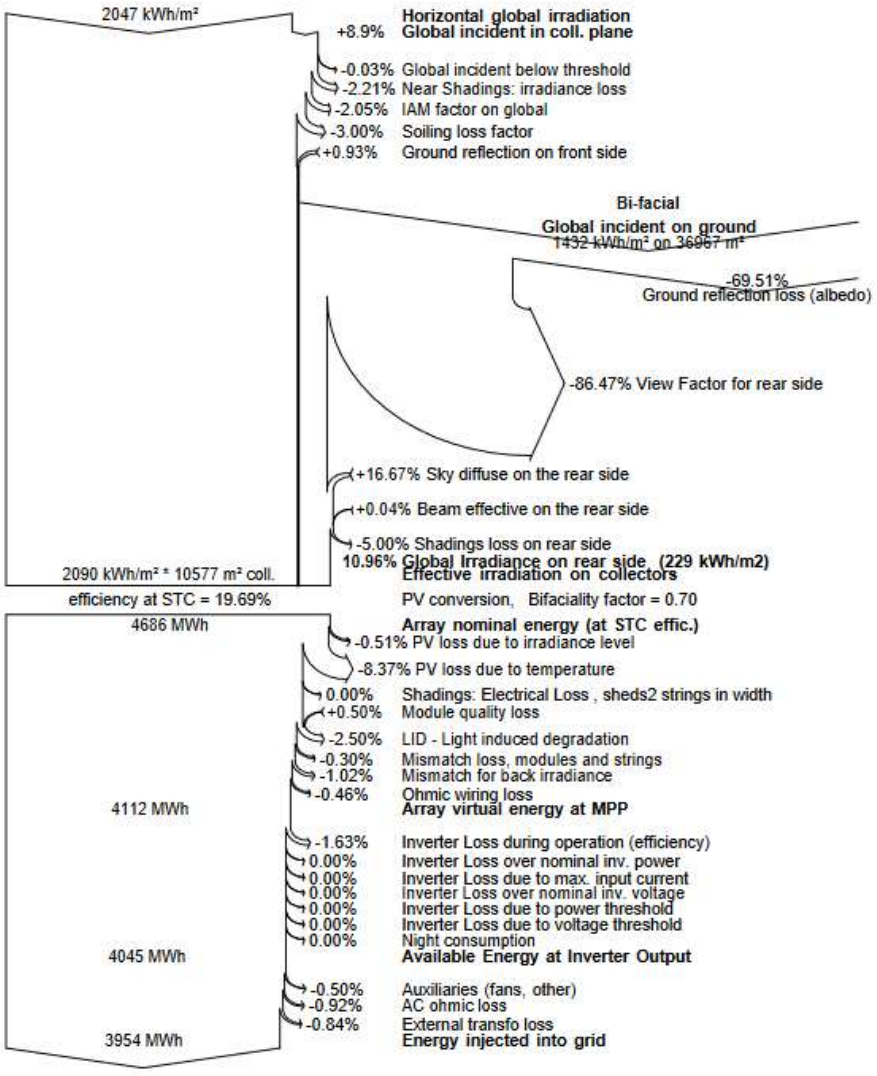
Grid-Connected System: Loss diagram

Project : PAK_Sindh

Simulation variant : Fixedtilt_0°Az_bifacial_30°_old

Main system parameters	System type	**Unlimited sheds**		
PV Field Orientation	Sheds disposition, tilt	30°	azimuth	0°
PV modules	Model	RSM144-6-400BMDG	Pnom	400 Wp
PV Array	Nb. of modules	5200	Pnom total	**2080 kWp**
Inverter	Model	SUN2000-185KTL-H0-Draft	Pnom	185 kW ac
Inverter pack	Nb. of units	10.0	Pnom total	**1850 kW ac**
User's needs	Unlimited load (grid)			

Loss diagram over the whole year

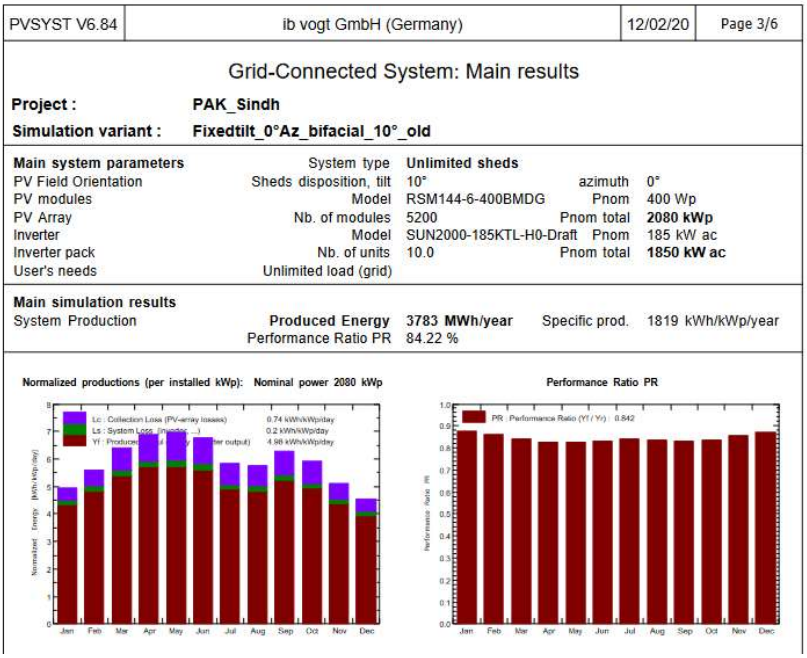


PVsyst Licensed to ib vogt GmbH (Germany)

Figure 50 showing grid connected system loss diagram

7.10.2 Seasonal Tilt

To assess the suitable technical design for the site, additional seasonal tilt design was also prepared by ib vogt design team for comparison with Fixed Tilt and Single Axis tracker yields.



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Grid-Connected System: Main results

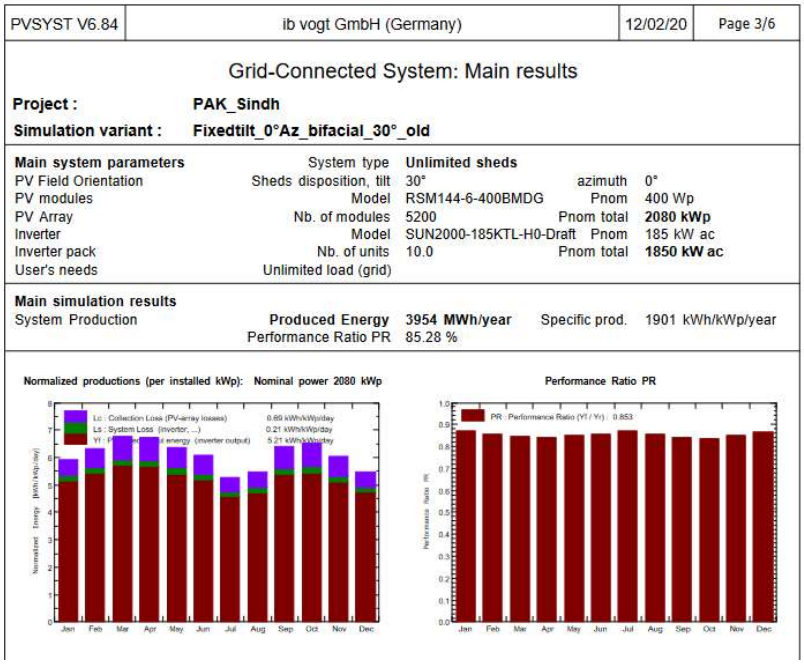
Project : PAK_Sindh
Simulation variant : Fixedtilt_0°Az_bifacial_10°_old

Main system parameters	System type	**Unlimited sheds**		
PV Field Orientation	Sheds disposition, tilt	10°	azimuth	0°
PV modules	Model	RSM144-6-400BMDG	Pnom	400 Wp
PV Array	Nb. of modules	5200	Pnom total	**2080 kWp**
Inverter	Model	SUN2000-185KTL-H0-Draft	Pnom	185 kW ac
Inverter pack	Nb. of units	10.0	Pnom total	**1850 kW ac**
User's needs	Unlimited load (grid)			

Main simulation results				
System Production	**Produced Energy**	**3783 MWh/year**	Specific prod.	1819 kWh/kWp/year
	Performance Ratio PR	84.22 %		

Normalized productions (per installed kWp): Nominal power 2080 kWp

Performance Ratio PR



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Grid-Connected System: Main results

Project : PAK_Sindh
Simulation variant : Fixedtilt_0°Az_bifacial_30°_old

Main system parameters	System type	**Unlimited sheds**		
PV Field Orientation	Sheds disposition, tilt	30°	azimuth	0°
PV modules	Model	RSM144-6-400BMDG	Pnom	400 Wp
PV Array	Nb. of modules	5200	Pnom total	**2080 kWp**
Inverter	Model	SUN2000-185KTL-H0-Draft	Pnom	185 kW ac
Inverter pack	Nb. of units	10.0	Pnom total	**1850 kW ac**
User's needs	Unlimited load (grid)			

Main simulation results				
System Production	**Produced Energy**	**3954 MWh/year**	Specific prod.	1901 kWh/kWp/year
	Performance Ratio PR	85.28 %		

Normalized productions (per installed kWp): Nominal power 2080 kWp

Performance Ratio PR

Figure 51 showing seasonal tilt, yield assessment for solar farm using manual seasonal tilt mounting structure (summer and winter results)

Fixedtilt_0°Az_bifacial_10°_old
Balances and main results

	GlobHor kWh/m²	DiffHor kWh/m²	T_Amb °C	GlobInc kWh/m²	GlobEff kWh/m²	EArray MWh	E_Grid MWh	PR
January	132.4	46.5	17.90	153.5	144.7	290.1	279.6	0.876
February	141.2	53.0	21.20	157.2	148.6	292.2	281.4	0.861
March	186.2	70.9	26.10	198.8	188.1	361.4	347.5	0.840
April	201.5	81.9	30.00	206.8	195.8	370.4	355.8	0.827
May	217.2	94.9	32.90	215.7	203.8	384.7	369.7	0.824
June	206.5	100.0	33.30	202.8	191.6	363.7	349.8	0.829
July	183.3	104.6	32.10	180.6	170.0	328.0	315.9	0.841
August	177.4	97.7	30.90	179.1	169.0	324.3	312.1	0.838
September	179.3	75.9	30.40	188.0	177.8	338.6	325.6	0.833
October	167.2	63.4	28.90	183.4	173.4	330.7	318.1	0.834
November	134.1	51.0	24.00	153.5	144.7	282.9	272.7	0.854
December	120.6	48.0	19.29	140.4	132.2	264.4	255.1	0.874
Year	2046.9	887.8	27.28	2159.7	2039.7	3931.4	3783.4	0.842

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

Fixedtilt_0°Az_bifacial_30°_old
Balances and main results

	GlobHor kWh/m²	DiffHor kWh/m²	T_Amb °C	GlobInc kWh/m²	GlobEff kWh/m²	EArray MWh	E_Grid MWh	PR
January	132.4	46.5	17.90	183.6	173.3	345.4	332.1	0.870
February	141.2	53.0	21.20	177.1	167.0	329.2	316.4	0.859
March	186.2	70.9	26.10	209.2	196.7	382.9	367.9	0.845
April	201.5	81.9	30.00	202.1	189.4	368.1	353.5	0.841
May	217.2	94.9	32.90	197.6	184.4	362.9	348.9	0.849
June	206.5	100.0	33.30	181.9	169.4	337.1	324.5	0.858
July	183.3	104.6	32.10	163.7	152.0	307.4	296.2	0.870
August	177.4	97.7	30.90	170.4	158.6	315.5	303.7	0.857
September	179.3	75.9	30.40	191.6	179.6	349.0	335.5	0.842
October	167.2	63.4	28.90	201.9	190.2	364.9	350.5	0.835
November	134.1	51.0	24.00	180.7	170.3	332.1	319.4	0.850
December	120.6	48.0	19.29	169.3	159.5	317.6	305.6	0.868
Year	2046.9	887.8	27.28	2229.1	2090.3	4112.0	3954.1	0.853

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

Table 10 showing balances and main results of yield assessment using manual seasonal tilt system

Annual Specific Yield for manual seasonal tilt summer season: 1819 kWh/kWp

Performance Ratio: 84.22%

Annual Specific Yield for manual seasonal tilt winter season: 1901 kWh/kWp

Performance Ratio: 85.28%

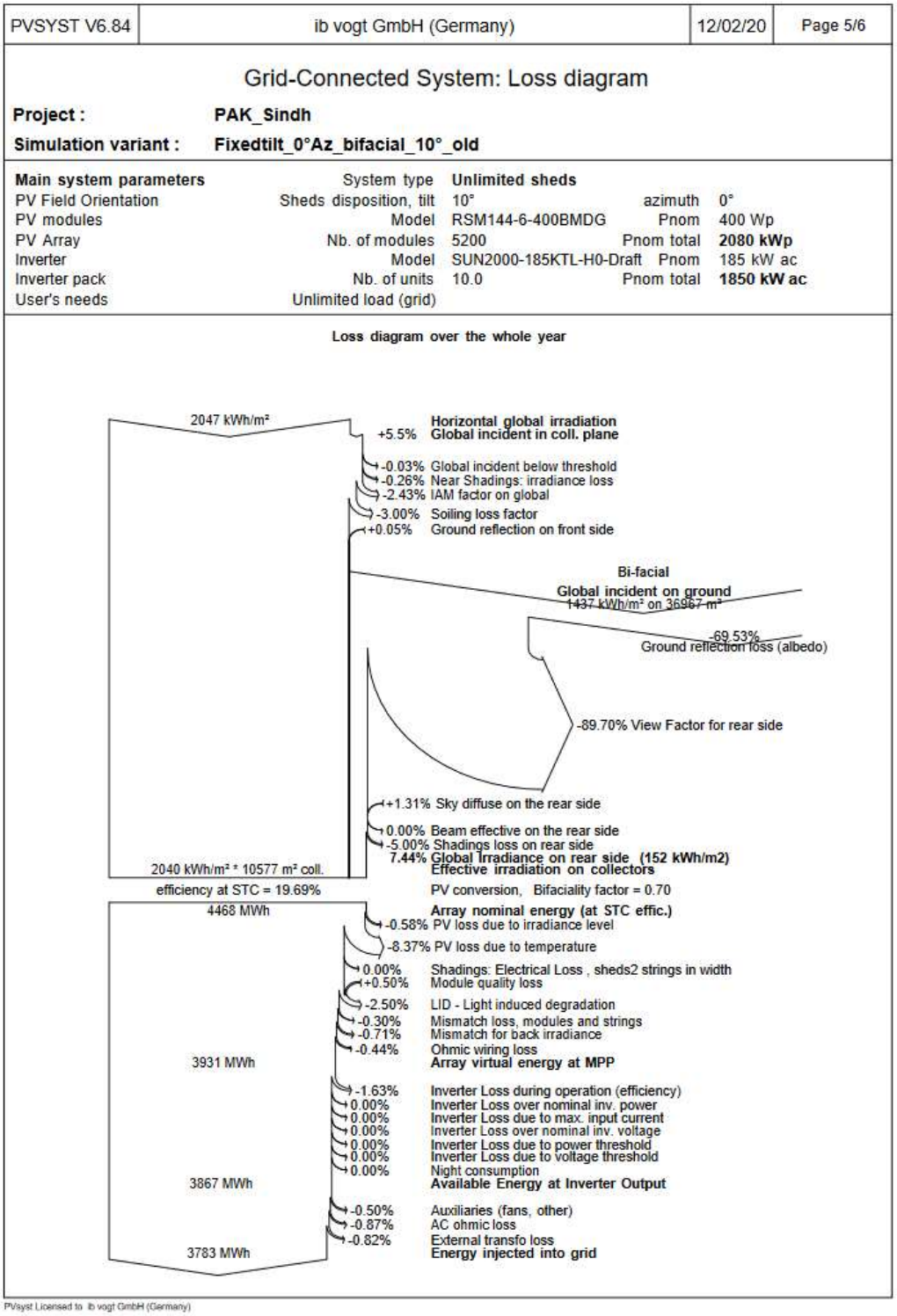

Figure 52 showing grid connected system loss diagram for Seasonal Tilt summer season

7.10.3 Single Axis trackers

Single axis tracker design using bifacial module, was finally carried out to compare the yield output with Fixed tilt and Seasonal tilt.

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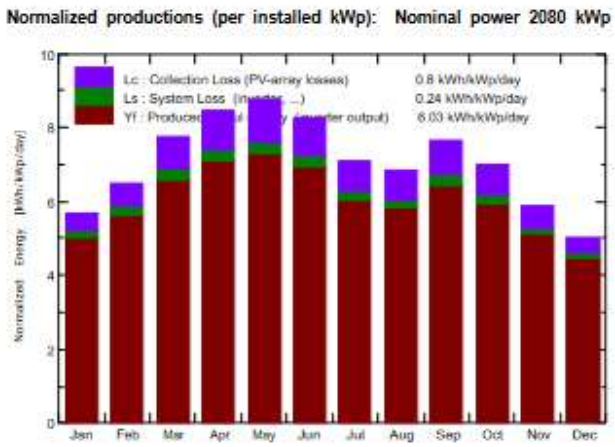
Grid-Connected System: Main results

Project : **PAK_Sindh**

Simulation variant : **Tracker_0°Az_bifacial**

Main system parameters	System type	**Trackers single array, with backtracking**		
Near Shadings	According to strings		Electrical effect	100 %
PV Field Orientation	tracking, tilted axis, Axis Tilt	0°	Axis Azimuth	0°
PV modules	Model	RSM144-6-400BMDG	Pnom	400 Wp
PV Array	Nb. of modules	5200	Pnom total	**2080 kWp**
Inverter	Model	SUN2000-185KTL-H0-Draft	Pnom	185 kW ac
Inverter pack	Nb. of units	10.0	Pnom total	**1850 kW ac**
User's needs	Unlimited load (grid)			

Main simulation results				
System Production	**Produced Energy**	**4581 MWh/year**	Specific prod.	2202 kWh/kWp/year
	Performance Ratio PR	85.23 %		



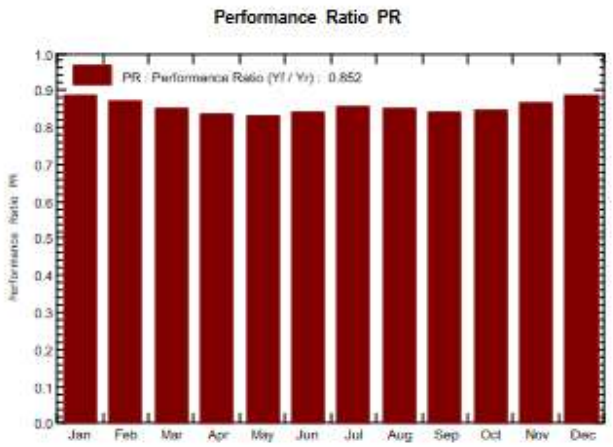


Figure 53 showing, yield assessment for solar farm using single axis trackers

Tracker_0°Az_bifacial
Balances and main results

	GlobHor kWh/m²	DiffHor kWh/m²	T_Amb °C	GlobInc kWh/m²	GlobEff kWh/m²	EArray MWh	E_Grid MWh	PR
January	132.4	46.5	17.90	176.2	165.7	336.7	324.4	0.885
February	141.2	53.0	21.20	181.4	171.1	342.2	329.3	0.873
March	186.2	70.9	26.10	240.8	228.0	443.6	426.1	0.851
April	201.5	81.9	30.00	254.6	240.9	461.4	442.6	0.836
May	217.2	94.9	32.90	271.6	257.0	489.3	469.5	0.831
June	206.5	100.0	33.30	248.3	234.3	451.2	433.3	0.839
July	183.3	104.6	32.10	219.4	206.4	405.1	389.7	0.854
August	177.4	97.7	30.90	211.4	198.8	389.8	374.7	0.852
September	179.3	75.9	30.40	229.9	217.3	419.6	403.1	0.843
October	167.2	63.4	28.90	217.3	205.3	397.5	382.1	0.846
November	134.1	51.0	24.00	177.1	166.6	330.3	318.3	0.864
December	120.6	48.0	19.29	156.5	146.7	298.6	288.1	0.885
Year	2046.9	887.8	27.28	2584.3	2437.9	4765.3	4581.2	0.852

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

Table 11 showing balances and main results of yield assessment using single axis trackers

Annual Specific Yield for Single Axis trackers: 2202 kWh/kWp

Performance Ratio: 85.23%

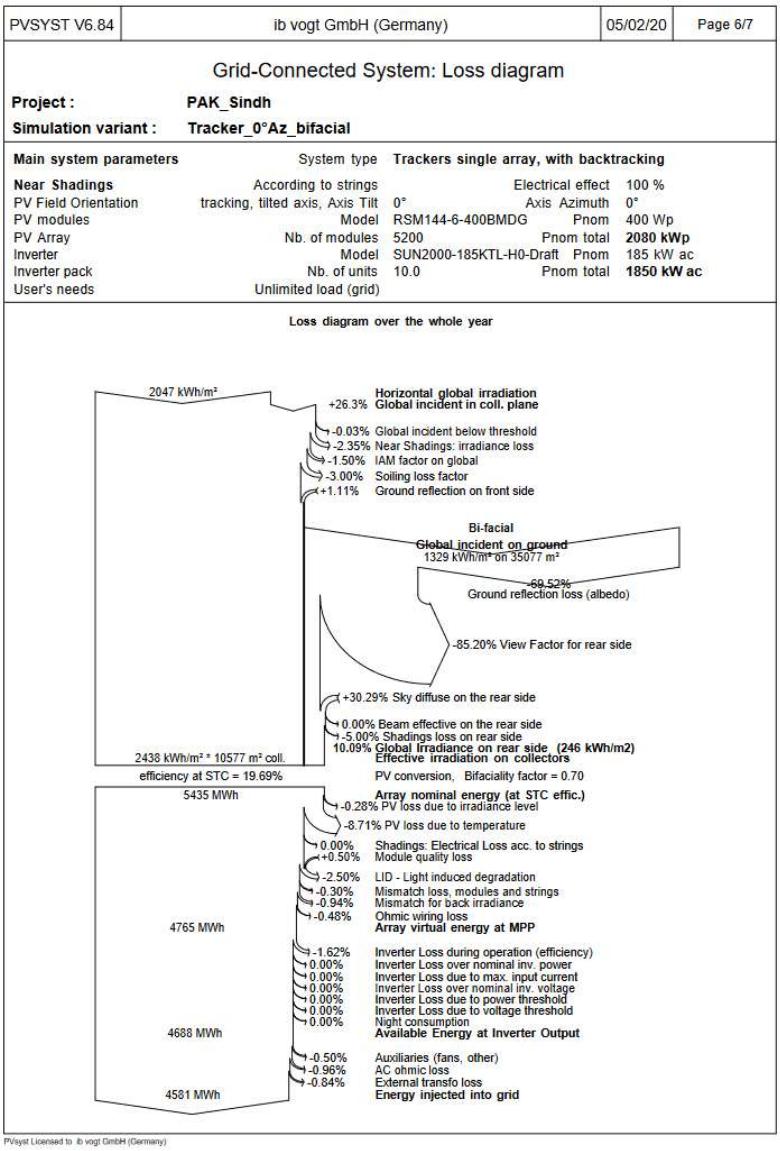


Figure 54 showing grid connected system loss diagram for single axis trackers

Summary:

The solar resource assessment for fixed tilt system, seasonal tilt and single axis tracker for Jamshorosite shows that better yield can be achieved by using the single axis trackers.

Yearly yield for fixed tilt system = 1901 KWhr / KWp

Yearly yield for seasonal tilt system (summer & winter) = 1891 KWhr / KWp & 1901 KWhr/KWp

Yearly yield for single axis trackers = 2202 KWhr / KWp

From energy production point of view clearly single axis solution is more viable option, but it will also have a cost impact on the project. As mounting structure cost for single axis trackers is higher as compared to fixed tilt and manual seasonal tilt system. Also it will increase the operation and maintenance cost of the project per megawatt.

Single axis trackers can only become viable if the excess energy produced overcomes the increase project cost and gives better project IRR when compared with fixed tilt & Seasonal Tilt.

A detailed financial modeling needed to be carried out to support the better technical solution of single axis trackers.

8. Economic Analysis

The economic analysis of a project represents one of the main steps in the assessment of the project's feasibility. Based on the technical aspects of the solar farm design as well as the findings of earlier analysis, ib vogt has developed an in depth economic analysis for a Solar PV power plant to be set up at Sindh, Jamshoro in Pakistan.

In addition to a project's viability analysis, different design options have been compared from a financial aspect, therefore optimizing the design and adding value to a potential project. During ib vogt's earlier high level analysis of the potential Jamshoro project a comparison of technologies and varying system sizes had been conducted. As a solid result of the analysis, a single-axis trackers technology has been identified as optimal technology. Besides a higher financial profitability, the single-axis trackers system also has various advantages over a seasonal tilt system during both construction and operation & maintenance phase of the project.

8.1 Financial Model Assumptions

The analysis is carried out using a designated, industry standard financial model, which was designed to suit the project needs.

The figures used and the assumptions made in the economic analysis are based on ib vogt's experience with solar projects around the world, and most importantly the guidelines provided by NEPRA in order to determine the tariff. Moreover, the SBP's revised financing scheme for renewable energy projects has been thoroughly considered in regards to the debt financing terms. However, this preliminary economic assessment is provided to demonstrate the likely feasibility of the project, and the final financial parameters would emerge upon reaching the advanced stage of the project.

The installed capacity of this project is 100 MWp. Within the first year of operating period, the annual power production will be approx. 220,139 MWh. In the subsequent years of operation, the power production should reduce with the degradation factor of 0.5% pa (standard assumption). The construction period is considered 12 months that is regarded as an ideal assumption for solar PV projects ranging from 100 MWp.

Inputs to the financial model are listed as follows.

8.1.1 Inputs

I. Total Project Costs

1. EPC Cost:

For a 2020 built project modules' costs can be expected to be in the range of USD 0.25 per MW – USD 0.30 per MW. Nevertheless, the dramatic fall of EPC costs over the last few years allows a realistic assumption of EPC costs (including grid costs, inverter costs and balance of system (BOS) costs, contingency, etc.) to be at USD 0.717 per MW, when utilizing single-axis trackers technology and Tier-1 monocrystalline bifacial solar panels. Furthermore, the EPC price allows the choice of equipment and suppliers with recognized quality, performance and bankability.

It has been noted that the Authority approved degradation factor of 0.5% in the latest cost-plus tariffs of solar technology, and hence, the aforementioned EPC costs of USD 0.717 per MW need to be adjusted for a degradation factor of 3.62% (levelized rate), either by increasing the EPC costs upfront or by making it a part of the approved total project cost based on the levelised rate of the EPC costs thereby adjusting the tariff. It is kindly requested that the authority shall consider this as a very important exercise. The table below details the components for EPC:

EPC	Costs (USD Million)
Module	25.000
Inverter	5.190
Mounting	10.000
Monitoring	1.490
Civil and Construction	19.800
Security	2.200
Grid Cost	8.000
EPC Excluding Degradation	**71.680**
Degradation	2.595
Total Construction Phase (EPC) Cost	**74.275**

Table 12 showing EPC cost of project

Under the claimed EPC cost ibvogt Gmbh shall install the equipment of the following brands, however these are subject to change following the completion of project design:

No.	Equipment	Brands
1	PV Modules	Tier 1 (Hanwah Q-Cells, Jinko, Trina, Longi solar, Risen Solar or similar)
2	Single-axis Tracker	Leading Global Supplier (Arctech, Soltec, Schletter or similar)
3	Inverter	ABB, GE, Sungrow, Huawei or similar
4	DC/AC brand	Faber or similar
5	Step – up transformers	Siemens, ABB, TBEA, QRE, Chint or similar
6	Medium voltage switch gear and 132KV substation	Siemens, ABB, Chint or similar
7	SCADA	Gatner, ABB, Schneider or similar
8	Civil works	ibvogt local entity or No limit local civil contractor
9	Project Management	ibvogt Gmbh
10	Construction Supervision	ibvogt Gmbh

Table 13 showing expected bankable equipment and service provider for the project

2. Land Cost:

The land for the project has already been determined at the lease rate of 55 USD per acre amounting the land lease cost of approx. USD 687,500 for a total land area of 500 acres for 25 years. The PKR/USD exchange rate is considered to be '120'.

3. Non-EPC and Project Development Cost:

Such costs intend to include all expenses related to development, licenses, permits, legal & tax advisor fees, due diligence costs and other establishment costs. Based on ib vogt's experience with solar projects around the world, the Non-EPC and Project Development Cost are assumed at USD 36,000 per MW (~USD 3.6 million).

4. Insurance During Construction:

As per the recently notified NEPRA Guidelines, the insurance cost during construction has been assumed as 0.4% of the proposed EPC Cost. Therefore, the total insurance cost for the construction period of 12 months is calculated as USD 0.297 million.

5. Financing Fees & Charges:

The NEPRA Guidelines suggest a financing fee to be 2% of debt amount. However, banks (specifically foreign lenders) levy some other charges in the form of lender's legal & technical advisor fee, upfront facility fee, commitment fee, agency fee etc. The amount under this head amounts to USD 1.26 million (at 2% of debt amount) containing the above fee. It is kindly requested that the authority shall assess the financing fee benchmark again based on actual costs.

6. Interest During Construction:

The interest during construction (IDC) is calculated as ~USD 3.28 million. This interest is determined on 6 month LIBOR 2.86% + Spread 4.25%. The financing parameters are discussed in the subsequent section.

As the above project costs under various heads is given hereunder:

Project Cost	(USD Million)
EPC Cost	74.27
Land Cost	0.69
Project Development Cost	3.60
Insurance during construction	0.30
Financing Fee & Charges	1.26
Interest During Construction	3.28
Total	**83.40**

Table 14 showing project cost breakdown

The table below details the components for Non-EPC:

Non-EPC	Costs (USD Million)
Project Development Cost	3.60
Land Acquisition	0.69
Insurance During Construction	0.30
Financial Charges	1.26
Total Non EPC Cost	**5.85**

Table 15 showing Non EPC cost breakdown

II. Capacity Utilization Factor

A capacity utilization factor of 25.13% is targeted to be achieved by installing the latest equipment including the sun tracking system. The capacity utilization factor is 7.13% higher than the NEPRA benchmark of 18% for the Southern region, this signifies the cutting edge solar technology being used in the local context.

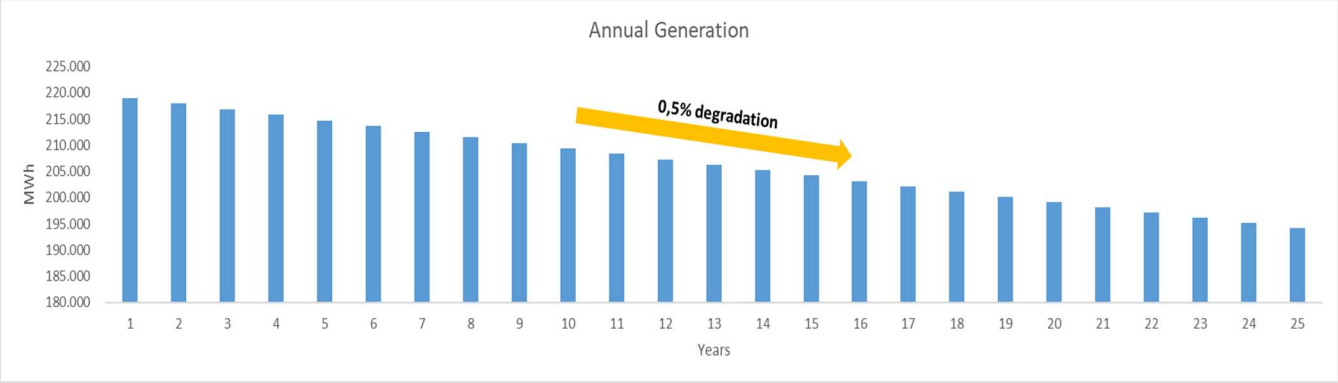
The table below details the Capacity:

Capacity/ Size	Units	Amount
Plant Size	MWp	100
Capacity Utilization Factor	%	25.13%
Annual Generation	MWh Year	220,139

Table 16 showing Plant size, CUF and annual generation

III. Degradation Factor

The degradation factor of 0.5% has been incorporated in the workings and has been done so in light of NEPRA's approvals of past projects, and this level being allowed in different parts of the world.



The annual generation Fig 55 shows a downward trend due to 0.5% degradation per annum.

IV. Total Operating Costs

1. Operation & Maintenance (O&M) Costs:

The O&M costs here include various annual costs related to operation & maintenance, inverter/spare part reserve, asset management, accounting & legal, utilities, security, facility

fee and other operating expenses. These costs commonly are one of the strongest drivers of project's annual operating expenditures and are strongly linked to country specific factors. The calculated tariff is based on annual O&M costs of USD 0.018 million/MW.

O&M Assumptions	Period	USD / MW
O&M Foreign	Per Year	7,000
O&M Local	Per Year	11,000
Total		**18,000**

Table 17 showing O&M cost breakdown

2. Insurance During Operation:

As per the recently notified NEPRA (Benchmarks for Tariff Determination) Guidelines, the insurance cost during operation has been assumed as 0.4% of the proposed EPC Cost. Therefore, the annual insurance cost during operation is calculated as USD 0.297 million.

V. Financing Parameters

The assumed financing terms for modelling and analysis purpose are primarily based on the previous approvals by NEPRA, SBP's revised financing scheme for renewable energy projects, and upon conducting initial market study.

VI. Financing/ Debt Terms

A debt to equity ratio of 80% is assumed in the financial model. The interest rate for the debt financing is set based on 6 months LIBOR plus 4.25% per year. The loan tenor is calculated as of 14 years. Moreover, the debt is assumed 100% foreign. The premium of 4.25% has been based on the most recent cases of comparable renewable technologies.

Furthermore, as an industry standard and additional security for the lender, the required Debt Service Reserve Account (DSRA) equivalent to 6 months' debt installment will be funded from the operating cash flow of the initial years.

VII. Revenues

Based on the Capacity Utilization Factor of 25.13% for this project and the industry standard assumption on an availability factor of 98% for single-axis trackers design, the first year power production would be approx. 220,139 MWh. However, this scenario assumes the

NEPRA tariff will be adjusted for the loss in production due to degradation. Consequently, the degradation is set to 0.5% to compute revenues for the plant's operating life of 25 years. The amount of USD 2.595 million has been made part of the approved project cost based on the levelized rate of 3.62% of the allowed EPC cost.

The tariff for this project has been calculated based on NEPRA tariff methodology while assuming the return on equity at 15% and determined total project costs (including the adjusted for degradation). The revenues are based on the tariff of US Cents 5.584 per Kwh during the debt-servicing period and US Cents 2.130 per Kwh thereafter, for electricity injected into the grid. **This leads to a levelised tariff of US Cents 4.9329 per Kwh.** For details relating to the tariff calculation, please refer to the Annexure - K. The authority shall kindly note that the project is located in the Southern Pakistan where solar irradiance levels are higher, thus a lower tariff shall be applied for the same.

All Cash Flows are calculated on a yearly basis and the project lifetime is fixed at 25 years. Furthermore, a corporate tax rate of 0% is assumed since profits derived from renewable electric power generation are exempt from tax in Pakistan.

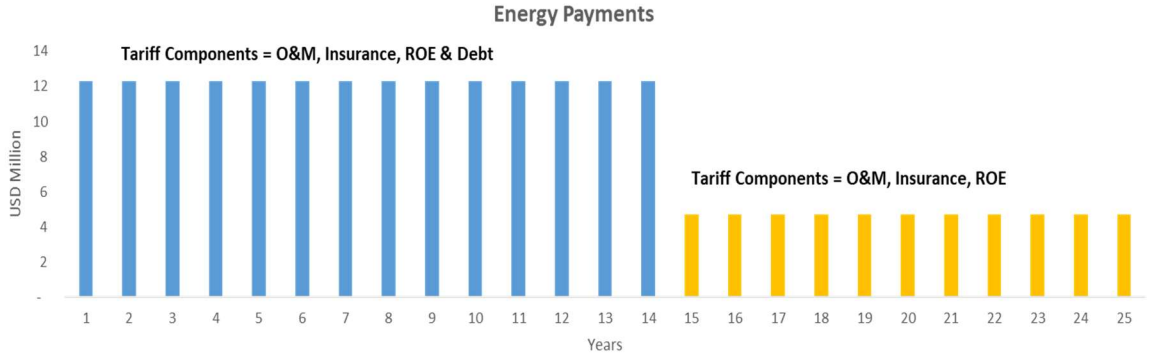


Fig 56 shows tariff loading due to debt component

For the stipulated period of year 1-14 the tariff component will be relatively higher as it contains the Debt component, however after the debt servicing period the Tariff component will fall as the Debt service period shall end.

VIII. Return on Equity

The return on equity at 15% on IRR basis has been assumed for Tariff calculation.

IX. Construction Period

The construction period has been set at 12 months. Similar sized projects also opted for upfront tariff with a construction period of 12 months. This duration has been set in light of previous approvals by NEPRA.

The following details the generation tariff alongside the terms of ibvogt Gmbh:

Tariff Components	Year 1-14	Year 15-25
Operations & Maintenance Cost	0.8177	0.8177
Insurance During Operation	0.1350	0.1350
Return on Equity	1.178	1.178
Debt Servicing	3.453	-
Total	**5.584**	**2.130**

Table 18 showing tariff components

- Levelized tariff works out to be US Cents 4.93 per Kwh
- The aforementioned tariff is applicable for twenty-five (25) years
- Debt service shall be paid in the first 14 years of commercial operation of the plant
- Debt Servicing has been worked out using six months LIBOR (2.86%) + Spread (4.25%).
- Debt to Equity of 80:20 has been used
- Return on Equity during construction and operation of 15% has been used.
- Construction period of ten (12) months has been allowed for the workings of ROEDC and IDC
- Insurance during Operation has been calculated as 0.40% of the allowed EPC Cost.
- Reference Exchange Rates of 120 PKR/USD has been used.
- Detailed component wise tariff Schedule is attached as Annex-I of this Economic Analysis

8.2 Profitability Analysis

The table below summarizes the assumptions of the various costs determined for this project, and the aforementioned KPIs obtained as a result of financial modelling & project valuation in regards to profitability.

When analyzing the cash flows to equity on a yearly basis as graphed in the figure below, the cash flows are levelised with the first 14 years representing the years in which the higher tariff is received and the debt service payments are applicable. Furthermore, it can be observed that the real cash flows to equity are considerably higher during the first 14 years of operation (debt service period) than those in later years. It is due to the decreasing energy production over the years (0.5% degradation) and the lower tariffs post-debt servicing.

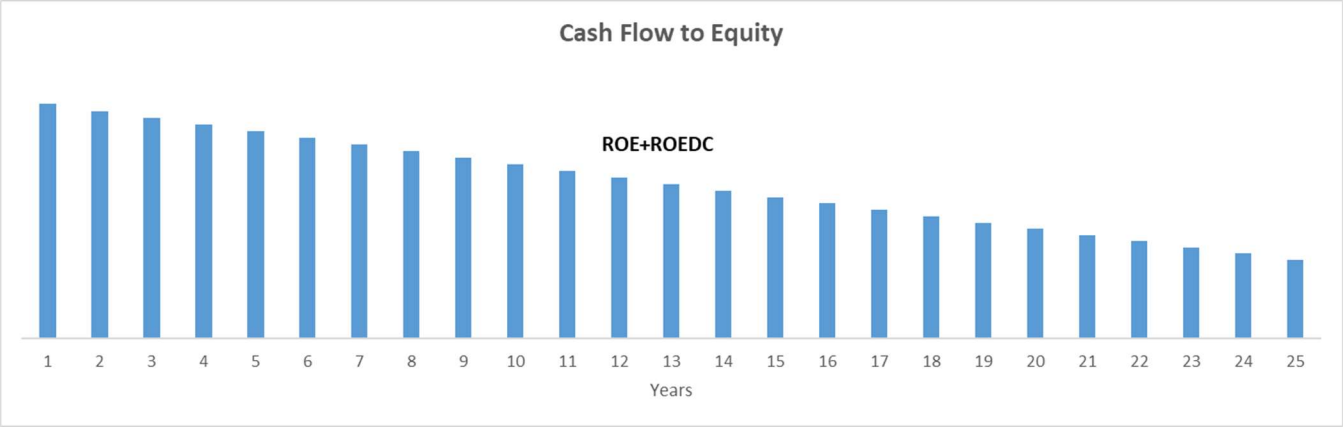


Fig 57 shows real cash flows

Summary

Project Company	F1 Solar PK Pvt Ltd	
Sponsor	Ibvogt	
Capacity	100 DC ~ 93MW AC	
Project Location	Sindh, Jamshoro	
Concession period	25 years	
Capacity Factor	25.13%	
Project Cost	**USD (Million)**	
EPC Cost	71.98	
Degradation	2.59	
Adjusted EPC Cost	74.57	
Project Development Land Cost	4.29	
Pre-COD Insurance cost	**Included in EPC cost figure**	
Financing fee & charges	1,261,751	
Interest during construction	3,277,035	
Total Project Cost	**83,398,201**	
Financing structure	Debt: 80% Equity: 20%	
Debt composition	100% Foreign	
Interest rate	6 month LIBOR + 4.25% pa	
Debt repayment term	14 years	
Repayment basis	Semi-Annual	
Return on Equity	15%	
Operations cost	45,000,000	
Tariff:	**PKR/Kwh**	**US Cents/ Kwh**
Year (1-14)	6.70	5.584
Year (15-25)	2.56	2.130
Levelized Tariff	**5.92**	**4.933**
Exchange Rate	1 USD=120 PKR	

Table 19 showing project financial overview

Tariff Sheet:

US Cents per Kwh

Concession period	O&M - Foreign	O&M – Local	Insurance during Operations	ROE	ROEDC	Foreign Debt Service		Local Debt Service		Total Tariff
						Financial charges	Principal payment	Financial charges	Principal payment	*US Cents per Kwh*
1	0.3180	0.4997	0.1350	1.065	0.112	2.1318	1.3216	-	-	5.584
2	0.3180	0.4997	0.1350	1.065	0.112	2.0362	1.4173	-	-	5.584
3	0.3180	0.4997	0.1350	1.065	0.112	1.9336	1.5198	-	-	5.584
4	0.3180	0.4997	0.1350	1.065	0.112	1.8237	1.6298	-	-	5.584
5	0.3180	0.4997	0.1350	1.065	0.112	1.7057	1.7477	-	-	5.584
6	0.3180	0.4997	0.1350	1.065	0.112	1.5792	1.8742	-	-	5.584
7	0.3180	0.4997	0.1350	1.065	0.112	1.4436	2.0098	-	-	5.584
8	0.3180	0.4997	0.1350	1.065	0.112	1.2982	2.1553	-	-	5.584
9	0.3180	0.4997	0.1350	1.065	0.112	1.1422	2.3113	-	-	5.584
10	0.3180	0.4997	0.1350	1.065	0.112	0.9749	2.4785	-	-	5.584
11	0.3180	0.4997	0.1350	1.065	0.112	0.7956	2.6579	-	-	5.584
12	0.3180	0.4997	0.1350	1.065	0.112	0.6032	2.8502	-	-	5.584
13	0.3180	0.4997	0.1350	1.065	0.112	0.3970	3.0565	-	-	5.584
14	0.3180	0.4997	0.1350	1.065	0.112	0.1758	3.2776	-	-	5.584
15	0.3180	0.4997	0.1350	1.065	0.112	-	-	-	-	2.130
16	0.3180	0.4997	0.1350	1.065	0.112	-	-	-	-	2.130
17	0.3180	0.4997	0.1350	1.065	0.112	-	-	-	-	2.130
18	0.3180	0.4997	0.1350	1.065	0.112	-	-	-	-	2.130
19	0.3180	0.4997	0.1350	1.065	0.112	-	-	-	-	2.130
20	0.3180	0.4997	0.1350	1.065	0.112	-	-	-	-	2.130
21	0.3180	0.4997	0.1350	1.065	0.112	-	-	-	-	2.130
22	0.3180	0.4997	0.1350	1.065	0.112	-	-	-	-	2.130
23	0.3180	0.4997	0.1350	1.065	0.112	-	-	-	-	2.130
24	0.3180	0.4997	0.1350	1.065	0.112	-	-	-	-	2.130
25	0.3180	0.4997	0.1350	1.065	0.112	-	-	-	-	2.130
	Levelized Tariff									
	0.3180	0.4997	0.1350	1,065	0,112	1.2238	1.5789	-	-	**4,9329**

Table 20 showing project tariff sheet

Expertise in solar power plants

ib vogt GmbH

www.ibvogt.com

ib vogt at a glance

About ib vogt

- Established in 2002, family-owned company
- Focus: Developing and delivering high-quality large-scale turnkey PV plants worldwide
- Strong network of local development partners
- Multi-source financing solutions including DFIs and ECGs
- Engineering “Made in Germany”

Worldwide presence

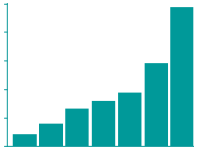
- Creating business in 43 countries
- Headquarters Berlin, Germany
- Offices in UK, Netherlands, Spain, France, Poland, Egypt, USA, Australia, India, Singapore, Philippines, Pakistan + joint ventures in more than 20 countries

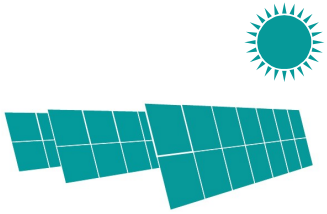
Global integrated developer of turnkey PV plants

- > 752 MWp of turnkey PV plants sold to institutional investors
- Funds raised > €1.15bn
- Clients: first-class "blue chip" financial, infrastructure and energy investors

ib vogt continues to grow

- > €170 m. turnover 2018
- > 350 MWp built and under construction 2018
- > 260 employees globally in a diversified organization comprising over 20 nationalities





> 5 GWp	> 1.15 GWp	> 525 MWp
PV Project Pipeline	PV Solutions built	Operations & Maintenance

Benefits – ib vogt as your partner

LOCAL DEVELOPERS

- We offer balanced, long-term partnerships to combine local market know-how with our international expertise in technology, financing and supply chain for the joint development of projects.
- We invest in the early stage to the late stage of development.
- We maintain excellent relations to banks, investors, buyers, development finance institutions (DFIs) and export credit agencies (ECAs).
- Fully integrated approach from conception to turnkey handover, supported by comprehensive financing capabilities.

INVESTORS AND LENDERS

- We create comprehensive financing models based on our multi-source financing experience and powerful internal project financing, legal and transaction capabilities.
- We have a strong track record of projects delivered on quality, on time and on budget.
- We maintain first class supplier relations for access to best components and best prices.
- Our clients include leading “Blue Chip” financial institutions and funds.

TURN-KEY INVESTORS AND CUSTOMERS

- We deliver turnkey PV assets with attractive risk-weighted returns.
- We offer an all-round service from project development to end of lifetime, accompanied by thorough documentation and certification.
- We select the best suppliers and components and combine them with German engineering for longevity, high performance and reliability.

History

2002
- Incorporation ib vogt GmbH
- Focus factory engineering

2009
- Focus PV plants
- Market entry UK
- EPCM Germany

2010
- First turnkey PV plant delivered Germany

2011
- First two 5 MWp Feed-in Tariffs (FIT) PV plants in UK

2012
- Establishment of Joint Venture for India and Southeast Asia
- Delivery first PV plants in Slovenia

2013
- Exceeding the 100 MWp barrier

2014
- Building of UK´s largest PV plant with 37.8 MWp in 8 weeks

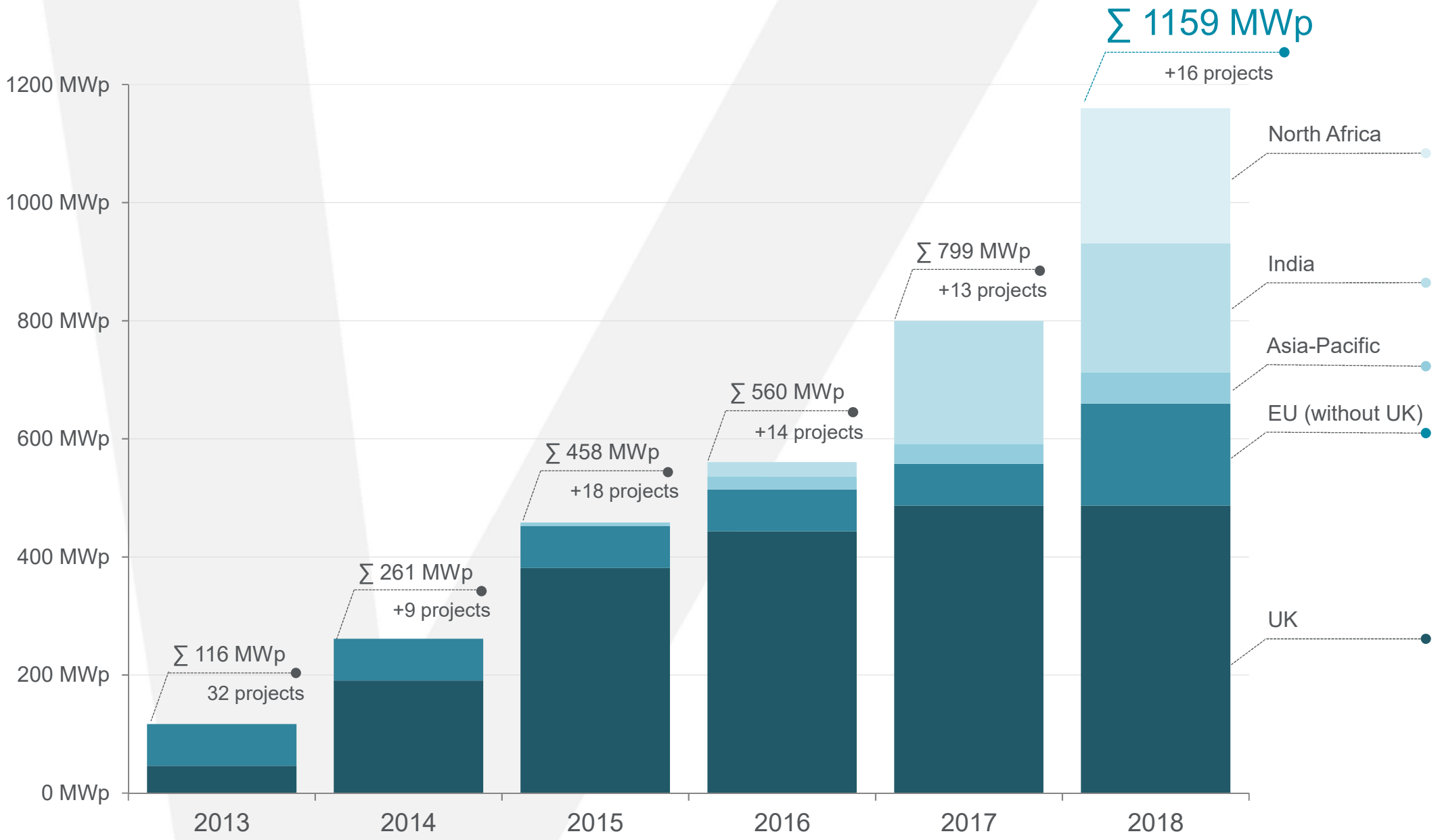
2015
- Portfolio of 3 PV plants commissioned in the Philippines

2016
- Delivery of first PV plants in Australia
- Infinity 50 - 64.1 MWp round one FiT project, Benban, Aswan, Egypt
- Market entry Netherlands, Ireland

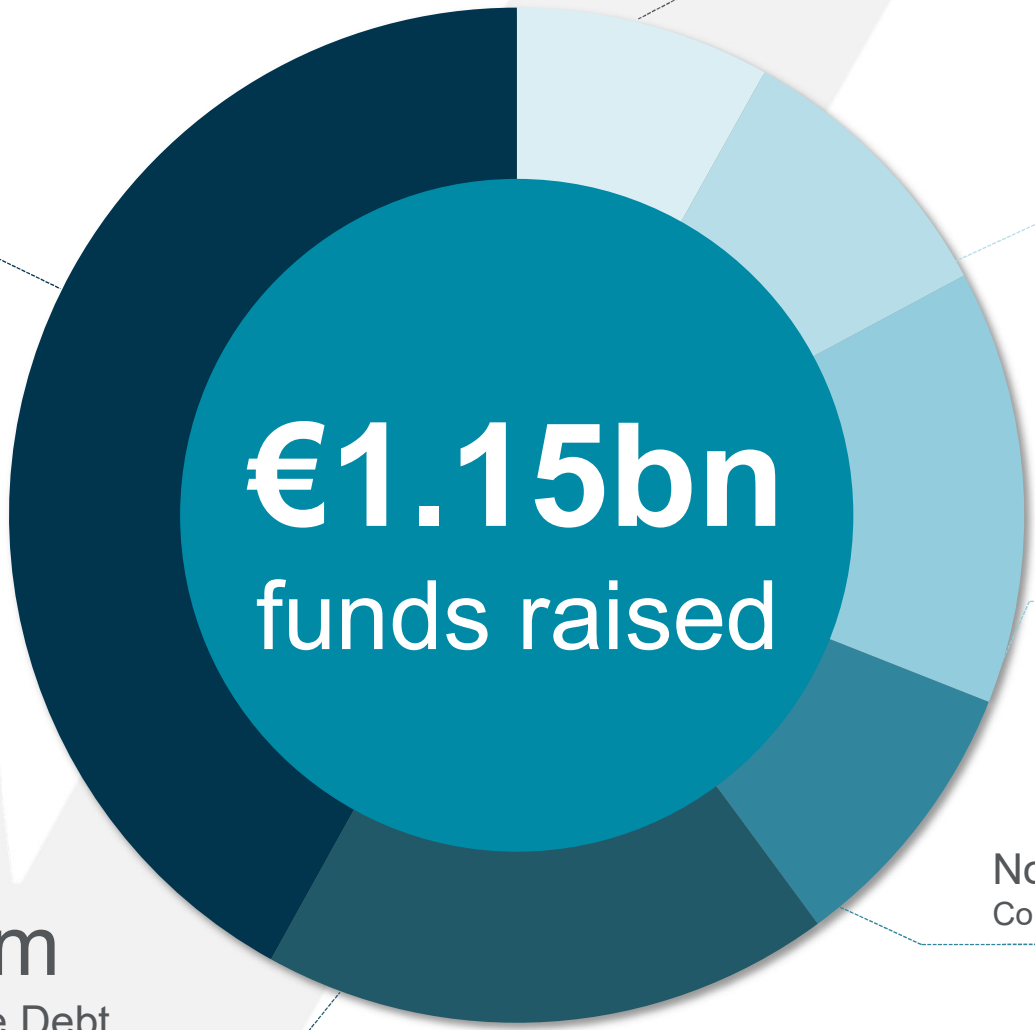
2017
- Financial close of three further PV plants with a total of 166 MWp in the second round of Egypt's FiT programme
- Delivery of first PV plants in the Netherlands, part of a several hundred MWp pipeline.

2018
- Construction of 166 MWp PV in Egypts Benban complex
- Delivery of the largest solar park in the Netherlands
- Acquisition of nv vogt Singapore Pte. Ltd.

Total capacity of solar power plants built and in construction



Solar project financing experience



€94m
Bonding lines

€105m
Non-Recourse Export Credit
Financing plus local tranches
Egypt, Hermes cover, 64MW

€160m
Bridge/Corp Financing
Family Offices/ Suppliers/ Banks

€103m
Non-Recourse Debt
Commercial

€210m
Non-Recourse Debt
DFIs & ECGs

€486m
Construction Financing
Refinancing from specialized funds

Integrated development: Scope of Services

Project Development

Holistic approach: When developing PV plants in our network, we take all regulatory, legal, technical and economic factors into consideration.

We invest in local development partnerships and contribute our international expertise, from site selection and permitting to grid connection and PPA´s.

Financing

ib vogt delivers comprehensive financing models based on our multi-source financing experience and powerful internal project financing.

At the same time, we maintain excellent relationships with banks, investors, buyers, development finance institutions (DFIs) and export credit agencies (ECAs).

Engineering, Procurement and Construction

ib vogt specialises in comprehensive EPC solutions for clients around the globe. Our expertise is centred on maximising energy yields and plant reliability through superior design and high quality component selection.

Ensuring strong operational and financial performance based on “Engineering in Germany” are key aspects of our engineering services.

Operation and Maintenance

Throughout the operational lifetime, we continuously maximize power generation and minimize downtime. We control expenses by ensuring fewer repairs, faster recoveries and less downtime.

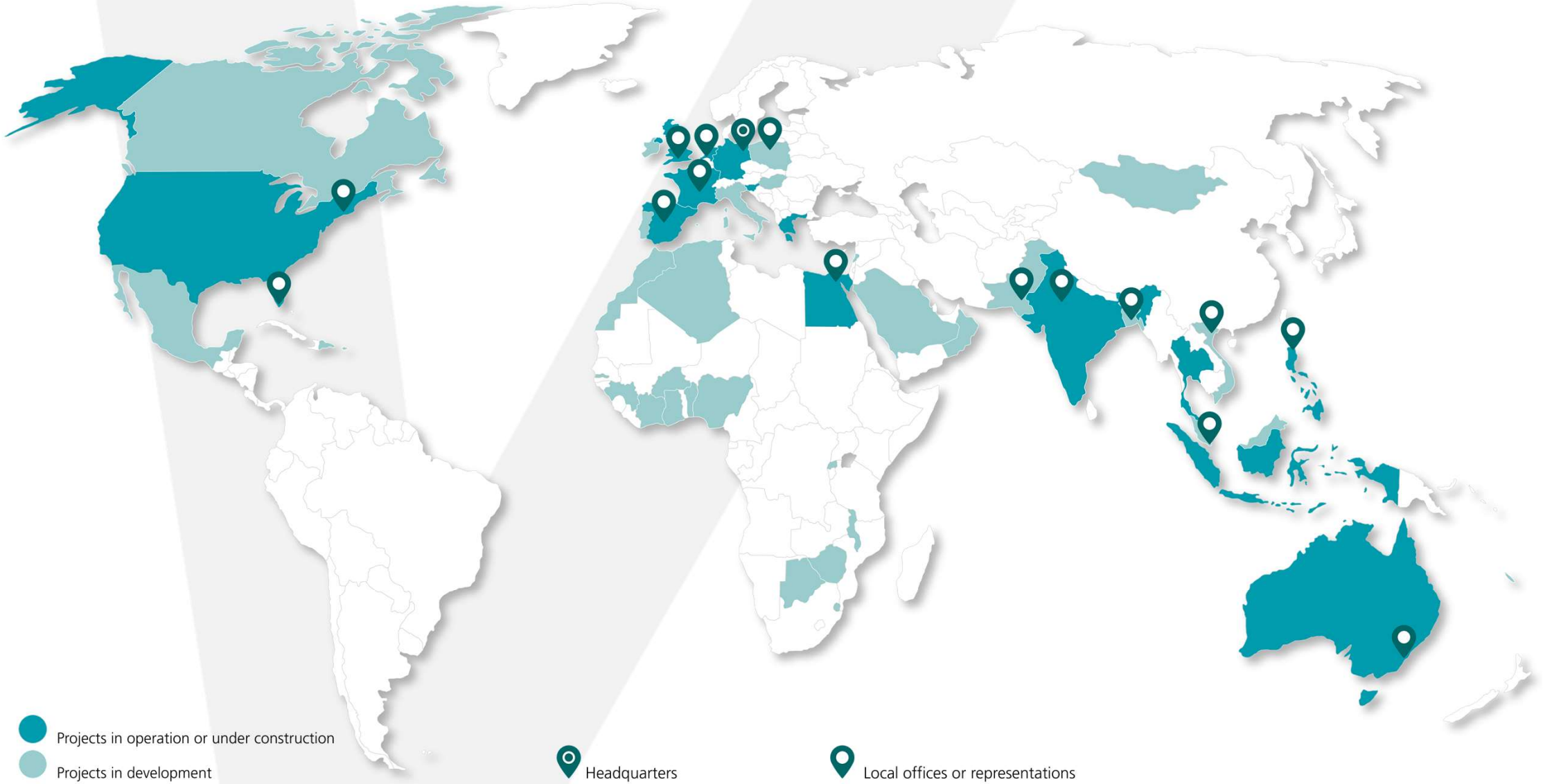
Asset management

We take over the entire management of your plant. This includes managing technical and administrative processes, verifying contractual obligations and managing supplier and customer relationships.

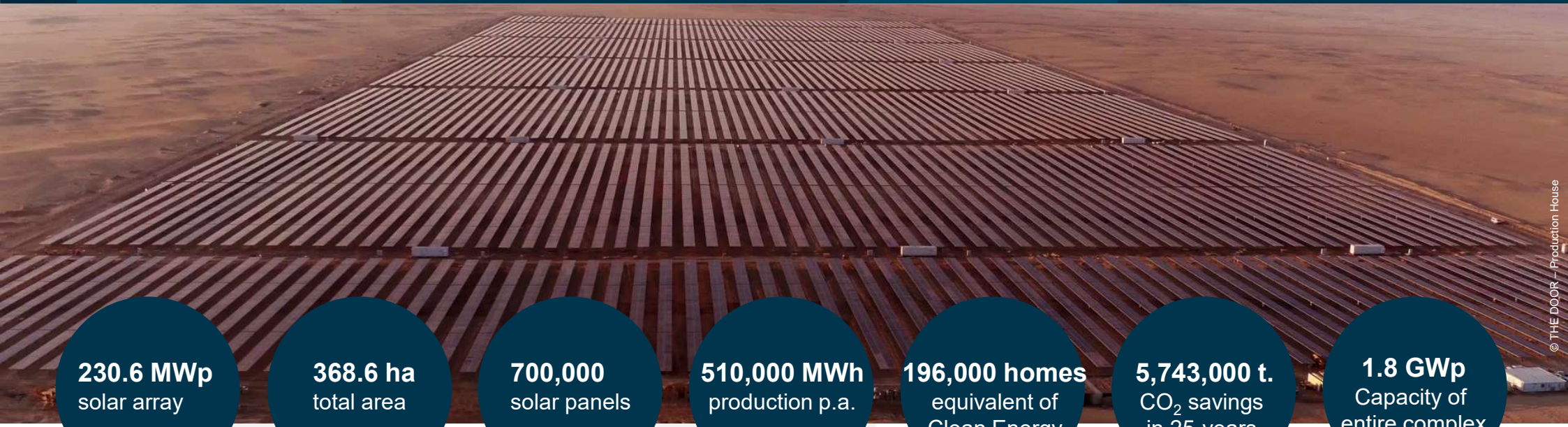
International markets

Committed to long term growth in the international markets.

Local challenges and global solutions. The success of our solar power projects stems from the partnerships we cultivate – both with local and international stakeholders. The results we produce consistently exceed our clients' expectations.



Project example – Egypt, Benban solar complex



230.6 MWp solar array

368.6 ha total area

700,000 solar panels

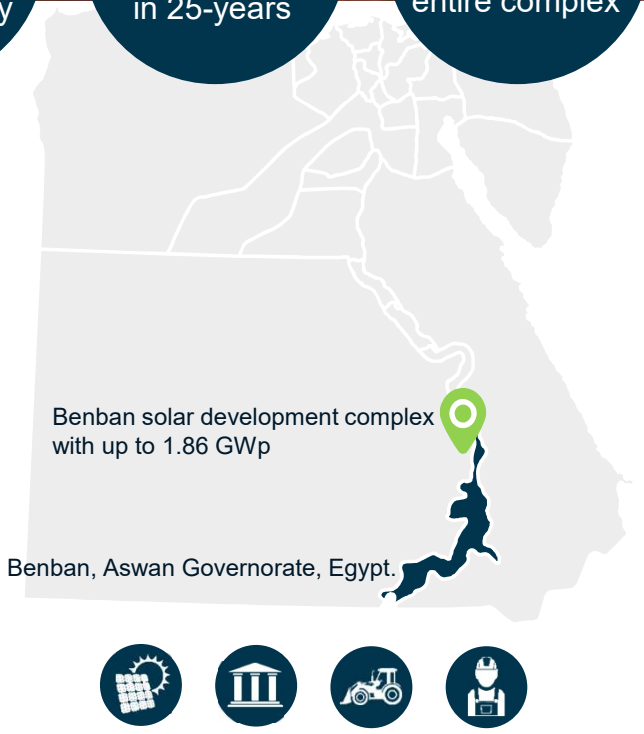
510,000 MWh production p.a.

196,000 homes equivalent of Clean Energy

5,743,000 t. CO_2 savings in 25-years

1.8 GWp Capacity of entire complex

- Project partners: International conglomerate consisting of ib vogt GmbH, Infinity Solar S.A.E, Phoenix Energy, BPE Partners and Solizer GmbH
- 25-year PPA with Egyptian Electricity Transmission Company (EETC)
- Financing provided by three consortia consisting of the European Bank for Reconstruction and Development (EBRD), the Dutch Development Bank (FMO) and the Green Climate Fund (GCF) and the International Finance Corporation (IFC), the Asian Infrastructure Investment Bank (AIIB) and the CDC Group, the Bayerische Landesbank and the Arab African International Bank, covered through an Euler Hermes ECG
- The project was constructed and commissioned by ib vogt GmbH as the EPC contractor and O&M services provider
- Energization of the last project section in Q1 of 2019



Project example – Netherlands, Scaldia 54.5 MWp

54.5 MWp
solar array

38 ha
total area

140,000
solar panels

8 KM
under HV overhead line

51,000 MWh
production p.a.

14,000 homes
equivalent of Clean Energy

738,000 t.
CO_2 savings in 30-years

- In 2016 the project obtained SDE+ and was acquired by ib vogt
- Non-recourse project financing of EUR 47 million raised
- 17-year PPA (Power Purchase Agreement) including GvO´s (Certificates of Origin) contract
- Energization of the project in Q3 2018

Our Leadership Team - Composed of experts within the solar industry.

Carsten Stang
Managing Director (CCO)
10 years*

Anton Milner
Managing Director (CEO)
19 years*

Carl von Braun
Managing Director (CFO)
14 years*

Joachim Altpeter
Executive Director
Middle East and Africa
22 years*

David Ludwig
Director Asia-Pacific
7 years*

Parish Gupta
Director India
6 years*

Olaf Salzwedel
Director Engineering &
Systems Integration
13 years*

Michael Reinhold
Director Operations
14 years*

Patrick Zenker
Director Procurement
13 years*

Mathias Künicke
Director EPC Projects
9 years*

José Joaquin Muñoz Osuna
Director of Project Finance
14 years*

David Trujillo
Head of Legal
12 years*

Heiko Ramisch
Director of Due Diligence
& Transaction Services
11 years*

Nicole Mattern
Director Accounting
16 years*

Alexander Hanke
Director Corporate Finance
13 years*

Angela Kleber
Head of Controlling
2 years*

Stefan Lissner
Director
of Strategic Projects
12 years*

* solar industry experience

Disclaimer

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GRID INTERCONNECTION ASSESSMENT OF 100MWp Ib Vogt SOLAR PV POWER PLANT

ARCO Energy

Draft Report
March 2020

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CONTENTS

EXECUTIVE SUMMARY

This Grid Interconnection Assessment (GIA) report provides the documentation of an assessment that has been performed for the connection of a 93.76MW (AC) Solar PV Power Generation project by F1 Solar PK Pvt Ltd. (SPV) to the Hyderabad Electric Supply Company (HESCO) transmission system at 132kV. The '93.76MW (AC) Solar PV Power Generation project' located in Jamshoro, Sindh, Pakistan and has a commercial operation date of March 2023. The project will be connected by making an In/Out on 132kV Single circuit between PAF – Jamshoro-Old grid station by a feed length of 7km of Lynx conductor.

Steady state power flow assessment has been performed using the network data provided by HESCO. Pre-project power flow study was conducted to analyze the magnitude and phase angles of bus voltages, line loadings and power flows under steady-state conditions. Post project power flow analysis has also been performed after the interconnection of the proposed project with the HESCO transmission system. The power flow results for the system intact and for the contingency conditions shows that the power flows on all the transmission line branches are within their normal thermal loading limit. There is no capacity constraint in terms of power flow or voltage ratings within the study area.

Dynamic stability analysis has been performed to access the dynamic impact of the Solar power plant on national grid system due to disturbances at the power plant and vice versa. The results of dynamic stability analysis indicate that the power system is stable for the interconnection proposal and it also fulfils all the criteria for generation connection with the power system.

Short circuit analysis has been performed to evaluate the contribution of the proposed project in fault current levels of substations in its electrical locality. Fault currents have been computed based on simulation of three-phase and single-line-to-ground faults by applying the criteria as mentioned in the IEC-60909 standard. Result of the analysis shows that the calculated fault currents are below the circuit-breaker interrupt ratings of existing grid stations located in locality of the project.

Based on the study results, it is concluded that proposed generation interconnection assessment for 93.76MW (AC) Solar PV Power Generation project meets the NEPRA grid code planning criteria.

1 INTRODUCTION

1.1 Project Description

This Grid Interconnection Assessment (GIA) report provides the documentation of an assessment that has been performed by ARCO Energy in response to a request made by F1 Solar PK Pvt Ltd. (SPV) "Project Owner" or "PO" for the connection of a 93.76 MW (AC) Solar PV Power Generation project ("Project") to the Hyderabad Electric Supply Company (HESCO) transmission System at 132kV. The PO has proposed a commercial operation date of March 2023 for the Project.

The project is located in Jamshoro, Sindh. Figure 1.1 shows Google site map of the project. The pre-project and post-project geographical representation of power plant is shown in Figure 1.2 and Figure 1.3.

Figure 1.1: Google Site Map of the Solar PV Power Generation Project.

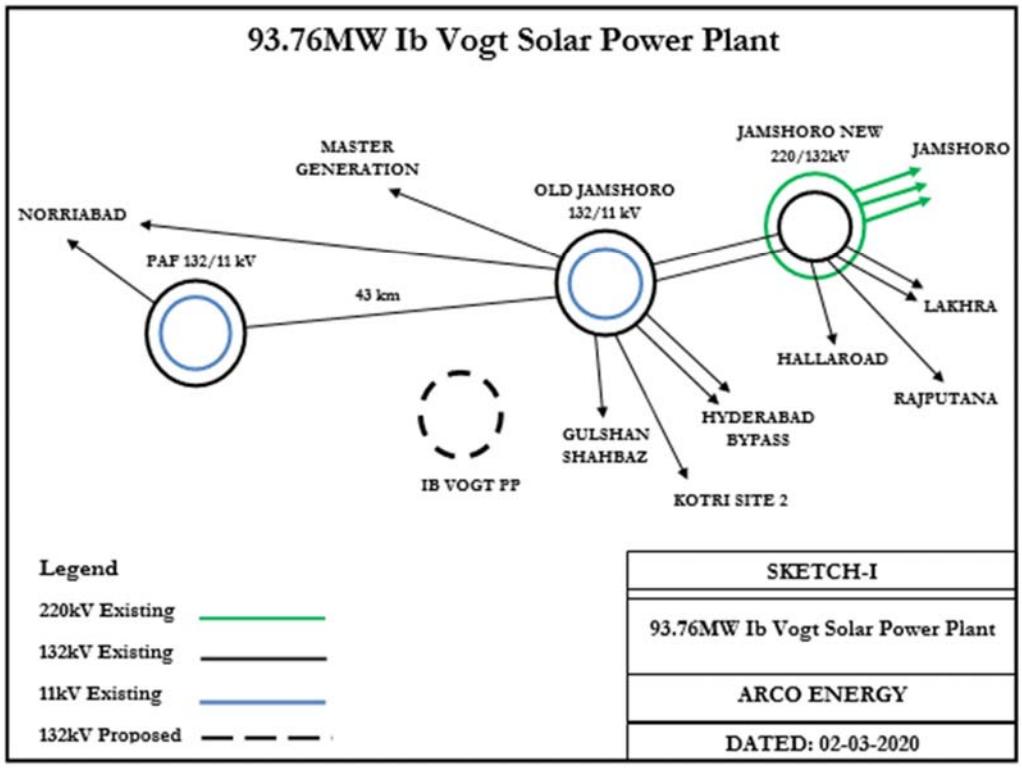

Figure 1.2: Existing Network around Ib Vogt Solar Park.

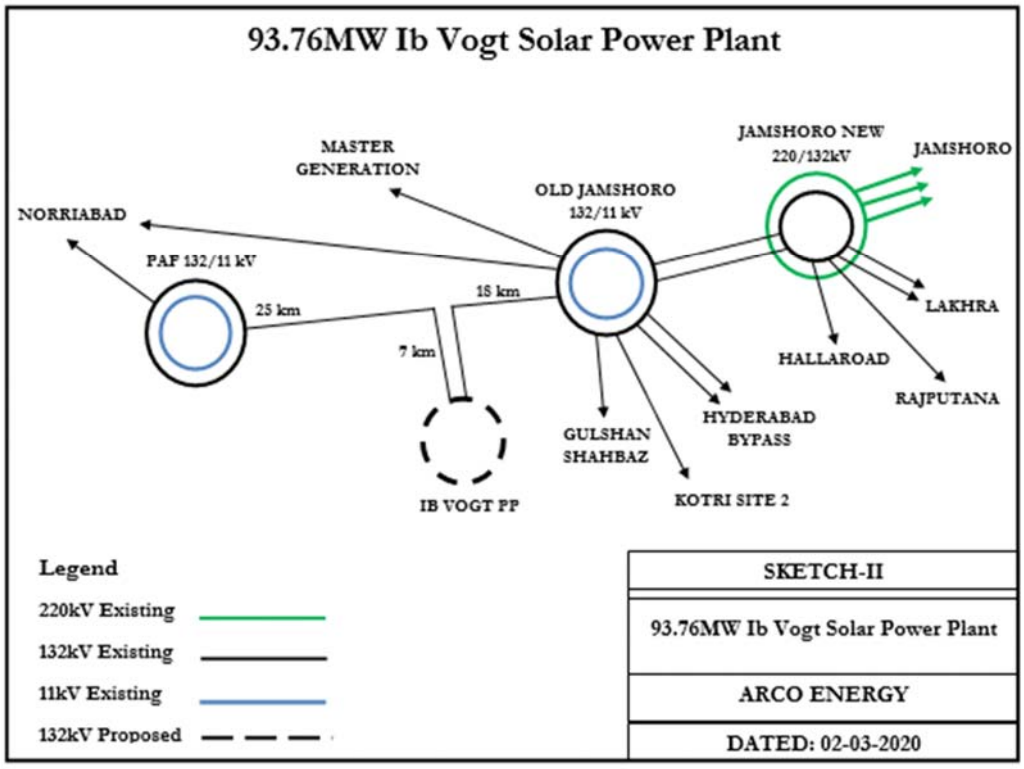

Figure 1.3: Interconnection Proposal of Ib Vogt Solar Park.

1.2 Grid Interconnection Arrangement

The project will be connected by making an In/Out on 132kV Single circuit between PAF – Jamshoro-Old grid station by a feed length of 7km of Lynx conductor. The objective of the GIA is to evaluate the impact of the proposed solar power plant on the HESCO transmission system.

1.3 Study Components

GIA includes the following three types of analyses to evaluate the impact of interconnecting the proposed project:

i) Steady state analysis.
ii) Dynamic stability analysis.
iii) Short circuit analysis.

This report documents the results of the steady state, dynamic stability, short circuit. The steady state analysis includes pre-project and post project power flow assessment. Dynamic stability analysis includes the post project dynamic stability assessment during occurrence of any fault. Short circuit analysis includes pre-project and post project short circuit current levels assessment at different buses in the vicinity of the project.

2 STUDY METHODOLOGY

2.1 Study Criteria

GIA has been carried out based on the National Electric Power Regulatory Authority (NEPRA) Grid Code planning criteria. Key parameters and their corresponding limits have been summarized in table below.

Parameter		Range
Voltage	Normal Condition	±5 % p.u at 132kV and below +8%,-5% p.u at 220kV and above
	Contingency	±10 % p.u
T/L Loading Capacity	Normal Condition	80%
	Contingency	100%
Frequency	Nominal	50 Hz
	Steady State Variation	49.8 Hz - 50.2 Hz
	Contingency Band	49.4 Hz - 50.5 Hz
Power Factor	Lagging	0.95
	Leading	0.95

2.2 Steady State Analysis

The purpose of steady-state analysis is to analyse the impact of the proposed solar power plant on transmission system facilities under steady-state conditions. It involves two distinct analyses: line loading analysis and voltage analysis. Power flow solutions using the PSS/E® program (Version 33.4) has been performed.

A "study area" was defined to represent the areas of interest which includes the following areas within HESCO:

- JAMSHORO-OLD
- NOORIABAD
- JHIMPER
- KOTRI
- PAF

2.2.1 System Intact Analysis

The incremental impact of the project on substation and transmission line loading under normal conditions was evaluated by comparing transmission system power flows without and with the proposed project. Loadings of the transmission facilities without and with the project were tabulated and compared.

2.2.2 Contingency Analysis

The contingency analysis for this study consists of single branch (N-1) outage in the study area.

2.2.3 T/L Loading Analysis

132kV and 33kV rated transmission facilities in the study area have been monitored for thermal loadings.

2.2.4 Voltage Analysis

Voltages at buses inside the study area have been monitored for possible pre and post project voltage violations in accordance with NEPRA Grid Code guidelines.

2.3 Dynamic Stability Analysis

The purpose of dynamic stability analysis is to analyse the impact of the proposed solar power plant on transmission system facilities under transient conditions. The system is considered to be stable if the system recovers with good damping after the transients die out and the synchronism is retained.

Fault clearing time for different voltage levels in accordance with NEPRA Grid Code guidelines is presented in table below.

Voltage Level	Fault Type	Fault Clearing Time
132kV	3-Phase	5 Cycles (100msec)
132kV (Stuck Breaker)	1-Phase	9 Cycles (180msec)

2.4 Short Circuit Analysis

The purpose of short-circuit analysis is to investigate the fault current levels at nearby substations without and with the proposed project online. To purpose the CBs Rating w.r.t. SC Level and to check whether the calculated pre-project and post-project fault currents are within the circuit breaker interrupt ratings. Short circuit analysis has been carried out by applying the criteria as mentioned in the IEC-60909 standard.

Key assumptions in IEC-60909 are given below.

- Tap ratios to unity

- Line charging to zero
- Shunts are set to zero in positive sequence
- Desired voltage magnitude at bus bars is set to 1.1p.u.

3 STEADY STATE ANALYSIS

3.1 Model Development

Project specific data was provided by the plant owner and it has been compiled and presented in Annexure-A. The steady state model of the power plant is presented in table below:

Generator					
No. of Collector Units	3	2	1	1	1
Generation size of each collector (MVA)	6.06	18.18	16.16	10.77	17.17
Active Power of each collector Pgen. (MW)	5.76	17.28	15.36	10.24	16.32
Power Factor	0.95 lagging, 0.95 leading				
Qmin, Qmax (MVAR)	-1.8932, 1.8932	-5.6797, 5.6797	-5.0486, 5.0486	-3.3567, 3.3567	-5.3641, 5.3641
Rated Frequency	50 Hz				
Generation Voltage	0.8kV				
Xsource	∞				

Switchyard Transformer	
No. of Transformer units	3
MVA Capacity of each GSU	55
Rating	22/132kV
% Reactance (X)	13%
(X+ve) = (Xzero) At 100MVA system base.	0.2 p.u

Generation Step Up (GSU) Transformer		
No. of Transformer units	5	1
MVA Capacity of each GSU	17.1	11.4
Rating	0.8/22kV	
% Reactance (X)	12%	9%
(X+ve) = (Xzero) At 100MVA system base.	0.5	0.72 p.u
Auxiliary Load	0.0432MW	

Steady state power flow assessment has been performed using the network data provided by HESCO.

3.2 Pre Project-Power Flow Assessment

A pre-project power flow study was conducted to analyze the magnitude and phase angles of bus voltages, line loadings and power flows under steady-state conditions.

The results of the pre-project power flow analysis are in **Annexure-C**.

3.2.1 Base Year 2023: Peak Loading Summer

Power flow analysis has been performed on the peak loading summer (September) case of HESCO network. This base case included a detailed representation of the HESCO transmission system in the study area.

The power flow results for the normal and contingency conditions depicts that the power flows on all the transmission line branches are within their normal loading limit. There is no capacity constraint in terms of power flow or voltage ratings within the study area.
Results from the power flow analysis are presented in table below.

Condition	Contingent Branch	Figure No.	Steady State Result
System Intact	-N.A-	Figure C-1	No overloading
Contingency	JAMSHORO OLD to PAF line out	Figure C-1.1	No overloading
Contingency	JAMSHORO OLD to NOORIABAD line out	Figure C-1.2	No overloading
Contingency	JAMSHORO OLD to KOTRI SITE-2 line out	Figure C-1.3	No overloading
Contingency	KOTRI GTPS to JHIMPIR line out	Figure C-1.4	No overloading
Contingency	JAMSHORO OLD to JAMSHORO NEW line out	Figure C-1.5	No overloading
Contingency	NOORIABAD to KHLUKUHR line out	Figure C-1.6	No overloading

3.3 Post Project Power Flow Assessment

Post project power flow study was conducted to determine the reliability impact of the proposed 93.76MW Ib Vogt Solar Park project on the HESCO transmission system. This includes the performance of a contingency analysis to identify any facility overload or voltage condition that

violates the NEPRA planning criteria. Any such violation that is either directly attributable to this project or for which it will have a shared responsibility is included in this report.

The results of the post project power flow analysis are plotted in **Annexure-D.**

3.3.1 Base Year 2023: Peak Loading Summer

A base case has been developed for peak loading summer (September) 2023 that allow us to judge the maximum impact of Ib Vogt Solar Park project on the HESCO network, using the network data provided by HESCO.

Post-project power flow analysis has been performed after the interconnection of the proposed project with the HESCO transmission system. This includes the detailed representation of the power plant. A simulation of all possible contingencies within the NEPRA Grid Code planning criteria has also been carried out.

The steady state results for the normal and contingency conditions depicts that the power flows on all the transmission line branches are within their normal loading limits. There is no capacity constraint in terms of load flow or voltage ratings around the study area.
Results from the power flow analysis are presented in table below.

Condition	Contingent Branch	Figure No.	Steady State Result
System Intact	-N.A-	Figure D-1	No overloading
Contingency	IB VOGT Solar PP to PAF line out	Figure D-1.1	No overloading
Contingency	JAMSHORO OLD to NOORIABAD line out	Figure D-1.2	No overloading
Contingency	JAMSHORO OLD to KOTRI SITE-2 line out	Figure D-1.3	No overloading
Contingency	KOTRI GTPS to JHIMPIR line out	Figure D-1.4	No overloading
Contingency	JAMSHORO OLD to JAMSHORO NEW line out	Figure D-1.5	No overloading
Contingency	NOORIABAD to KHLUKUHR line out	Figure D-1.6	No overloading

3.3.2 Base Year 2023: Peak Loading Winter

A base case has been developed for peak loading winter (January) 2023 that allow us to judge the maximum impact of Ib Vogt Solar Park project on the HESCO network, using the network data provided by HESCO.

Post-project power flow analysis has been performed after the interconnection of the proposed project with the HESCO transmission system. This includes the detailed representation of the power plant. A simulation of all possible contingencies within the NEPRA Grid Code planning criteria has also been carried out.

The steady state results for the normal and contingency conditions depicts that the power flows on all the transmission line branches are within their normal loading limits. There is no capacity constraint in terms of load flow or voltage ratings around the study area.
Results from the power flow analysis are presented in table below.

Condition	Contingent Branch	Figure No.	Steady State Result
System Intact	-N.A-	Figure D-2	No overloading
Contingency	IB VOGT Solar PP to PAF line out	Figure D-2.1	No overloading
Contingency	JAMSHORO OLD to NOORIABAD line out	Figure D-2.2	No overloading
Contingency	JAMSHORO OLD to KOTRI SITE-2 line out	Figure D-2.3	No overloading
Contingency	KOTRI GTPS to JHIMPIR line out	Figure D-2.4	No overloading
Contingency	JAMSHORO OLD to JAMSHORO NEW line out	Figure D-2.5	No overloading
Contingency	NOORIABAD to KHLUKUHR line out	Figure D-2.6	No overloading

3.3.3 Future Year 2025: Peak Loading Summer

A base case has been developed for peak loading summer (September) 2025 that allow us to judge the maximum impact of Ib Vogt Solar Park project on the HESCO network.

Post-project power flow analysis has been performed after the interconnection of the proposed project with the HESCO transmission system. This includes the detailed representation of the power plant. A simulation of all possible contingencies within the NEPRA Grid Code planning criteria has also been carried out.

The steady state results for the normal and contingency conditions depicts that the power flows on all the transmission line branches are within their normal loading limits. There is no capacity constraint in terms of load flow or voltage ratings around the study area.

Results from the power flow analysis are presented in table below.

Condition	Contingent Branch	Figure No.	Steady State Result
System Intact	-N.A-	Figure D-3	No overloading
Contingency	IB VOGT Solar PP to PAF line out	Figure D-3.1	No overloading
Contingency	JAMSHORO OLD to NOORIABAD line out	Figure D-3.2	No overloading
Contingency	JAMSHORO OLD to KOTRI SITE-2 line out	Figure D-3.3	No overloading
Contingency	KOTRI GTPS to JHIMPIR line out	Figure D-3.4	No overloading
Contingency	JAMSHORO OLD to JAMSHORO NEW line out	Figure D-3.5	No overloading
Contingency	NOORIABAD to KHLUKUHR line out	Figure D-3.6	No overloading

3.4 Conclusion

Steady state power flow assessment has been performed. Pre and Post project power flow study was conducted to analyze the magnitude and phase angles of bus voltages, line loadings, and power flows under steady-state conditions. The power flow results for the normal and for the contingency conditions showed that the power flows on all the transmission line branches are within their normal loading limit. There is no capacity constraint in terms of power flow or voltage ratings within the study area.

4 DYNAMIC STABILITY ANALYSIS

Dynamic stability analysis has been performed to access the dynamic impact of the solar power plant on national grid system due to disturbances at the power plant and vice versa.

4.1 Dynamic Model Development

Generic dynamic models, available in the PSSE model library, for the solar power plant have been used to develop the dynamic model of the power plant. Dynamic model of the power plant is presented in table below;

Component	Model
Generator	PVGU1
Electrical	PVEU1
Mechanical	PANELU1
Pitch	IRRADU1

4.2 Post-Project Dynamic Stability Assessment

4.2.1 Base Year 2023: Peak Loading Summer

Dynamic stability analysis has been carried out for the Base Year 2023 peak loading summer conditions. To access the dynamic behavior of power plant and system towards the disturbances, simulations have been carried out of 3 Phase fault at Ib Vogt Solar Park cleared in 5 cycles.

Each simulation has been performed for one second to depict steady state condition. Then fault is applied and system has been simulated for the fault clearance time. Post-fault condition has been simulated, from clearance of fault followed by a certain contingency, till 15 seconds.

4.2.2 3 Phase fault at 132kV Ib Vogt Solar Park cleared in 5 cycles

Three phase fault has been applied at Ib Vogt Solar Park, fault has been cleared in 100msec (5 cycles) with a particular N-1 contingency and dynamic stability response of the system is monitored, the same has been summarized in the table below.

Fault E-1: 3 Phase fault at 132kV Ib Vogt Solar Park bus cleared in 5cycles (Standard Opening in 100msec)

No.	Contingency	Monitored Element	Figure No.	System Response
E-1.1	132kV line from Ib Vogt PP to PAF	Bus Voltages of (i) 0.8kV Ib Vogt LV (ii) 22kV Ib Vogt MV (iii) 132kV Ib Vogt PP (iv) 132kV PAF (v) 132kV Nooriabad (vi) 132kV Jamshoro Old	E-1.1A	Stable
		Frequency of (i) 132Kv Ib Vogt Solar PP	E-1.1B	Stable
		MW and MVAR of Ib Vogt LV	E-1.1C	Stable
		Rotor Angles w.r.t. Sahiwal Slack Bus: (i) TGF (ii) Khalukuhr (iii) Nooriabad	E-1.1D	Stable
		Active (P) and Reactive (Q) power flows on interconnecting 132kV lines from (i) Ib Vogt PP to PAF (ii) Ib Vogt PP to Jamshoro Old	E-1.1E	Stable
E-1.2	132kV line from Ib Vogt PP to Jamshoro Old	Bus Voltages of (i) 0.8kV Ib Vogt LV (ii) 22kV Ib Vogt MV (iii) 132kV Ib Vogt PP (iv) 132kV PAF (v) 132kV Nooriabad (vi) 132kV Jamshoro Old	E-1.2A	Stable

No.	Contingency	Monitored Element	Figure No.	System Response
		Frequency of (i) 132kV Ib Vogt Solar PP Bus	E-1.2B	Stable
		MW and MVAR of Ib Vogt LV	E-1.2C	Stable
		Rotor Angles w.r.t. Sahiwal Slack Bus: (i) TGF (ii) Khalukuhr (iii) Nooriabad	E-1.2D	Stable
		Active (P) and Reactive (Q) power flows on interconnecting 132kV lines from (i) Ib Vogt PP to PAF (ii) Ib Vogt PP to Jamshoro Old	E-1.2E	Stable

4.2.3 3 Phase fault at 132kV PAF cleared in 5 cycles

Three phase fault has been applied at PAF, fault has been cleared in 100msec (5 cycles) with a particular N-1 contingency and dynamic stability response of the system is monitored, the same has been summarized in the table below.

Fault E-2: 3 Phase fault at 132kV PAF bus cleared in 5cycles (Stuck Breaker in 100msec)

No.	Contingency	Monitored Element	Figure No.	System Response
E-2.1	132kV line from PAF to Ib Vogt PP	Bus Voltages of (i) 0.8kV Ib Vogt LV (ii) 22kV Ib Vogt MV (iii) 132kV Ib Vogt PP (iv) 132kV PAF (v) 132kV Nooriabad (vi) 132kV Jamshoro Old	E-2.1A	Stable
		Frequency of (i) 132kV Ib Vogt Solar PP Bus	E-2.1B	Stable
		MW and MVAR of Ib Vogt LV	E-2.1C	Stable
		Rotor Angles w.r.t. Sahiwal Slack Bus: (i) TGF (ii) Khalukuhr (iii) Nooriabad	E-2.1D	Stable

		Active (P) and Reactive (Q) power flows on interconnecting 132kV lines from (i) Ib Vogt PP to PAF (ii) Ib Vogt PP to Jamshoro Old	E-2.1E	Stable

4.2.4 3 Phase fault at 132kV Jamshoro Old cleared in 5 cycles

Three phase fault has been applied at Jamshoro Old Grid, fault has been cleared in 100msec (5 cycles) with a particular N-1 contingency and dynamic stability response of the system is monitored, the same has been summarized in the table below.

Fault E-3: 3 Phase fault at 132kV Jamshoro Old bus cleared in 5cycles (Stuck Breaker in 100msec)

No.	Contingency	Monitored Element	Figure No.	System Response
E-3.1	132kV line from Jamshoro Old to Ib Vogt PP	Bus Voltages of (i) 0.8kV Ib Vogt LV (ii) 22kV Ib Vogt MV (iii) 132kV Ib Vogt PP (iv) 132kV PAF (v) 132kV Nooriabad (vi) 132kV Jamshoro Old	E-3.1A	Stable
		Frequency of (i) 132kV Ib Vogt Solar PP Bus	E-3.1B	Stable
		MW and MVAR of Ib Vogt LV	E-3.1C	Stable
		Rotor Angles w.r.t. Sahiwal Slack Bus: (i) TGF (ii) Khalukuhr (iii) Nooriabad	E-3.1D	Stable
		Active (P) and Reactive (Q) power flows on interconnecting 132kV lines from (i) Ib Vogt PP to PAF (ii) Ib Vogt PP to Jamshoro Old	E-3.1E	Stable

4.2.5 1 Phase fault at 132kV Ib Vogt Solar Park cleared in 9 cycles

Single phase fault has been applied at Ib Vogt Solar Park, fault has been cleared in 180msec (9 cycles) with a particular N-1 contingency and dynamic stability response of the system is monitored, the same has been summarized in the table below.

Fault E-4: 1 Phase fault at 132kV Ib Vogt Solar Park bus cleared in 9cycles (Standard Opening in 180msec)

No.	Contingency	Monitored Element	Figure No.	System Response
E-4.1	132kV line from Ib Vogt PP to PAF	Bus Voltages of (i) 0.8kV Ib Vogt LV (ii) 22kV Ib Vogt MV (iii) 132kV Ib Vogt PP (iv) 132kV PAF (v) 132kV Nooriabad (vi) 132kV Jamshoro Old	E-4.1A	Stable
		Frequency of (i) 132Kv Ib Vogt Solar PP	E-4.1B	Stable
		MW and MVAR of Ib Vogt LV	E-4.1C	Stable
		Rotor Angles w.r.t. Sahiwal Slack Bus: (i) TGF (ii) Khalukuhr (iii) Nooriabad	E-4.1D	Stable
		Active (P) and Reactive (Q) power flows on interconnecting 132kV lines from (i) Ib Vogt PP to PAF (ii) Ib Vogt PP to Jamshoro Old	E-4.1E	Stable
E-4.2	132kV line from Ib Vogt PP to Jamshoro Old	Bus Voltages of (i) 0.8kV Ib Vogt LV (ii) 22kV Ib Vogt MV (iii) 132kV Ib Vogt PP (iv) 132kV PAF (v) 132kV Nooriabad (vi) 132kV Jamshoro Old	E-4.2A	Stable

No.	Contingency	Monitored Element	Figure No.	System Response
		Frequency of (i) 132kV Ib Vogt Solar PP Bus	E-4.2B	Stable
		MW and MVAR of Ib Vogt LV	E-4.2C	Stable
		Rotor Angles w.r.t. Sahiwal Slack Bus: (i) TGF (ii) Khalukuhr (iii) Nooriabad	E-4.2D	Stable
		Active (P) and Reactive (Q) power flows on interconnecting 132kV lines from (i) Ib Vogt PP to PAF (ii) Ib Vogt PP to Jamshoro Old	E-4.2E	Stable

4.2.6 1 Phase fault at 132kV PAF cleared in 9 cycles

Single phase fault has been applied at PAF, fault has been cleared in 180msec (9 cycles) with a particular N-1 contingency and dynamic stability response of the system is monitored, the same has been summarized in the table below.

Fault E-5: 1 Phase fault at 132kV PAF bus cleared in 9cycles (Stuck Breaker in 180msec)

No.	Contingency	Monitored Element	Figure No.	System Response
E-5.1	132kV line from PAF to Ib Vogt PP	Bus Voltages of (i) 0.8kV Ib Vogt LV (ii) 22kV Ib Vogt MV (iii) 132kV Ib Vogt PP (iv) 132kV PAF (v) 132kV Nooriabad (vi) 132kV Jamshoro Old	E-5.1A	Stable
		Frequency of (i) 132kV Ib Vogt Solar PP Bus	E-5.1B	Stable
		MW and MVAR of Ib Vogt LV	E-5.1C	Stable
		Rotor Angles w.r.t. Sahiwal Slack Bus: (i) TGF (ii) Khalukuhr (iii) Nooriabad	E-5.1D	Stable

		Active (P) and Reactive (Q) power flows on interconnecting 132kV lines from (iii) Ib Vogt PP to PAF (iv) Ib Vogt PP to Jamshoro Old	E-5.1E	Stable

4.2.7 1 Phase fault at 132kV Jamshoro Old cleared in 9 cycles

Single phase fault has been applied at Jamshoro Old Grid, fault has been cleared in 180msec (9 cycles) with a particular N-1 contingency and dynamic stability response of the system is monitored, the same has been summarized in the table below.

Fault E-6: 1 Phase fault at 132kV Jamshoro Old bus cleared in 9cycles (Stuck Breaker in 180msec)

No.	Contingency	Monitored Element	Figure No.	System Response
E-6.1	132kV line from Jamshoro Old to Ib Vogt PP	Bus Voltages of (i) 0.8kV Ib Vogt LV (ii) 22kV Ib Vogt MV (iii) 132kV Ib Vogt PP (iv) 132kV PAF (v) 132kV Nooriabad (vi) 132kV Jamshoro Old	E-6.1A	Stable
		Frequency of (i) 132kV Ib Vogt Solar PP Bus	E-6.1B	Stable
		MW and MVAR of Ib Vogt LV	E-6.1C	Stable
		Rotor Angles w.r.t. Sahiwal Slack Bus: (i) TGF (ii) Khalukuhr (iii) Nooriabad	E-6.1D	Stable
		Active (P) and Reactive (Q) power flows on interconnecting 132kV lines from (i) Ib Vogt PP to PAF (ii) Ib Vogt PP to Jamshoro Old	E-6.1E	Stable

Dynamic Stability Analysis Results are attached in **Annexure-E**.

4.3 Conclusion

Dynamic stability analysis has been performed to access the dynamic impact of the solar power plant on national grid system due to disturbances at the power plant and vice versa. The results of dynamic stability analysis indicate that the power system is stable for the interconnection proposal and it also fulfils all the criteria for generation connection with the power system.

5 SHORT CIRCUIT ANALYSIS

Short circuit analysis has been performed to propose the Circuit Breaker rating for power plant switchyard and to determine the need for any breaker replacements due to impacts of the solar power plant project. Single-line-to-ground and three-phase fault current values have been calculated for buses in the vicinity of the solar power plant project. The calculated fault currents observed at these buses were compared with the interrupting current capabilities of corresponding circuit breakers to determine need for upgrading existing circuit breakers.

5.1 Short Circuit Model Development

Short circuit database provided by HESCO has been used as a base case to perform short circuit assessment. The study project has been added to the base case to develop the post-project case.

5.2 Post-Project Short Circuit Assessment

With the addition of power plant, short circuit current at each bur bar is increased, so the circuit breaker capacity has analysed. Post-project short circuit assessment has been performed to evaluate the contribution of the proposed project in fault current levels of substations in its electrical locality and to compute the fault levels at Ib Vogt Solar Park**.**

5.2.1 Maximum Short Circuit: Base Year 2023

The maximum short circuit levels have been computed according to IEC-60909 standard. Pre and Post project maximum short circuit levels at the buses within the study area in the year 2023 have been presented in table below.

Bus Name	Bus kV	Pre-Project		Post Project	
		1-Φ Fault Level (kA)	3-Φ Fault Level (kA)	1-Φ Fault Level (kA)	3-Φ Fault Level (kA)
IB VOGT Solar MV Bus	22	-N.A-	-N.A-	0.0	20.91
IB VOGT Solar Bus	132	-N.A-	-N.A-	4.96	7.20
PAF	132	4.94	7.03	5.68	7.98
NOORIABAD	132	8.29	10.24	7.87	9.74
JAMSHORO OLD	132	21.63	24.64	19.74	22.46
GULSHAN SHAHBAZ	132	14.36	17.58	13.07	15.99

Pre and Post project maximum short circuit analysis summary for the base year 2023 are attached in **Appendix F-1 and F-2** respectively.

Note:

In the attached short circuit study reports, both three phase and single-phase fault currents with polar coordinates and detailed output showing contribution from adjoining sources (i.e. lines and transformers connected to the bus bar) to the fault currents are included.

5.3 Conclusion

Short circuit analysis has been performed to evaluate the contribution of the proposed project in fault current levels of substations in its electrical locality. Fault currents have been computed based on simulation of three-phase and single-line-to-ground faults by applying the criteria as mentioned in the IEC909 standard. The short circuit value is well within the limits of circuit breaker as per approved NTDC specification. Therefore, rating of 40kA is recommended. Further it shows that the calculated fault currents are below the circuit-breaker interrupt ratings of existing grid stations located in locality of the project.

6 CONCLUSIONS

6.1 Steady State Assessment

Steady state power flow assessment has been performed using the network data provided by HESCO. Pre-project power flow study was conducted to analyze the magnitude and phase angles of bus voltages, line loadings, and power flows under steady-state conditions. Post project power flow analysis has also been performed after the interconnection of the proposed project with the HESCO transmission system. The power flow results for the normal and for the contingency conditions showed that the power flows on all the transmission line branches are within their normal loading limit. There is no capacity constraint in terms of power flow or voltage ratings within the study area.

The steady state results found no capacity constraint in terms of power flow and voltage ranges.

6.2 Dynamic Stability Assessment

Dynamic stability analysis has been performed to access the dynamic impact of the solar power plant on national grid system due to disturbances at the power plant and vice versa. The results of dynamic stability analysis indicate that the power system is stable for the interconnection proposal and it also fulfils all the criteria for generation connection with the power system.

6.3 Short Circuit Assessment

Short circuit analysis has been performed to evaluate the contribution of the proposed project in fault current levels of substations in its electrical locality. Fault currents have been computed based on simulation of three-phase and single-line-to-ground faults by applying the criteria as mentioned in the IEC-60909 standard. Result of the analysis shows that the calculated fault currents are below the circuit-breaker interrupt ratings of existing grid stations located in locality of the project. The short circuit value is well within the limits of circuit breaker as per approved NTDC specification. Therefore, rating of 40kA is recommended. Further it shows that the calculated fault currents are below the circuit-breaker interrupt ratings of existing grid stations located in locality of the project.

Hence, it is concluded that based on the study results the proposed generation interconnection assessment for 93.76MW (AC) IB VOGT Solar Park meets the NEPRA grid code planning criteria.