BLUE STAR ELECTRIC(PRIVATE) LIMITED

Lahore: 37, Street 1, Sector B, Askari 10 Lahore Cantt. Pakistan, Fax 0092 42 36500086

Mardan: Fauji Bijli Ghar, P.O. Tazagram, Tehsil Takht Bhai, Distt **Mardan**. Tel: 0092-937-520004, 0092 321 4421767 FAX: 0092 937 520574

Email: hassan.khalid.aku@gmail.com. Company Registration No: 0088308

No: BSEPL/NEPRA/14/LIC/1

Dated : 14th July 2014

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

Subject: Application for Generation License Pursuant To "NEPRA Licensing (Application & Modification Procedure) Regulation 1999" for 1 MW Solar Power Plant by Blue Star Electric (Private) Limited

Dear Sir,

1. To introduce ourselves, we are the sister company of Blue Star Energy (Pvt.) Ltd. Blue Star Energy Pvt. Ltd. is currently holding a Generation License for 3 MW Machai Hydropower Project. The Generation License was awarded in August 2008 bearing number SGC/036/2008.

2. We intend to set up a Solar Power Plant near Pind Dadan Khan in District Jehlum, Punjab.

3. The capacity of this plant shall be 1 MWp.

4. It is intended to sell the electric power to Islamabad Electric Supply Company under the provisions of Section 8.2.1 of "Policy for Development of Renewable Energy for Power Generation-2006" issued by GOP on 16 De 2006.

5. Pursuant to "NEPRA Licensing (Application & Modification Procedure) Regulation 1999", the Application for Generation License for the proposed Solar Power Project is submitted herewith in triplicate as enclosure to this letter, for approval of Worthy Authority.

6. The check list of the documents required for generation license for a ne facility as per the "NEPRA Licensing (Application & Modification Procedure Regulation 1999" is attached.

7. Pay order no. 2259414 amounting Rs 40,000/= is enclosed.

Best regards

Yours Sincerely,

Hassan Khalid,
Director.

Blue Star Electric (Pvt.) Ltd.

BLUE STAR ELECTRIC(PRIVATE) LIMITED

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Email: hassan.khalid.aku@gmail.com. Company Registration No: 0088308

The Registrar

National Electric Power Regulatory Authority

Subject: **Application for a Generation Licence**

I, Hassan Khalid, Director, being the duly authorized representative of Blue Star Electric (Pvt.) Limited by virtue of Board Resolution dated 12th July, 2014, hereby apply to the National Electric Power Regulatory Authority for the grant of a Generation Licence to the Blue Star Electric (Pvt) Ltd (BSEPL) pursuant to section 15 of the Regulation of Generation, Transmission and Distribution of Electric Power Act, 1997.

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

A Pay Order in the sum of Rupees 40,000/=, being the non-refundable licence application fee calculated in accordance with Schedule II to the National Electric Power Regulatory Authority Licensing (Application and Modification Procedure) Regulations, 1999, is also attached herewith.

Date: 14th July 2014

Hassan Khalid,

Director.

BLUE STAR ELECTRIC(PRIVATE) LIMITED

Lahore: 37, Street 1, Sector B, Askari 10 Lahore Cantt. Pakistan, Fax 0092 42 36500086

Mardan: Fauji Bijli Ghar, P.O. Tazagram, Tehsil Takht Bhai, Distt **Mardan**. Tel: 0092-937-520004, 0092 321 4421767 FAX: 0092 937 520574

Email: hassan.khalid.aku@gmail.com. Company Registration No: 0088308

Passed by the Circulation
by the Board of Directors of M/S Blue Star Electric (Pvt) Ltd.
On 12th July 2014

Resolved that the application be filed for Generation License for 1MW Solar Power Plant with National Electric Power Regulatory Authority.

Further Resolved that Mr. Hassan Khalid, the Chief Executive Officer, of the Company is hereby authorized to sign singly the necessary documents / papers, pay the filing fees, appear before the authority as required, to do and cause to be done all acts, deed and things which may be necessary to give effect of this resolution and to do all acts necessary for completion and processing of these applications.

Further resolved that a certified true copy of the resolution be submitted to National Electric Power Regulatory Authority under signature of the Company Secretary.

Mr. Hassan Khalid

Mr. Amar Khalid

Blue Star Electric (Pvt.) Ltd.

Amar Khalid
Company Secretary

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A000898

SECURITIES AND EXCHANGE COMMISSION OF PAKISTAN

COMPANY REGISTRATION OFFICE, LAHORE

CERTIFICATE OF INCORPORATION

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

Corporate Universal Identification No.0088308

I hereby certify that **BLUE STAR ELECTRIC (PRIVATE) LIMITED** is this day incorporated under the Companies Ordinance, 1984 (XLVII of 1984) and that the company is **Limited by Shares.**

Given under my hand at **Lahore** this **Fifteenth** day of **May,** Two **Thousand** and **Fourteen**.

Fee Rs.**12,000/-**

(LIAQAT ALI DOLLA)
Additional Registrar of Companies

No.ARL/25533 DATED: 15/5/2014

CERTIFIED TO BE TRUE

11/8/14

DEPUTY REGISTRAR
COMPANY REGISTRATION OFFICE
LAHORE

THE COMPANIES ORDINANCE, 1984

--:0:--

(PRIVATE COMPANY LIMITED BY SHARES)

-- : O : --

Memorandum of Association

of

BLUE STAR ELECTRIC (PRIVATE) LIMITED

I. The name of the Company is "BLUE STAR ELECTRIC (PRIVATE) LIMITED".

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

III. The Sole Object of the Company is:-

1. To set up an undertaking for production of electricity and for its further utilization either for self use or for manufacture of other goods / materials or sale to another party subject to permission required from NEPRA/Other relevant authorities.

2. In order to achieve the above object, the Company is authorized :-

a) To market all its products both in and outside Pakistan.

b) To import, purchase from local market or fabricate the plant and machinery for the purpose of installation or operation of the unit and for that purpose, purchase land and acquire any other utility, to purchase or import raw materials, chemicals, spares, stores and other articles for use as required by the company.

c) To hire manpower / labor from inside Pakistan or from abroad under the applicable rules for making the undertaking operational or for its running.

d) To borrow or raise money by means of loans or other legal arrangements from banks, or other financial institutions, or Directors in such manner as the Company may think fit and in particular by issue of debentures, debenture-stock, perpetual or otherwise convertible into shares and to mortgage, or charge the whole or any part of the property, assets of the Company, present or future, by special assignment or to transfer or convey the same absolutely or in trust as may seem expedient and to purchase, redeem or payoff any such securities.

e) To open bank accounts of the Company and to draw, accept, make, endorse, discount, execute and issue cheques, promissory notes, bills of exchange, bills of lading or other negotiable or transferable instruments related to the business of the Company.

f) To arrange local and foreign currency loans from scheduled banks, industrial banks and other financial institutions for the purpose of purchase and import of machinery, construction of factory, building, raw material and for working capital or for any other purpose of the Company.

g) To guarantee the performance of contract and obligations of the Company in relation to the payment of any loan, debenture, bonds, obligations or securities issued by or in favor of the Company and to guarantee the payment or return on such investments.

h) To distribute any of the property of the Company amongst the members in specie or kind at the time of winding up.

i) To carry out joint venture agreements with other companies or countries.

j) To cause the Company to be registered or recognized in any foreign country.

k) To apply for and obtain necessary consents, permissions and licenses from any Government, State, Local and other Authorities for enabling the Company to carry on any of its objects into effect.

l) To invest and deal with surplus moneys of the Company not immediately required in such manner as may from time to time be determined.

m) To do all such other things as may be deemed incidental or conducive to the attainment of the above object.

n) To guarantee the payment of money unsecured or secured by or payable under or including but not limited to in respect of promissory notes, bonds, debentures, loan finances debenture stock, contracts, mortgage, charges, obligations, instruments and securities of associated companies and generally to guarantee or become sureties for the performance of any contracts or obligations of associated companies.

3. Notwithstanding anything stated in any object clause, the company shall obtain such other approval or license from the competent authority, as may be required under any law for the time being in force, to undertake a particular business.
4. It is declared that notwithstanding anything contained in the foregoing object clause of this Memorandum of Association, nothing contained therein shall be construed as empowering the Company to undertake or to indulge in business of banking company, banking, leasing, investment, or insurance business directly or indirectly as restricted under the law or any other unlawful operation.

IV. The liability of the members is limited.

V. The Authorized Capital of the Company is Rs. 2,000,000/- (Rupees Two Million only) divided into 200,000 (Two Hundred thousand only) ordinary shares of Rs. 10/- (Rupees Ten only) each with powers to increase and reduce the Capital of the Company and to divide the shares in the Capital for the time being into several classes in accordance with the provisions of the Companies Ordinance, 1984.

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

	Name and Surname (Present & Former) in Full (in Block Letters)	Father's Name (in Full)	Nationality with any former Nationality	Occupation	Residential Address (in Full)	Number of shares taken by each sub-scriber	Signature
1.	HASSAN KHALID N.I.C 38403-0985925-7	*S/O* Khalid Parvez Nadeem	Pakistani	Businessman	House No. 37/B, Street No.1, Askari 10, Lahore – Cantt, Lahore.	4,000 Four Thousand	
2.	AMAR KHALID N.I.C 38403-2245072-7	*S/O* Khalid Parvez Nadeem	Pakistani	Businessman	House No. 37/B, Street No.1, Askari 10, Lahore – Cantt, Lahore.	1,000 One Thousand	
					Total Number of Shares Taken	5,000 Five Thousand	

Company Registration Office Lahore Securities and Exchange Commission of Pakistan SECP

Dated this 12th day of May 2014.

Witness to the above signatures:

Full Name: "National Institutional Facilitation Technologies (Pvt.) Ltd"

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

CERTIFIED TO BE TRUE COPY
30/06/14
DEPUTY REGISTRAR OF COMPANIES
COMPANY REGISTRATION OFFICE
LAHORE

THE COMPANIES ORDINANCE, 1984

-- : O : --

(PRIVATE COMPANY LIMITED BY SHARES)

-- : O : --

Articles of Association of

BLUE STAR ELECTRIC (PRIVATE) LIMITED

PRELIMINARY

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

PRIVATE LIMITED COMPANY

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

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

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

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

BUSINESS

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

4. The business of the Company shall include the object enumerated in the Memorandum of Association.

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

CAPITAL

6. The Authorized Capital of the Company is Rs. 2,000,000/- (Rupees Two Million only) divided into 200,000 ordinary shares of Rs. 10/- (Rupees Ten only) each with powers to increase, reduce, consolidate, sub-divide, or otherwise re-organize the share capital of the Company.

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

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

SHARES, TRANSFER AND TRANSMISSION

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

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

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

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

GENERAL MEETING

13. The First Annual General Meeting shall be held within 18 months from the date of incorporation of the Company in accordance with the provisions of Section 158 and thereafter once at least in every year and within a period of four months following the close of its financial year and not more than fifteen months after the holding of its last preceding Annual General Meeting as may be determined by Directors. The Directors may, whenever they think fit, call an Extraordinary General Meeting of the shareholders in terms of Section 159 of the Companies Ordinance, 1984.

PROCEEDINGS AT GENERAL MEETING

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

15. The Chief Executive, with the consent of a meeting at which quorum is present and

shall if so directed by the meeting may adjourn the meeting from time to time and from place to place, but no business shall be transacted at any adjourned meeting other than the business left unfinished at the meeting from which the adjournment took place.

QUORUM

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

VOTES OF MEMBERS

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

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

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

CHAIRMAN

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

CHIEF EXECUTIVE

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

DIRECTORS

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

1. MR. HASSAN KHALID
2. MR. AMAR KHALID

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

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

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

26. The remuneration of Directors except regularly paid Chief Executive and full time working Directors shall, from time to time, be determined by the Board of Directors but it shall not exceed Rs. 500/- per meeting at which the Directors are present.

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

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

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

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

NOMINEE DIRECTOR

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

NOTICES

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

MANAGEMENT

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

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

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

(a) To take on lease, purchase, erect or otherwise acquire for the Company any assets, stocks, lands, buildings, property, rights or privileges which the Company is authorized to acquire at such price and generally on such terms and conditions as they think fit.

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

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

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

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

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

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

Company.

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

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

BORROWING POWERS

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

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

THE SEAL

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

ACCOUNTS

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

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

AUDIT

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

INDEMNITY

42. In connection with carrying on the business of the Company, the Chief Executive, every Director, or other officers of the Company shall be indemnified by the Company for all losses and expenses occasioned by error of judgment or oversight on his part, unless the same

happens through his own dishonesty or willful act and defaults:

SECRECY

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

ARBITRATION

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

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

WINDING UP

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

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

	Name and Surname (Present & Former) in Full (in Block Letters)	Father's Name (in Full)	Nationality with any former Nationality	Occupation	Residential Address (in Full)	Number of shares taken by each sub-scriber	Signature
1.	HASSAN KHALID N.I.C 38403-0985925-7	*S/O* Khalid Parvez Nadeem	Pakistani	Businessman	House No. 37/B, Street No.1, Askari 10, Lahore – Cantt, Lahore.	4,000 Four Thousand	
2.	AMAR KHALID N.I.C 38403-2245072-7	*S/O* Khalid Parvez Nadeem	Pakistani	Businessman	House No. 37/B, Street No.1, Askari 10, Lahore – Cantt, Lahore.	1,000 One Thousand	
					Total Number of Shares Taken	5,000 Five Thousand	

Company Registration Office Lahore
Securities and Exchange Commission of Pakistan

Dated this: 12th day of May 2014.

Witness to the above signatures:

Full Name: "National Institutional Facilitation Technologies (Pvt.) Ltd"

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

CERTIFIED TO BE TRUE COPY
30/06/2014
DEPUTY REGISTRAR OF COMPANIES
COMPANY REGISTRATION OFFICE
LAHORE.

BLUE STAR ELECTRIC(PRIVATE) LIMITED

Lahore: 37, Street 1, Sector E, Askari 10 Lahore Cantt. Pakistan, Fax 0092 42 36500086

Mardan: Fauji Bijli Ghar, P.O. Tazagram, Tehsil Takht Bhai, Distt **Mardan**. Tel: 0092-937-520004, 0092 321 4421767 FAX: 0092 937 520574

Email: hassan.khalid.aku@gmail.com. Company Registration No: 0088308

PROFILE OF EXPERIENCE OF APPLICANT

The applicant company has been incorporated by Blue Star Energy Private Limited as the parent company, for the purpose of execution of 1.0 MW Solar Power Plant as well as other renewable energy projects. Parent Company (Blue Star Energy) is a holder of Generation License from NEPRA and it also has requisite experience in the field of Electric Power generation as a pioneer.

For the satisfaction of the Authority, a certificate from Blue Star Energy Private Limited (Parent Company) is attached as Annex E.

Blue Star Electric (Pvt.) Ltd.

ALI ASGHAR JAFFERY

Personal Details

Date of Birth: 16th May 1981
Gender: Male
Marital Status: Married

Contact Details

Address: 654 W, DHA, Lahore.
E-Mail: aajaffery@hotmail.com
Tel: (+92) (321) 4926851 / (+92) (423) 5723384

Professional Experience

1. *Currently working as **Chief Technical Officer at Blue Star Hydel Private Limited and Blue Star Electric Private Limited** since May 2014*
2. *Worked as **Service and Commissioning Engineer** at **Pall Corporation** from October 2008 to February 2013*
3. *Worked as **Field Service Engineer** with **Tetra Pak Pakistan Pvt Ltd** from October 2004 to January 2008*

Pall Corporation
Job Responsibilities

- Involved in Sales gas black powder removal projects installation, commissioning and maintenance for clients like Aramco and Gasco.
- Responsible for Oil purifier installation, commissioning and maintenance.
- Involved in large scale industrial/municipal water treatment projects Installation and commissioning,
- Involved in project engineering design including defining and developing system operating philosophy, P&ID review and component selection for an efficient control and process design.
- Responsible for maintenance and trouble shooting of all electromechanical parts including valves, pumps, compressors, PLC, I/O blocks etc.
- Responsible for installation, calibration, maintenance, repair, and documentation of plant instrument systems (Flow, Level, Pressure, Temperature, quality analyzers, etc in various applications).
- Review and modifications of Control Wiring Diagram, Instrument Index, Drive List, Instrument Mounting Standard, Junction Box Specifications etc
- Carry out pilot studies by operating and analyzing performance of Microfiltration Pilot plants for various water applications and generating reports based on data recorded over the research period.

Tetra Pak
Job Responsibilities

- Involved in planning and execution of Tetra Pak packaging machines installation and commissioning.
- Involved in defining, planning and implementation of value added after sales service activities.
- Responsible for developing and enhancing customer in-house technical and operational capability by providing specific system trainings.
- Maximize production line efficiency by monitoring machine production data, planning and implementing predictive and corrective maintenance and thus reducing or eliminating breakdowns.
- To provide feedback reports so that newer and better system upgrades can be developed to enhance system production efficiency.
- Troubleshoot critical electrical and mechanical problems at customer end.

Expertise

- Skilled in building and scheduling plans, generating reports and developing and implementing cost effective process and control solutions.
- Have gained thorough knowledge of VFD'S, PLC'S (**including, Control Logix 5000, Siemens S7, GE Fanuc)** microcontrollers, motors (AC, DC, and Servos), power circuits, sensors, temperature controllers etc.
- Have worked on many process instruments including pressure, temperature, flow and level transmitters as well as process controllers, process recorders and protection devices.
- Skilled in pneumatic and hydraulic systems.
- Skilled at diagnosing malfunctions, providing predictive/preventive maintenance, installing new equipment,. Have worked on gear systems, all kind of pumps, valves, compressors, levers and cams.

Professional Trainings

- GE Fanuc Proficy PLC training, Lahore.
- Field Quality Assurance training, Jeddah
- Customer Relation Training, Dubai
- Basic Machine Maintenance Training, Sweden
- Water/Waste Water Treatment Training, Dubai.

Achievements

- Was involved in **Berry Junction** Sales gas Filtration unit installation and maintenance for **Saudi Aramco**.
- Successfully completed many large scale projects (20000m3/day) for Pall in Industrial/municipal water and energy sector. Some of the important projects were for customers like **Total, DEWA, Jordan Bromine,** etc.
- Was instrumental in **successfully** reducing the line wastage down from 6% to 1% on a maintenance project for **Haleeb Dairy while working for Tetra Pak.**
- Successfully completed the **Engineering certification process in Tetra Pak Pakistan** to become one of the few certified engineers in the market company.
- Received "Best Design Award" in Annual Robotics Competition in Pakistan using PID controllers.

Professional Skills

Computer:

- Proficient in Windows based applications such as Word, Excel, PowerPoint etc.
- Proficiency in different design tools including Electronics Workbench, Circuit Maker,

Presentation: Developed ability to produce reports and presentations to a professional standard.

Analysis & Evaluation: Proficient in assessing data and formulating solutions.

Organizational: Effective at time management and prioritizing tasks to achieve deadlines.

Education

Qualification	Institution	Year	Grade/GPA/Div.
B.E (Mechatronics)	College of E&ME (National University Of Science and Technology), Pakistan	2004	3.11
HSSC	Garrison College, Lahore, Pakistan	2000	1st
SSC	Garrison Academy, Lahore, Pakistan	1998	1st

Major Reports/Projects

- Final Year Project: Design and Fabrication of Omni-directional Vehicle using Micro-controllers
- Fire Fighting Robot (Mechatronics Design Lab)
- Rhino Robot Programming (Robotics)
- Simulation software for 6 DOF robot (Theory of Machines)
- Power Supply Design and Fabrication (Electronic Devices)

Co-Curricular Activities

Scale Modeling, RC flying, and sports

References

To be furnished on request

HASSAN KHALID

Telephone: Cell: 92-321-4421767, Res: 92-42-36501086
Address: 36/B, Street 1, Askari 10, Lahore Cantt, Lahore, Pakistan.
Email [redacted]

EDUCATION:

Bachelor of Medicine, Bachelor of Surgery (M.B.B.S.)	Oct 2007- Sep2012	Aga Khan University, Karachi, Pakistan

WORK EXPERIENCE:

- April 2007 – to date; **Blue Star Energy (Pvt.) Ltd.** as Installation and Operation Officer.
- May 2014 - to date; **Blue Star Electric (Pvt.) Ltd.** as Chief Executive Officer

AREAS OF STRENGTHs:

- Always looking forward to start new ventures.
- Thorough technical knowledge of power plants.
- Good speculations about the power industry.
- Strong international contacts with electrical equipment buyers and sellers.
- Solo management of large scale projects.

MAJOR PROJECTS UNDERTAKEN:

- **Successful execution of a power plant in Private Sector of Pakistan.**

REFERENCES:

References will be provided on request.

AMAR KHALID

Telephone: Cell: 92-321-4453447, Res:92-42-36501086
Address: 36/B, Street 1,Askari 10,Lahore Cantt, Lahore, Pakistan.
Email [redacted]

EDUCATION:

Masters in Business Administration	Jan.2008- May 2010	American University in Dubai, U.A.E.	A
B.E. in Electrical Engineering	2001-2004	National University of Sciences and Technology, Pakistan.	1st Division

WORK EXPERIENCE:

- April 2007 – to date, **Blue Star Energy (Pvt.) Ltd. , Blue Star Hydel (Pvt.) Ltd. and Blue Star Electric (Pvt.) Ltd.** as Director.
- Apr 2005 – Apr 2007 **Ericsson Pakistan (Pvt.) Ltd.** as Radio Network Engineer.

AREAS OF STRENGTHs:

- Always looking forward to start new ventures.
- Thorough technical knowledge of power plants.
- Good speculations about the power industry.
- Strong international contacts with electrical equipment buyers and sellers.
- Solo management of large scale projects.

MAJOR PROJECTS UNDERTAKEN:

- **Successful execution of a power plant in Private Sector of Pakistan.**

HONOURS & AWARDS

- Won scholarship for engineering at the national level.
- Was appointed as the senior student during the third year of engineering.

REFERENCES:

References will be provided on request.

KHALID PARVEZ NADEEM

Telephone: Cell: 92-300-8582219, Res:92-42-36501086
Address: 36/B, Street 1, Askari 10,Lahore Cantt, Lahore, Pakistan.
Email brig.khalid@gmail.com

EDUCATION:

Masters in War Studies	Jan.1986- Dec.1986	Army Command and Staff college, Quetta	B+
BSc. in Physics, Chemistry and Maths.	1971-1973	Government College Faisalabad.	1st Division
Pakistan Technical Staff Course	Jan.1987- Dec.1987	College of Electrical & Mechanical Engineering	A
Pakistan Gunnery Staff Course	Jan.1988- Dec.1988	Army Air Defence College Karachi.	A

WORK EXPERIENCE:

- April 2007 – to date, **Blue Star Energy (Pvt.) Ltd.** as **Chief Executive Officer** and **Blue Star Hydel (Pvt.) Ltd.** as **Director.**
- Apr 2005 – Apr 2007 **Director General NADRA for the Province of NWFP.**
- April 1974 – April 2007 **Served in Pakistan Army.** (Retired at the rank of Brigadier).

AREAS OF STRENGTHs:

- Thorough technical knowledge of latest sciences and technologies.
- Solo management of large scale projects.
- Planning and execution of Projects hitherto considered impossible in Pakistan.

MAJOR PROJECTS UNDERTAKEN:

- **Reorganization and Modernization of NADRA** for the Province of NWFP to make it completely automated, directed towards serving the customers in a more efficient and speedy manner.
- **Successful execution of First Hydro Power IPP in Private Sector of Pakistan.**

HONOURS & AWARDS

- Sitara e Imtiaz (Military)

REFERENCES:

References will be provided on request.

CURRICULUM VITAE

CHIEF ENGR NASIR ALI BANGASH

Chief Engineer (R) WAPDA

Personal Information

Date of-Birth	Feb 15 1947,
Domicile	FATA Kurram Agency
N.I.C No	17301-6205061-1
Address	H-98, J-1, St 9, Phase 3, Hayat abad, Peshawar.
Phone No	(Mob.)0333-5143726

Qualification:

B. Sc. Engineering (electrical) from UET-Peshawar-Pakistan
MIEEE (PAK)
MIEEE (USA)

Courses/Certificates;

6 Months Training Course HARZA Engg Consultants USA
03 Months Course of Organization & Operation of Electrification systems under American Power Consultants, OHIO USA
03 Months Electrical Distribution Management under Swed Power Company Stockholm.

Experience:

Retired from WAPDA as Chief Engineer after 37 Yr Service.

Senior Technical Consultant for 1 MW Hydroelectric Power Plant by Blue Star Energy

Service Experience as SDO in WAPDA	7 yrs
Service Experience as Senior Engineer in WAPDA	18 yrs
Service Experience as SE in WAPDA	2 yrs
Service Experience as Director in WAPDA	8 yrs
Service Experience as Chief Engr in WAPDA	2 yrs

Interests

MS Words, MS excel. Typing System Analysis. Report Writing, Task Oriented Jobs

BLUE STAR ENERGY (PRIVATE) LIMITED

Lahore: 36-B, Askari 10 Lahore Cantt. Pakistan, Fax 0092 42 36500086

Mardan: Fauji Bijli Ghar, P.O. Tazagram, Tehsil Takht Bhai, Distt **Mardan**. Tel 0092-937-520004, 92 300 4121653 FAX: 0092-937-520574

email brig.khalid@gmail.com NTN 2217217-3 Company Registration No 13370/20040302 Sales Tax Regn No. 50-47-2060-016-4

Dated 21 Aug 2014

To:

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

Subject: Issuance of Generation License to Blue Star Electric Private Limited for 1.0 MW Solar Power Plant

It is submitted that we, the undersigned, have incorporated Blue Star Electric Private Limited (BSEPL) Company for the execution of renewable energy projects. BSEPL has applied for a Generation License for our 1.0 MW Solar Power Plant near Pind Dadan Khan, District Jehlum with the worthy Authority. In connection with the same, NEPRA under regulation 3(5)(d)(i) to Regulation 3(5)(d)(vi) has asked to provide evidence satisfactory to the Authority for the availability of financial and technical resources and such evidence may consist of cash balances, credit assurance, employment record of staff, profile of contractors and verifiable references in respect of experience of the applicant and subcontractors. In this regard, following lines are submitted for the satisfaction of the Authority:-

a. Blue Star Energy Private Limited is the pioneer and a reliable name in the field of renewable energy, which not only obtained Generation License from NEPRA but has executed first Hydel Power Plant in private sector of Pakistan. Phase I of this has been completed and Phase II is going to be completed after issuance of Hydel Upfront Tariff, which is in the knowledge of worthy Authority.

b. It is certified that Blue Star Energy Private Limited undertakes responsibility for all finances, credits, guarantees, provision of Engineering and Technical Staff, Contractors/ Sub-contractors and references required for this solar project.

Yours Sincerely,

Blue Star Energy (Pvt) Ltd

Chief Executive
BLUE STAR ENERGY (PRIVATE) LIMITED
Brigadier (R) Khalid Parvez Nadeem
Sitara e Imtiaz

EXECUTIVE SUMMARY

2.0 Background:

Located on the Western stretch of the South Asian Continent, Islamic Republic of Pakistan is largely under the influence of tropical desert climate. The relative shortage of conventional energy resources in Pakistan, when coupled with the increasing energy prices worldwide, leads to a constrained power supply system in the country. The Government of Pakistan has placed the issue of power generation and supply as one of the country's highest priorities and has committed to investing in renewable energies such as solar.

A Renewable Energy Policy has been created by the Pakistan Government to encourage the private sector to invest in the development of renewable energy solutions. The Alternative Energy Development Board (AEDB) has been established to facilitate the implementation of the renewable energy projects.

AEDB issued LOI to Blue Star Electric for the construction and operation of 1.0 MW solar farm in the Province of Punjab. Blue Star Electric has subsequently identified earmarked 10 acres of land in the Pind Dadan Khan area of Punjab for the location of the Solar Project.
The technology selected by Blue Star Electric is industry proven, has the highest level of reliability currently available and is suitable for the environmental conditions of the Punjab province. The project is economically viable for both the private investor and the Government of Pakistan.

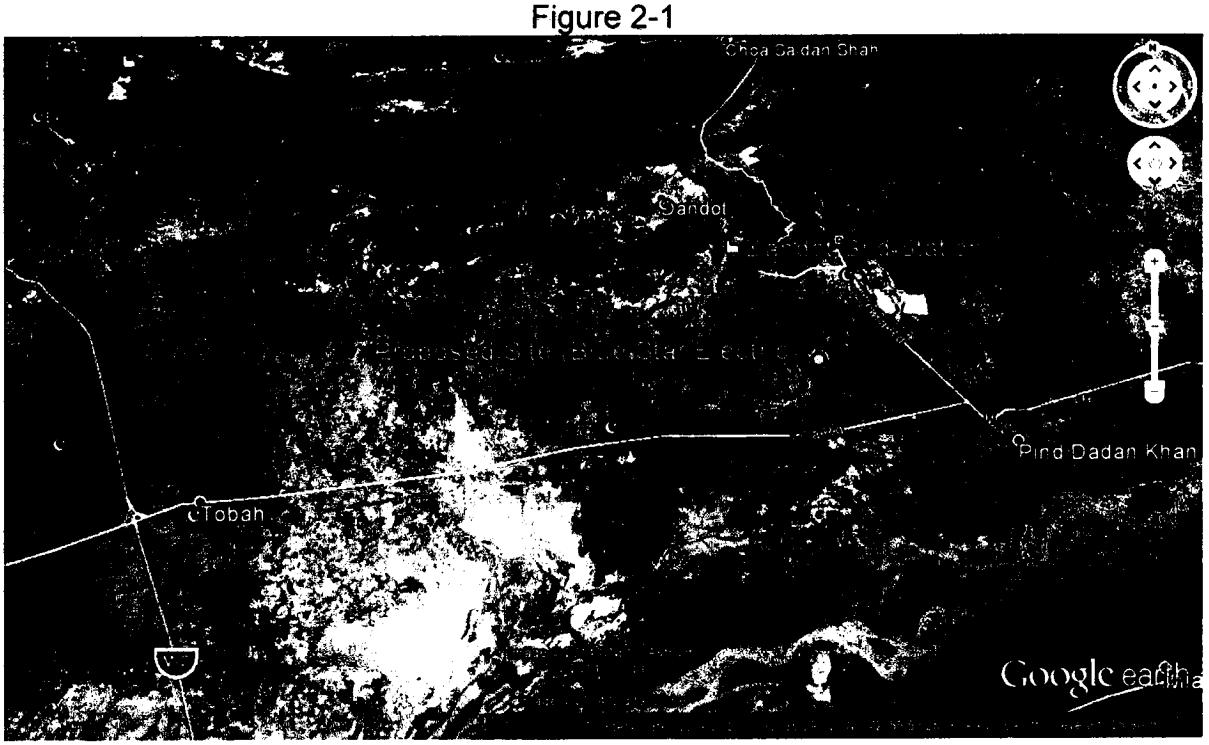
2.1 Project Overview

2.1.1 The Project & Sponsors

Blue Star Electric Pvt. Ltd. has been incorporated by Blue Star Energy Pvt. Ltd. as its parent company, which itself was incorporated in 2004. The main purpose of Blue Star Energy and Blue Star Electric is to set up power plants using renewable energy resources. Currently, Blue Star Energy owns and operates a 1 MW Hydroelectric Power Plant in District Mardan in the province of Khyber Pakhtunkhwa. Based on the experience of the parent company i.e. Blue Star Energy in the field of renewable energy, Blue Star Electric decided to diversify in renewable energy by using solar as the source of power production.

2.1.2 The Project Location The following satellite image in Figure 2-1 gives an overview of the wide area surrounding the planned site of the Solar PV power plant. It is planned about 18.5 Km away from the Pind Dadan Khan Exit on M-2 Motorway. After taking the exit, a main metaled road leads towards Pind Dadan Khan. Moving towards Pind Dadan Khan, about 18.5km on this road the project site is located about 1 km deep on the left near Dandot Grid Station.

Figure 2-1



2.1.3 Site Description

The total project area is approximately 10 acres. The terrain is an almost flat surface with terrain height varying from 210.0 m to 215 m. Since there is scarcity of water in this belt, hence major portion of the area in and around the project site is barren.

A metaled road terminates at a distance of approximately 900m in a village west of the project site. This metaled road is broad enough to carry out all the logistics of the project. However, the 900m distance from the project site to the existing metaled road shall be developed by construction of a metaled road by Blue Star Electric.

Since it is a Solar Power Project, hence no huge quantities of coal, oil or water shall be required. There shall be a staff colony of about 15 people within the premises of the project. The water requirements of the staff shall be met by underground water resources while all other human consumables shall be procured from the nearby village.

2.1.4 Geological Conditions

A foundation investigation study was conducted on the site of the planned project:

Foundation Design and Type

It was concluded that the foundations should meet these essential requirements during the lifetime of the structure:

a) They should be at a sufficient depth below the ground surface so as not to be affected by seasonal variations.
b) The foundation depth should be adequate to provide a reasonable range of allowable load bearing values, with regard to the imposed loads. The adopted depth should allow development of adequate passive resistance against horizontal loads.
c) These must be adequately safe against the possibility of shear failure.
d) These should not undergo excessive uniform and differential settlements.
e) The designed foundation should not have an angular distortion in excess of 1/500, and a total settlement in excess of 25 mm.

2.1.5 Interconnection

An interconnection study for the project was prepared by Power Planners International Ltd (PPI) in May 2014. The report investigated the Blue Star Electric grid connection scheme for the project. Blue Star Electric plans to connect to the nearest Islamabad Electric Supply Company (IESCO) substation at Dandot.

Detailed load flow studies have been carried out for the peak load conditions of September 2015 for the proposed scheme under normal and N-1 contingency conditions to meet the reliability criteria. The steady state analysis by load flow reveals that the proposed scheme is adequate to evacuate the maximum power of 1 MW of the plant under normal and contingency conditions.

The maximum short circuit level of 11 kV bus bar of the power plant is 11.25 kA and 10.91 kA for 3-phase and 1-phase faults respectively. Therefore industry standard switchgear with a short circuit rating of 12.5 kA is considered adequate with enough margins for future increases in fault levels due to future reinforcements in this area.

The stability check for the worst case of a three phase fault on the power plant substation 11 kV bus bar followed by the final trip of 11 kV circuits emanating from this substation was performed for a fault clearing of 10 cycles (200 ms). The system was found to be strong enough to remain stable and recovered with fast damping. The proposed scheme successfully passed the dynamic stability checks for near and far faults.

According to PPI, the proposed interconnection scheme has no technical constraints or problems. It fulfils all the criteria of reliability and stability under steady state load flow, contingency load flows, short circuit currents and dynamic/transient conditions; and was therefore recommended to be adopted.

2.1.6 Capacity/Generation

It is expected that in the first full year of operation, the 1.0 MW design shall deliver net 1,469,928 kWh of electricity to the grid before taking into account first year degradation and losses. Over the twenty five years of planned operation the power plant is expected to generate 33.820 GWh of electrical energy.

2.1.7 The Proposed Tariff

Blue Star Electric (Pvt.) Ltd. intends to opt for the Upfront Tariff for Solar Power Plants between capacities of 1MWp and 10 MWp, as determined by National Electric Power Regulatory Authority as under:

	North Region		Indexation
	Year 1-10	Year 11-25	
	Rs./kWh	Rs./kWh	
Fixed O&M	1.8137	1.8137	CPI , US CPI, US$/PKR
Insurance	1.2091	1.2091	Actual on annual basis
Debt Service- Foreign	12.8872	-	US$/PKR & LIBOR
Return on Equity	6.1097	6.1097	US$ /PKR
Total	22.0197	9.1325	

2.1.8 Technology:

The technical solution utilizes the proven technology of poly crystalline Photovoltaic solar cells in order to convert solar energy to electrical energy. Given below are the details of the main system components of the final design.

EQUIPMENT	SPECIFICATION
PV Modules	CS6P250P
Inverters	Sunny Central 1000 MV-11
Transformer	Power Zone

2.1.10 Key Milestones

The table below shows an overview of the main stages of the project along with the expected months of completions:

Date	Activity
August 2014	Environmental Study
September 2014	Expected Approval-Interconnection Study
September 2014	Submit Revised Feasibility study to AEDB
October 2014	Feasibility Approval
November 2014	Filing of Tariff/Generation License Application with NEPRA
January 2015	Approval of Tariff/ Generation License Issuance
February 2015	Issuance of LOS by AEDB
March 2015	Financial Close
December 2015	COD

2.1.11 Construction

The estimated construction period for the Solar PV Plant is 8 months with flat open terrain and good road and electrical infrastructure nearby.

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

No heavy machinery is required for the construction and erection. The site will be restored to the original landscape following project completion.

2.1.12 O&M Management

The operations and maintenance of the solar project will be supervised by Blue Star Electric and managed by a small dedicated management team within the company. The O&M will consist of routine operational checks via remote and local monitoring, check calibration and maintenance of electrical equipment, module cleaning and general ground work and repair. The majority of maintenance shall be planned but a strategy, along with the ability to respond effectively, will be in

place to quickly turn around Forced Outages. The financial considerations for O&M through the life of the project have been included in the derivation of the tariff.

2.1.13 Health & Safety

Blue Star Electric requires the Plants and all systems forming part of it, to be constructed and operated with safety as a prime consideration. The health and safety of all personnel, whether constructors, operators, maintenance workers or others, shall be considered at all stages of the development, and the Sub-Contractor shall ensure that the safety of all personnel is guaranteed during development and upgrading of the Plant.

Sub-Contractor's health and safety policy and procedures shall include the international safety practices covering but not be limited to the rules governing welfare, health, sanitation and safety of employees.

Sub-Contractor's safety policy and procedures shall also comply with any special safety regulations identified in the licensing, planning and design stages.

2.1.14 Environmental

An Initial Environmental Examination (IEE) has been conducted for the proposed project which shows that the Project will have number of positive impacts and negligible negative impacts to the existing environment as follows:

- Significant improvement in the economic activities in the surrounding areas due to generation of direct and indirect employment opportunities:
- 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 be implemented by Blue Star Electric 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 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.

2.1.15 Social

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. Blue Star Electric 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.

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.

2.2 Pakistan Electricity Market

The energy demand over the next five years is expected to grow at a rate of 7.4 % per annum. In order to meet the growing demand, the objectives of Government of Pakistan for the development of the power sector include:

- Conversion of existing integrated state owned utilities into professionally managed, competitive, financially viable, and efficient electric power system of generation, transmission and distribution in the private sector.
- Enhancing access to electricity and quality of services at affordable prices.
- Maximizing new generation capacity requirement from indigenous resources (i.e. hydro, coal, local gas, nuclear and renewable) and
- Tilting hydro-thermal mix towards hydro and local coal.

2.3 Rational for Solar Power in Pakistan

The country's unsustainable electricity generation mix, that has heavy reliance on imported fuels, requires urgent diversification. Both hydro power and coal power generation need to be accorded high priority; however, there are issues and challenges in development of these two indigenous resources.

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

Solar energy has excellent potential in areas of Pakistan that receive high levels of solar radiation throughout the year. Pakistan being in the Sun Belt is ideally located to take advantage of solar energy technologies. The country receives an average of about 19 Mega Joules per square metre of solar energy on a daily basis. This energy source is widely distributed and abundantly available in the country.

The major benefits of solar power generation are:

- Substantial fuel cost and foreign exchange savings.
- Stable cost of production as no inflationary impact of fuel price.
- Short Construction & Commissioning Period — approximately 6-8 months.
- Flexible project configuration — Given the land resource capacity can be increased.
- Environmental Benefits — Emissions to land, sea and air are deminimus.
- Reduction in Transmission Losses — Can use on or off grid designs (straight into local communities).
- Reduced Over the Fence Purchases — Reducing exposure to energy markets & risks.
- Ideal peak production timing — Delivers at a time of peak air-conditioning load.

BLUE STAR ELECTRIC(PRIVATE) LIMITED

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Mardan: Fauji Bijli Ghar, P.O. Tazagram, Tehsil Takht Bhai, Distt **Mardan**. Tel: 0092-937-520004, 0092 321 4421767 FAX: 0092 937 520574

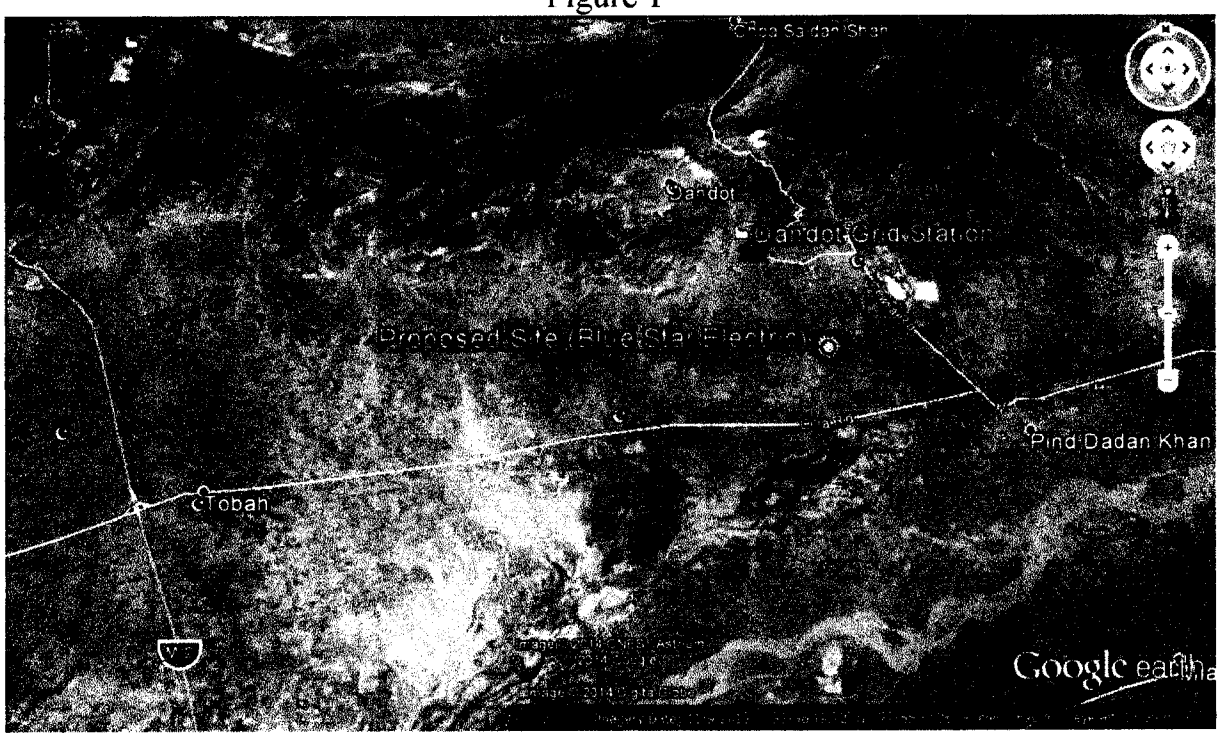
Email: hassan.khalid.aku@gmail.com. Company Registration No: 0088308

4

LOCATION MAP, SITE MAPS AND LAND

The proposed project shall be of 1MWp capacity utilizing Solar photovoltaic technology. The energy produced shall be dispatched to the nearest Dandot Grid station (IESCO) through an 11kV transmission line. Covering an area of approximately 10 acres, the project shall be located near Pind Dadin Khan, in District Jehlum, Punjab. This location is about 18.5 Km away from the Pind Dadan Khan Exit on M-2 Motorway. After taking the exit, a main metaled road leads towards Pind Dadan Khan. Moving towards Pind Dadan Khan, about 18.5km on this road the project site is located about 1 km deep on the left. The proposed location is shown in Figure 1. The project site is almost flat terrain with no human settlements nearby. Since there is scarcity of water in this area, hence major portion of the area is barren.

Figure 1



The pictures in Figure 2 and Figure 3 shall give a good idea of the land of the proposed project site.

BLUE STAR ELECTRIC(PRIVATE) LIMITED

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Email: hassan.khalid.aku@gmail.com. Company Registration No: 0088308

Figure 2

Figure 3

BLUE STAR ELECTRIC(PRIVATE) LIMITED

Lahore: 37, Street 1, Sector B, Askari 10 Lahore Cantt. Pakistan, Fax 0092 42 36500086

Mardan: Fauji Bijli Ghar, P.O. Tazagram, Tehsil Takht Bhai, Distt **Mardan**. Tel: 0092-937-520004, 0092 321 4421767 FAX: 0092 937 520574

Email: hassan.khalid.aku@gmail.com. Company Registration No: 0088308

SUMMARY IMPLEMENTATION PLAN

Sr. No	MILE STONES	TIME FRAME IN MONTHS
1.	Issuance of 'LOI'	0
2.	Completion of Feasibility Study	0-4
3.	Initial Environmental Examination (IEE)	0-3
4.	Approval of IEE from EPA Punjab	4-5
5.	Conducting interconnection studies with IESCO	0-3
6.	Acknowledgement of Feasibility study by AEDB	5-6
7.	Approval from IESCO for interconnection	4-5
8.	Application for Tariff and Generation License from NEPRA	6-7
9.	Award of Tariff and Generation License from NEPRA	8-9
10.	Financial Close for the Project	10-11
11.	Signing of PPA with IESCO	12-13
12.	Mobilization for the site	14-16
13.	Civil Works	17-20
14.	Installation and commissioning	21-22
15.	Test Period	23
16.	Project Completion	24

Note: Month '0' is the month when LOI is issued. All figures in column 3 are with reference to month '0'.

BLUE STAR ELECTRIC(PRIVATE) LIMITED

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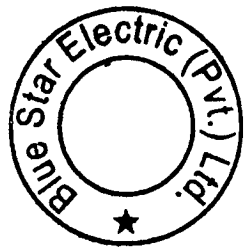
Email: hassan.khalid.aku@gmail.com. Company Registration No: 0088308

PLANT CHARACTERISTICS

1. GENERATION VOLTAGE	:	11000 V
2. POWER FACTOR	:	1.0 TO 0.95
3. FREQUENCY	:	59Hz ±1%
4. AUTOMATIC GENERATION CONTROL	:	YES
5. RAMPING RATE	:	100KW/minute for increasing/decreasing.
6. CONTROL METERING	:	YES
7. INSTRUMENTATION	:	ALL INTERNATIONAL STANDARDS.



F

Technical Proposal For Punjab 1MW PV Project, Pakistan

Concept Design

Date: April 20th 2014

Canadian Solar Inc.

TABLE OF CONTENT

1 Introduction

1.1 Canadian Solar Inc. PROFILE

About Us

Canadian Solar Inc. is one of the largest solar companies in the world. As a leading vertically-integrated manufacturer of ingots, wafers, cells, solar modules and solar systems, Canadian Solar delivers solar power products of uncompromising quality to worldwide customers. Canadian Solar's world class professional team works closely with our customers to provide them with solutions for all their solar needs.

Canadian Solar was founded in Canada in 2001 and was successfully listed on NASDAQ Exchange (symbol: CSIQ) in November 2006. To date, Canadian Solar has successfully established seven wholly-owned manufacturing subsidiaries in China, with a module capacity of 2.05 GW in mid-2011.

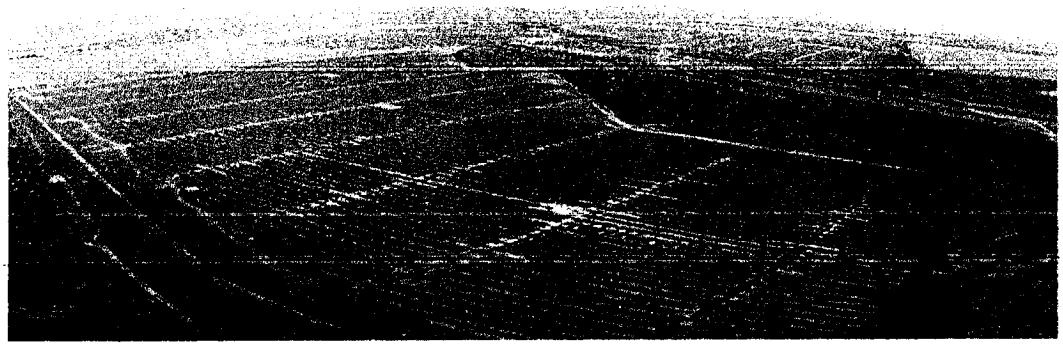
Canadian Solar is headquartered in Ontario, Canada, with subsidiaries in USA, Germany, Spain, Italy, Japan, Korea, Australia and China.

With global operations covering three major continents, Canadian Solar is able to combine the advanced technology and management experience from the West with the low manufacturing cost and fast products delivery from the East to best serve its customers' needs.

Canadian Solar has been serving customers around the world, with major customers in Germany, Spain, Italy, USA, Canada, Korea, Japan and China. Canadian Solar's modules have been used in various ground mounted large solar power plants as well as roof top solar power systems in different climate zones. These systems are either grid-connected or off-grid power systems ranging from 25KW to over 100 MW systems.

1.2 Canadian Solar PROJECTS

1.2.1 Major Projects – Module Supply Experience and EPC Experience!



Canadian Solar and GP Joule Announce 97 MW Solar Module Supply Agreement

"With Canadian Solar, we know we've got a proven partner at our side **capable of delivering high performance, high value modules, able to support large scale projects,**"

"**Canadian Solar's modules set the standard** and excel by their versatile use in particular, and they will be mostly deployed in Germany, but also all over Europe."

GP JOULE
Simply energy!

Mr. Ove Petersen

CEO of GP Joule

Source: http://phx.corporate-ir.net/phoenix.zhtml?c=196781&p=irol-newsArticle&ID=1553073&highlight=

Canadian Solar Announces 81 MW Sales Agreement with Saferay

"We are proud to be working with Canadian Solar. **The company came out on top of our selection criteria, including quality, reliability, customer service and brand attractiveness to customers.** "

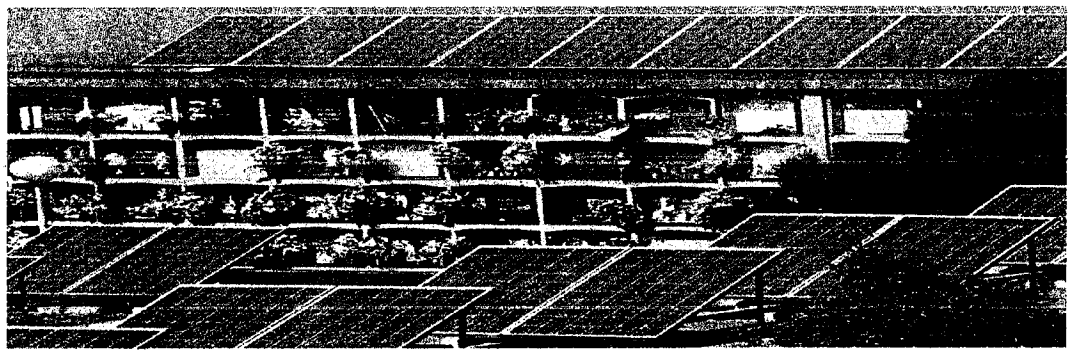
"**Strong partners**, like Canadian Solar, are critical to Saferay's continued success and fast growth."

Dr. Marko Schulz

CEO of Saferay GmbH

Source: http://phx.corporate-ir.net/phoenix.zhtml?c=196781&p=irol-newsArticle&ID=1563802&highlight=

Punjab 1MW PV Project



Canadian Solar Signs 100 MW Solar Module Supply Agreement with Fire Energy Group

"Fire Energy Group has selected Canadian Solar products **because of its consistent high quality, reliable delivery and strong customer commitment.**"

"As Fire Energy Group continues to expand across Europe, it is critical we have a proven partner working alongside us. Canadian Solar is that proven partner."

Mr. John Liu

Chairman and CEO of Fire Energy Group

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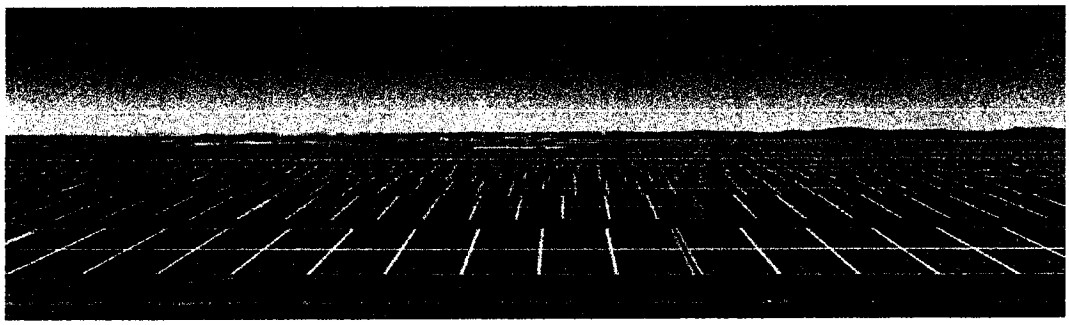


Canadian Solar Supplies More than 35,000 Solar Modules to EOSOL's 8 MW French Solar Power Plant

"This was an easy decision for EOSOL EN to expand its relationship with Canadian Solar given **its meticulous design and production techniques, which ensure a high-yield, long-term performance for their modules.** "

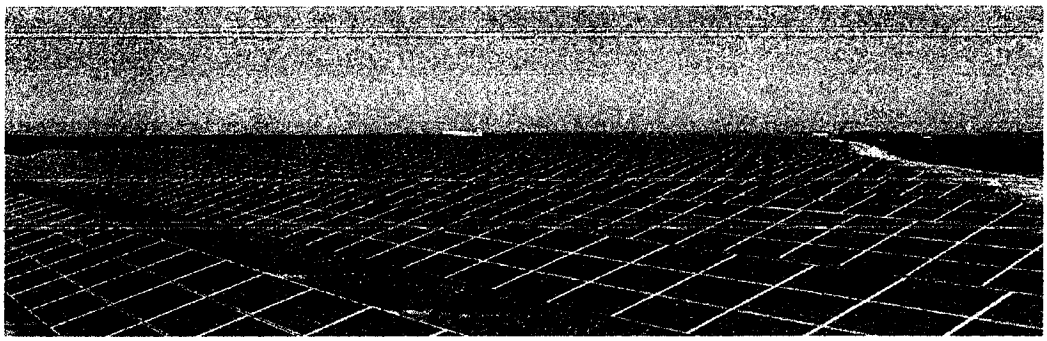
"Canadian Solar's solar panels have been **field-tested to offer higher energy production and include an industry-leading plus power tolerance.** "

Mr. M. Bruno BERNAL

President of EOSOL Group

Source: http://phx.corporate-ir.net/phoenix.zhtml?c=196781&p=irol-newsArticle&ID=1551761&highlight=

Punjab 1MW PV Project



Canadian Solar Announces 15 MW Sales Agreement with Isolux for Three UK Solar Farms

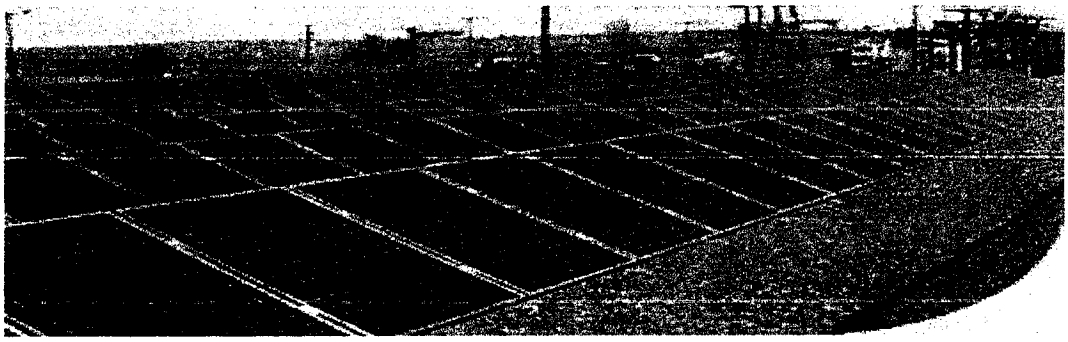
"Canadian Solar's solar modules have an **attractive cost-performance-ratio, high reliability and top quality, along with a 25 year, non-cancellable warranty backed by AM best rated insurance companies in Europe and the U.S. "**

"Canadian Solar's leadership and warranty insurance policy definitely helped our project finance on the bank side. This way, we can guarantee our systems' high performance,"

ISOLUX CORSÁN
Building the present. Shaping the future

Mr. Manuel Codes Diaz
ISOLUX CORSAN

Source: http://phx.corporate-ir.net/phoenix.zhtml?c=196781&p=irol-newsArticle&ID=1568017&highlight=



Canadian Solar Expands into India: 33 MW Solar PV Module Sales Agreement with Cirus Solar Systems

"We have selected Canadian Solar products because of their **high quality, reliable delivery and strong commitment to customer service.**"

"We look forward to working with Canadian Solar to develop awareness and to drive adoption of solar power in India."

Mr. I. Syam Prasad Reddy
Chairman of Indu Group
Owner of EPC firm, Cirus Solar

Source: http://phx.corporate-ir.net/phoenix.zhtml?c=196781&p=irol-newsArticle&ID=1591015&highlight=

Punjab 1MW PV Project

Canadian Solar Inc. to Build Third SkyPower Solar Park Located in Thunder Bay, Ontario, Canada

"As Canada's largest developer and owner of solar projects, we are pleased to expand our relationship with Canadian Solar and once again select them to build this important project;"

""We look forward to the completion of these three solar projects as we continue to build out our extensive solar pipeline across the Province, which will to bring an abundance of economic, environmental and health benefits to the communities where we are actively building. "

SKYPOWER

Mr. Kerry Adler

President and CEO of SkyPower.

Source: http://phx.corporate-ir.net/phoenix.zhtml?c=196781&p=irol-newsArticle&ID=1539698&highlight=

2 Concept Design

2.1 Site Details

- Location:

Pind Dadan Khan, District Jehlum, Punjab, Pakistan.

1) Latitude 32° 37'N
2) Longitude 72° 59'E

- General Global Irradiation for this site (Data Source NASA)

Geographical Coordinates | Monthly meteo

Site: **Pind Dadan Khan (India)**

Data source: NASA-SSE satellite data, 1983-1993, release 6

	Global Irrad. kWh/m2.day	Diffuse kWh/m2.day	Temper. oC	Wind Vel. m/s
January	3.26		10.3	
February	4.13		13.1	
March	5.08		18.9	
April	6.24		25.3	
May	7.12		30.4	
June	7.14		33.5	
July	6.01		31.6	
August	5.56		29.5	
September	5.19		27.6	
October	4.64		23.1	
November	3.76		17.6	
December	3.06		12.3	
Year	**5.09**		**22.8**	

Required Data
- [x] Horizontal global irradiation
- [x] Average Ext. Temperature

Extra data
- [ ] Horizontal diffuse irradiation
- [ ] Wind energy

Irradiation units
- (•) kWh/m2.day
- ( ) kWh/m2.mth
- ( ) MJ/m2.day
- ( ) MJ/m2.mth
- ( ) W/m2
- ( ) Clearness Index Kt

2.2 System Configuration

Solar panel array output DC power under sunlight and the inverter convert the DC power to AC power and step up to higher voltage for grid connection.
The total 1MW solar farm needs about 4000 pcs solar panel of CS6P250P, 1 grid inverters with rated power of 1000KWp .

2.3 System Description

1. The panels will be ground mounted. The ground mounting will require a flat level surface and will be set into concrete. The panels will require an area that is exposed to the sun. All the panels will be at least 1.5m from the ground level.

2. The panels will be mounted in rows and electrically connected with cables. The cables will need to be made safe and tamper proof. The electrical output from the PV panels will be fed via cables to a bank of inverters.

3. These inverters will be housed in a structure to protect them from the weather and from tampering. A design decision based on cost will need to be made whether the inverters are all located in one area or are interspersed around the site.

4. The power plant will have a SCADA system to monitor the output of the rows of panels. In this way, any system faults can be detected to a particular array and rectified. Electrical protection equipment will be required, to be specified in conjunction with National Grid Company, for the connection of the PV plant to the electrical network.

2.4 PV System Components

The major equipment and systems involved in the solar PV power plant comprise of two parts. One part is the solar PV system and the other is the auxiliaries including power evacuation and grid interface facility. The solar PV system will be supplied and installed as turn-key package including design and optimization. Auxiliaries will be

procured from different suppliers, installed and commissioned.

2.4 .1 PV PANEL

Our solar PV module will have technical characteristics under the following heads:

Warranted minimum power (Pmax)

Voltage at P max (Vmax)

Current at P max (Imax)

Open circuit voltage (Voc)

Short circuit current (Isc)

Maximum system voltage

Maximum series fuse rating

Temperature coefficient of P

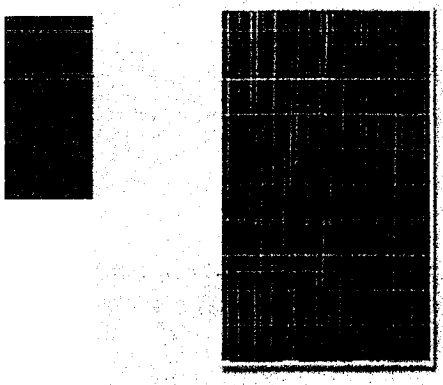
Temperature coefficient of Voc

Temperature coefficient of Isc

We will design the PV module for safe operation under tropical weather conditions with module operating temperature of up-40 °C to +85 °C. The dielectric insulation voltage, Vdc shall be minimum of of 1000 volts.

CSI Poly Modules stand for reliably high yields and long service life. They are undergoing constant critical quality checks to ensure the lowest claim rates and high reliability. Thanks to the positive performance tolerance of up to 5W, more electricity is produced throughout the operational life of the system, in addition, comprehensive product and efficiency warranties guarantee a secure investment.

CanadianSolar

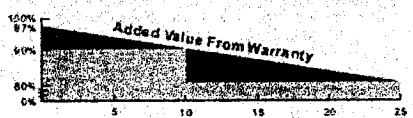


CS6P
230/235/240/245/250P

CS6P is a robust solar module with 60 solar cells. These modules can be used for on-grid solar applications. Our meticulous design and production techniques ensure a high-yield, long-term performance for every module produced. Our rigorous quality control and in-house testing facilities guarantee Canadian Solar's modules meet the highest quality standards possible.

Key Features

- High module efficiency up to 15.54%
- Positive power tolerance: 0 ~ +5W
- Robust frame to up to 5400Pa load
- Anti-reflective with self-cleaning surface
- Outstanding performance at low irradiance
- High energy yield at Low NOCT
- Backed By Our New 10/25 Linear Power Warranty Plus our added 25 year insurance coverage



- 10 year product warranty on materials and workmanship
- 25 year linear power output warranty

Best Quality

- 235 quality control points in module production
- EL screening to eliminate product defects
- Current binning to improve system performance
- Potential-Induced Degradation (PID) free
- Accredited Salt mist/Ammonia resistant
- Top performance by PVUSA Test Conditions (PTC) rating

Best Warranty Insurance

- 25 years worldwide coverage
- 100% warranty term coverage
- Providing third party bankruptcy rights
- Non-cancellable
- Immediate coverage
- Insured by 3 world top insurance companies

Comprehensive Certificates

- IEC 61215, IEC 61730, IEC61701ED2, UL1703, KEMCO, CEC Listed, CE, JET and MCS
- ISO9001: 2008: Quality Management System
- ISO/TS16949:2009: The automotive quality management system
- ISO14001:2004: Standards for Environmental management system
- QC080000 HSPM: The Certification for Hazardous Substances Regulations
- OHSAS 18001:2007 International standards for occupational health and safety
- Reach Compliance

www.canadiansolar.com

CS6P-230/235/240/245/250P

Electrical Data

STC	CS6P-230P	CS6P-235P	CS6P-240P	CS6P-245P	CS6P-250P
Nominal Maximum Power (Pmax)	230W	235W	240W	245W	250W
Optimum Operating Voltage (Vmp)	29.5V	29.5V	29.9V	30.7V	30.1V
Optimum Operating Current (Imp)	7.79A	7.93A	8.03A	8.17A	8.30A
Open Circuit Voltage (Voc)	36.8V	36.9V	37.0V	37.1V	37.2V
Short Circuit Current (Isc)	8.34A	8.46A	8.58A	8.74A	8.87A
Module Efficiency	14.36%	14.61%	14.92%	15.23%	15.54%
Operating Temperature	-40°C~+85°C				
Maximum System Voltage	1000V (IEC)/600V (UL)				
Maximum Series Fuse Rating	15A				
Application Classification	Class A				
Power Tolerance	0 ~ +5W				

Under Standard Test Conditions (STC) of irradiance of 1000W/m², spectrum AM 1.5 and cell temperature of 25°C

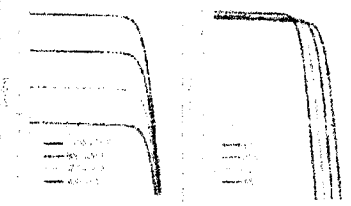
NOCT	CS6P-230P	CS6P-235P	CS6P-240P	CS6P-245P	CS6P-250P
Nominal Maximum Power (Pmax)	167W	170W	174W	178W	181W
Optimum Operating Voltage (Vmp)	27.0V	27.2V	27.5V	27.4V	27.5V
Optimum Operating Current (Imp)	6.18A	6.27A	6.38A	6.49A	6.60A
Open Circuit Voltage (Voc)	33.6V	33.9V	34.0V	34.1V	34.2V
Short Circuit Current (Isc)	6.76A	6.86A	6.96A	7.08A	7.19A

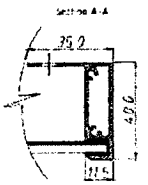
Under Normal Operating Cell Temperature, Irradiance of 800 W/m², spectrum AM 1.5, ambient temperature 20°C, wind speed 1 m/s

Mechanical Data

Cell Type	Poly-crystalline 156 x 156mm, 2 or 3 Busbars
Cell Arrangement	60 (6 x 10)
Dimensions	1638 x 982 x 40mm (64.5 x 38.7 x 1.57 in)
Weight	19kg (41.9 lbs)
Front Cover	3.2mm Tempered glass
Frame Material	Anodized aluminum alloy
J-BOX	IP65, 3 diodes
Cable	4mm² (IEC)/12AWG(UL), 1000mm
Connectors	MC4 or MC4 Comparable
Standard Packaging (Modules per Pallet)	24pcs
Module Pieces per container (40 ft. Container)	672pcs (40'HQ)

I-V Curves (CS6P-250P)





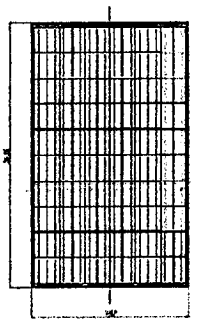
Temperature Characteristics

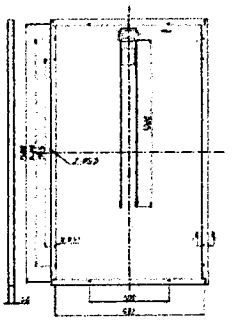
Temperature Coefficient	Pmax	-0.43%/°C
	Voc	-0.34 %/°C
	Isc	0.065 %/°C
Normal Operating Cell Temperature		45±2°C

Performance at Low Irradiance

Industry leading performance at low irradiation environment, +95.5% module efficiency from an irradiance of 1000w/m² to 200w/m² (AM 1.5, 25 °C)

Engineering Drawings





*Specifications included in this datasheet are subject to change without prior notice.

About Canadian Solar

Canadian Solar Inc. is one of the world's largest solar companies. As a leading vertically-integrated manufacturer of ingots, wafers, cells, solar modules and solar systems, Canadian Solar delivers solar power products of uncompromising quality to worldwide customers. Canadian Solar's world class team of professionals works closely with our customers to provide them with solutions for all their solar needs.

Canadian Solar was founded in Canada in 2001 and was successfully listed on NASDAQ Exchange (symbol: CSIQ) in November 2006. Canadian Solar has module manufacturing capacity of 2.05GW and cell manufacturing capacity of 1.3GW.

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Guelph | Ontario N1K 1E6 | Canada
Tel: +1 519 837 1881
Fax: +1 519 837 2550
inquire.ca@canadiansolar.com
www.canadiansolar.com

Benefits to the system operator:

- Top ranked PVUSA (PTC) rating in California for higher energy production
- Industry first comprehensive warranty insurance by AM Best rated leading insurance companies in the world
- Industry leading plus only power tolerance: 0 ~ +5W
- Strong framed module, passing mechanical load test of 5400Pa to withstand heavier snow load
- The 1st manufacturer in the PV industry certified for ISO:TS16949 (The automotive quality management system) in module production since 2003
- ISO17025 qualified manufacturer owned testing lab, fully complying to IEC, TUV, UL testing standards
- Backed by 10/25 years Linear Power Warranty Plus added 25 years insurance coverage

Benefits to the installer:

- Flexible deployment in areas of extreme weather conditions
- Secure installation thanks to reverse polarity protected plugs with twist lock
- Modules delivered in perfect condition thanks to secure transportation packaging and robust module frames
- Reliable operation thanks to high-quality components
- Customer-friendly after sales service

2.4 .2 Grid Inverter

The grid tie inverter in the solar PV power plant converts the DC power generated by the PV module into suitable AC power for feeding to the grid. This inverter automates the start-up and shutdown functions. By incorporating advanced maximum power point tracking technology, it maximizes the energy harvested from PV modules. To minimize the power losses during the conversion process, the inverter switching

technology uses insulated gate bipolar transistors. Multiple inverters are paralleled for this installation. High efficiency of conversion under partial load conditions is essential, and has been considered in our design for economic viability of the entire solar power station. The inverters with their own weatherproof enclosure installed in close proximity to PV modules are considered for this project.

We have considered a typical inverter system that will have the following technical specifications:

Emergency off switch

Power switch AC side

Power switch DC side

Monitored surge voltage arresters – AC

Monitored surge voltage arresters – Aux. Power

Display

Ground Fault Monitoring

Heating System

EMC

Standards for the following:

Grid monitoring

CE conformity

Enclosure rating and ambient conditions

Enclosure type according to EN 60529

Permissible ambient temperature

Maximum elevation above sea level

Air Quality (minimal) according to EN 60529

Punjab 1MW PV Project

SUNNY CENTRAL for direct medium-voltage feed-in
1000MV / 1250MV / 1600MV

Technical data	Sunny Central 1000MV	Sunny Central 1250MV
Input (DC)		
Max. DC power (@ cos φ = 1)	1120 kW	1426 kW
Max. input voltage[1]	1000 V / 1100 V optional	1000 V / 1100 V optional
MPP voltage range (@ 25 °C / @ 40 °C at 50 Hz)[2]	449 V - 820 V / 430 V - 820 V	529 V - 820 V / 500 V - 820 V
Rated input voltage	480 V	550 V
Max. input current	2500 A	2700 A
Min. input voltage / V_{DC} at low V_{AC}	429 V / 450 V	498 V / 500 V
Number of independent MPP inputs	2	2
Number of DC inputs	18 inputs equipped with fuses	18 inputs equipped with fuses
Output (AC)		
Rated power (@ 25 °C) / nominal AC power (@ 40 °C)	1100 kVA / 1000 kVA	1400 kVA / 1250 kVA
Nominal AC voltage / range	20000 V / 18000 V - 22000 V	20000 V / 18000 V - 22000 V
AC power frequency / range	50 Hz / 47 Hz ... 53 Hz	50 Hz / 47 Hz ... 53 Hz
Rated power frequency / rated grid voltage	50 Hz / 20000 V	50 Hz / 20000 V
Max. output current	31.8 A	40.4 A
Max. total harmonic factor	< 3 %	< 3 %
Power factor at rated power / displacement power factor adjustable[3]	1 / 0.9 overexcited ... 0.9 underexcited	
Feed-in phases / connection phases	3 / 3	3 / 3
Efficiency[4]		
Max. efficiency	98 % (98.2 %)[5]	98 % (98.2 %)[5]
European weighted efficiency / CEC efficiency	97.5 % (97.8 %)[5]	97.6 % (97.8 %)[5]
Protective devices		
DC disconnect device	Motor-driven DC switch-disconnector	
AC disconnect device	Optionally (switch-disconnector with HV fuses)	
DC overvoltage protection / AC overvoltage protection on the LV side	Surge arrester type I / surge arrester type II	
Grid monitoring / plant monitoring	● / Optionally (via Sunny Portal)	● / Optionally (via Sunny Portal)
Ground-fault monitoring / remote-controlled ground-fault monitoring	○ / ○	○ / ○
Insulation monitoring	○	○
Galvanic isolation	●	●
Protection class (according to IEC 62103) / electric arc resistance (according to IEC 62271-202)	I / IAC AB 20 kA 1s	I / IAC AB 20 kA 1s
General data		
Dimensions (W / H / D)	5400 / 3605 / 3000 mm (212.6 / 141.9 / 118.1 inch)	
Weight	33245 kg / 73293 lb	33725 kg / 74351 lb
Operating temperature range	-20 °C ... +40 °C / -4 °F ... +104 °F	-20 °C ... +40 °C / -4 °F ... +104 °F
Noise emission	< 65 dB(A)	< 65 dB(A)
Max. self-consumption (operation) / self-consumption (night)	3000 W[6] / < 180 W + 1100 W[6]	3000 W[6] / < 180 W + 1350 W[6]
External auxiliary supply voltage / external backup fuse for auxiliary power supply	230 / 400 V (3/N/PE) / B 32 A, 3-pin	
Cooling principle (inverter / transformer)	Forced cooling / natural convection	
Degree of protection (according to IEC 60529)[7]	IP23D	IP23D
Application	In unprotected outdoor environments	In unprotected outdoor environments
Use in a chemically aggressive environment	○	○
Max. permissible value for relative humidity (non-condensing)	15 % ... 95 %	15 % ... 95 %
Max. operating altitude above MSL	1000 m	1000 m
Fresh air consumption (inverter)	6200 m³/h	6000 m³/h
Features		
DC connection	Ring terminal lug	Ring terminal lug
AC connection, MV side	External taper angle plug	External taper angle plug
Display[8]	HMI touchscreen	HMI touchscreen
Communication protocols / Sunny String-Monitor	Ethernet, Modbus/RS485/none (Optiprotect)	
SC-COM/Commuit	● / ○	● / ○
Transformer for auxiliary power supply	○	○
Medium-voltage transformer with amorphous core	○	○
Medium-voltage switchgear	○	○
Color enclosure / door / base / roof	RAL 7035 / 7024 / 7024 / 7024	
Certificates and approvals (more available on request)	EN 61000-6-2, EN 61000-6-4, IEC 62271-202, EMC conform, CE compliant, Arrêté du 23/04/08, R.D. 1663/2000, R.D. 661/2007, BDEW-MSRL / FGW / TR8	
● Standard feature ○ Optional feature — Not available		
Type designation	SC 1000MV-20	SC 1250MV-20

2.4 .3 Control and Automation

In order to have a smooth functioning of inverter, control and automation forms an integral part of PV system. Different types of controllers are available. We have considered a typical controller which will have following control and automated functions.

Inverter start up, shut off and disconnection sequence

Over / under voltage & frequency protection

Anti islanding protection

Power tracking to match inverter to the arrays

Adjustment of delay periods to customize system shutdown sequence

Graphical user interface for real time communications, monitoring and control

Optical remote monitoring via internet modem

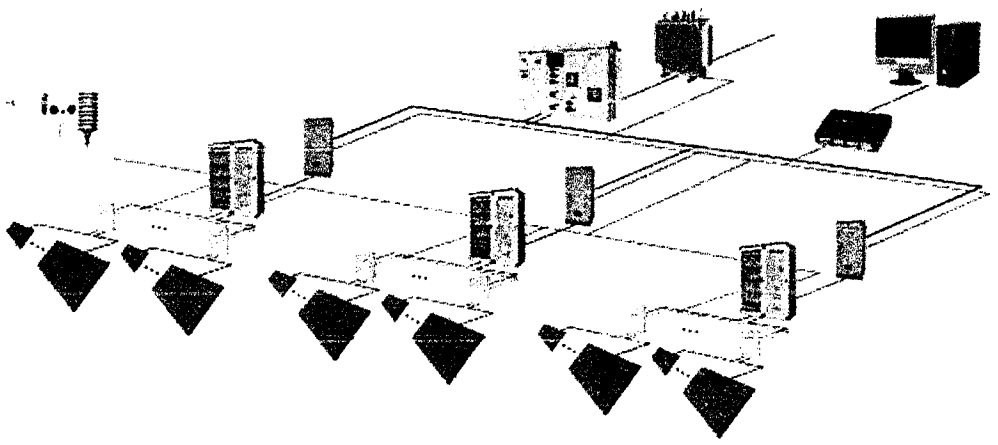
Faults notification via modem

Data acquisition and logging

DC monitoring

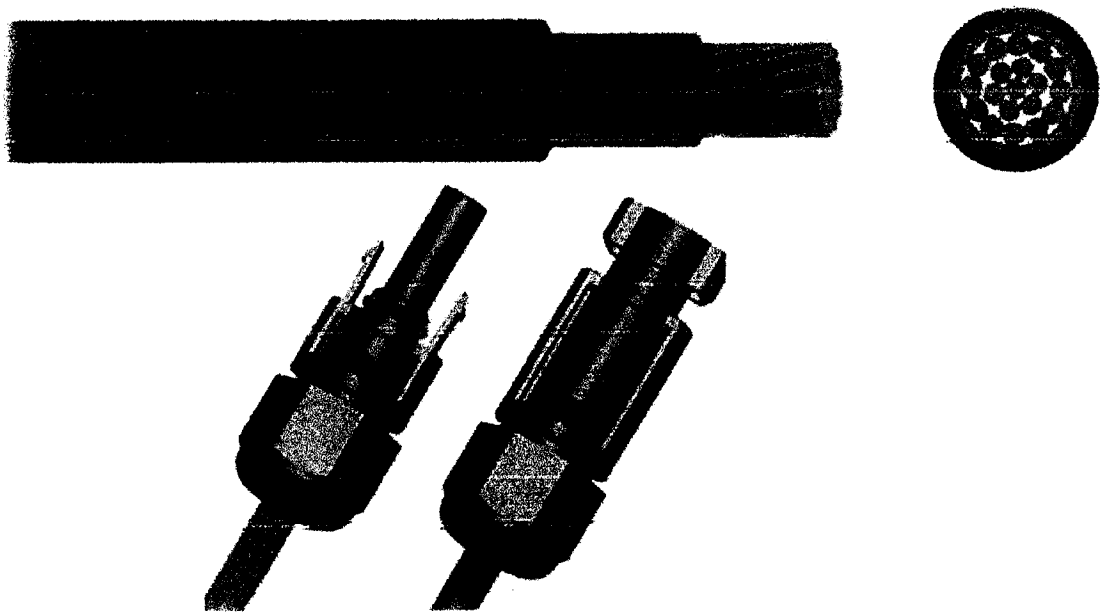
2.4 .4 Monitoring system

The system considered in our design will enable remote diagnostic and monitoring functions of all components. All the equipment will be controlled and monitored through SCADA. Ethernet or wireless technologies will be used for communication.



2.4 .5 Wiring and cabling

We have considered Solar cables which are extremely robust and resist high mechanical load abrasion, high temperature resistance and excellent weatherproofing characteristics provide a long service life to the cables used in this large-scale project. The connectors with high current capacity and easy mode of assembly will be used for the connections of the power plant cables.



2.5 System Simulation

PVSYST V5.56		21/04/14

Grid-Connected System: Simulation parameters

Project :	**Pind Dadan Khan 1MW PV Project**			
Geographical Site	**Pind Dadan Khan**		**Country**	**India**
Situation	Latitude	32.6oN	Longitude	73.0oE
Time defined as	Legal Time	Time zone UT+6	Altitude	215 m
	Albedo	0.20		
Meteo data :	Pind Dadan Khan, Synthetic Hourly data			

Simulation variant :	**Pind Dadan Khan 1MW PV Project**			
	Simulation date	21/04/14 09h03		

Simulation parameters

Collector Plane Orientation	Tilt	30 deg	Azimuth	0 deg
Horizon	Free Horizon			
Near Shadings	No Shadings			

PV Array Characteristics

PV module	Si-poly	Model	**CS6P - 250P**		
		Manufacturer	Canadian Solar Inc.		
Number of PV modules		In series	20 modules	In parallel	200 strings
Total number of PV modules		Nb. modules	4000	Unit Nom. Power	250 Wp
Array global power		Nominal (STC)	**1000 kWp**	At operating cond.	891 kWp (50oC)
Array operating characteristics (50oC)		U mpp	541 V	I mpp	1646 A
Total area		Module area	**6434 m2**	Cell area	5842 m2
Inverter		Model	**Sunny Central 1000 MV-11**		
		Manufacturer	SMA		
Characteristics		Operating Voltage	450-820 V	Unit Nom. Power	1000 kW AC

PV Array loss factors

Thermal Loss factor	Uc (const)	20.0 W/m2K	Uv (wind)	0.0 W/m2K / m/s
=> Nominal Oper. Coll. Temp. (G=800 W/m2, Tamb=20oC, Wind=1 m/s.)			NOCT	56 oC
Wiring Ohmic Loss	Global array res.	5.6 mOhm	Loss Fraction	1.5 % at STC
Module Quality Loss			Loss Fraction	1.0 %
Module Mismatch Losses			Loss Fraction	2.0 % at MPP
Incidence effect, ASHRAE parametrization	IAM =	1 - bo (1/cos i - 1)	bo Parameter	0.05

User's needs : Unlimited load (grid)

PVSYST V5.56		21/04/14

Grid-Connected System: Main results

Project : **Pind Dadan Khan 1MW PV Project**

Simulation variant : **Pind Dadan Khan 1MW PV Project**

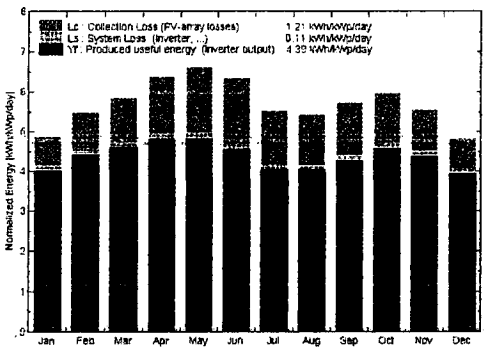
Main system parameters					
System type	**Grid-Connected**				
PV Field Orientation	tilt	30 deg	azimuth	0 deg	
PV modules	Model	CS6P - 250P	Pnom	250 Wp	
PV Array	Nb. of modules	4000	Pnom total	**1000 kWp**	
Inverter	Model	Sunny Central 1000 MV-11	Pnom	1000 kW ac	
User's needs	Unlimited load (grid)				

Main simulation results

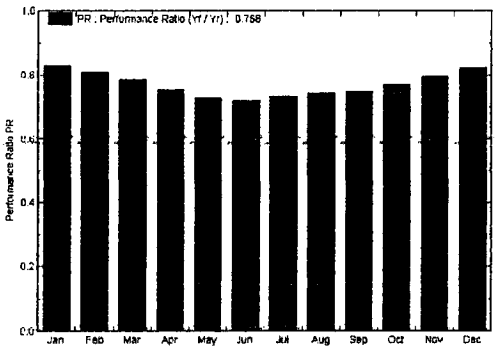
System Production — **Produced Energy** **1604007 kWh/year** Specific prod. 1604 kWh/kWp/year

Performance Ratio PR 76.8 %

Normalized productions (per installed kWp): Nominal power 1000 kWp



Performance Ratio PR



Pind Dadan Khan 1MW PV Project

Balances and main results

	GlobHor kWh/m2	T Amb oC	GlobInc kWh/m2	GlobEff kWh/m2	EArray kWh	E_Grid kWh	EffArrR %	EffSysR %
January	101.1	10.30	151.2	147.1	128656	125501	13.22	12.90
February	115.6	13.10	153.8	149.7	127796	124608	12.81	12.59
March	157.5	18.80	181.7	176.7	146756	143110	12.56	12.24
April	187.2	25.30	191.7	186.1	148322	144605	12.02	11.72
May	220.7	30.40	205.2	198.7	153814	149883	11.65	11.35
June	214.2	33.50	190.5	184.2	140724	137191	11.48	11.19
July	186.3	31.60	171.4	165.7	129259	126040	11.72	11.43
August	172.4	29.50	168.8	163.4	128948	126766	11.88	11.58
September	155.7	27.60	172.1	167.1	132460	129195	11.96	11.67
October	143.8	23.10	165.1	160.3	146382	142714	12.29	11.98
November	112.8	17.60	166.3	162.0	135631	132338	12.67	12.36
December	95.5	12.30	148.4	145.2	126084	123053	13.12	12.80
Year	1862.8	22.80	2087.3	2026.3	1644832	1604007	12.25	11.94

Legends:

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

Punjab 1MW PV Project

PVSYST V5.56		21/04/14

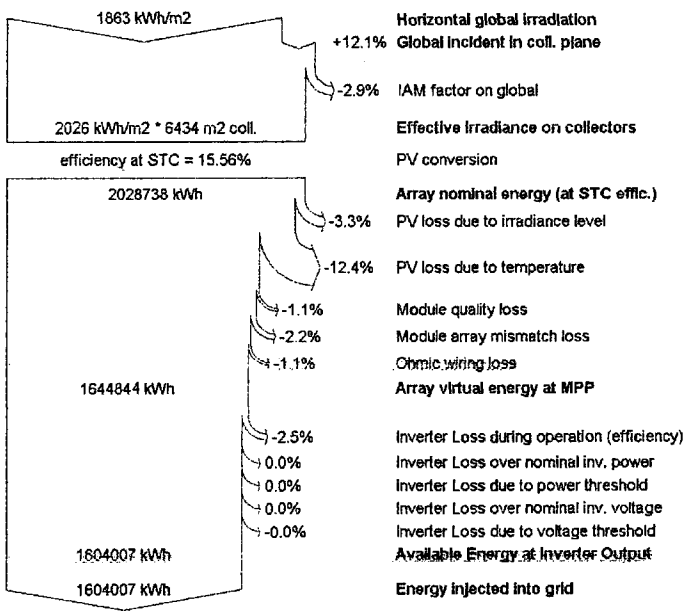
Grid-Connected System: Loss diagram

Project : **Pind Dadan Khan 1MW PV Project**

Simulation variant : **Pind Dadan Khan 1MW PV Project**

Main system parameters	System type	**Grid-Connected**			
PV Field Orientation	tilt	30 deg	azimuth	0 deg
PV modules	Model	CS6P - 250P	Pnom	250 Wp
PV Array	Nb. of modules	4000	Pnom total	**1000 kWp**
Inverter	Model	Sunny Central 1000 MV-11	Pnom	1000 kW ac
User's needs	Unlimited load (grid)			

Loss diagram over the whole year



2.7 Summary of Key Parameter

Project Name	Punjab 1MW PV Project
Location	Pind Dadan Khan, District Jehlum
Project Size	1MW
Module Type	CS6P-250P
Module Quantity	4000pcs
Inverter Type	1000kWp
Inverter Quantity	1set
Average Performance Ration	76.8%
System Production	1604MWh/year

BLUE STAR ELECTRIC(PRIVATE) LIMITED

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Mardan: Fauji Bijli Ghar, P.O. Tazagram, Tehsil Takht Bhai, Distt **Mardan**. Tel: 0092-937-520004, 0092 321 4421767 FAX: 0092 937 520574

Email: hassan.khalid.aku@gmail.com. Company Registration No: 0088308

PROSPECTUS

1. BRIEF INTRODUCTION OF THE APPLICANT

1.1. Blue Star Electric (Pvt.) Limited is a Private Limited company which was registered in Pakistan under the Companies Ordinance 1984 to construct power plants using renewable energy resources. It is the sister company of Blue Star Energy (Pvt.) Limited sharing common directors. Blue Star Energy's first venture was a 3 MW hydel power station on Upper Swat Canal at RD 52+775. The company was issued the generation licence for this 3 MW project in August 2008. The Generation Licence Number as allotted by National Electric Power Regulatory Authority was SGC/036/2008.

Now, Blue Star Electric (Pvt.) Limited plans to utilize solar energy to set up a new undertaking of 1 MW capacity near Pind Dadan Khan, district Jehlum under the jurisdiction of Islamabad Electric Supply Company. In this application, the generation license is applied for this project. It is intended to sell the electric power to IESCO under the provisions of Section 8.2.1 of Policy for Development of Renewable Energy for Power Generation 2006 issued by GOP on 16.12.2006.

2. SALIENT FEATURES OF THE FACILITY

2.1. The solar power plant under consideration is planned to be constructed using Photovoltaic Technology. The proposed site is located near the city of Pind Dadan Khan in District Jehlum.

2.2. The project is about 18.5 Km away from the Pind Dadan Exit on M-2 Motorway. After taking the exit, a main metaled road heads towards Pind Dadan Khan. Moving towards Pind Dadan Khan, about 18.5km on this road the project site is located about 1 km deep on the left.

2.3. The project shall cover an area of approximately 10 acres.

2.4. It shall be connected to Dandot Grid station with an outgoing busbar voltage of 11kV.

2.5. The plant is proposed to be of Chinese Origin.

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Email: hassan.khalid.aku@gmail.com. Company Registration No: 0088308

2.6. The project will yield both direct and indirect financial benefits. The direct benefits include annual power revenue obtained from the availability of electricity generated by the project over its useful life. The indirect benefits will come in the form of savings of foreign exchange used for importing fuel to be used for operating thermal units.

3. PROPOSED INVESTMENT

3.1. The cost estimates of this project are based on the Upfront Tariff for Solar Power Plants determined by NEPRA. The project cost alongwith the breakdown is given in the table below:

Description	Amount(US$)
EPC Cost	1,692,708
Non EPC & Project Development Cost	132,000
Insurance during construction	12,695
CAPEX	1,832,825
Financing Fees & Charges	48,231
Interest During Construction	15,052
Total Project Cost	1,900,686

3.2. The planned debt equity ratio is 70:30.

3.3. The debt part is planned to be obtained through a local financial institution.

4. SOCIAL AND ENVIRONMENTAL IMPACT OF THE PLANT

4.1. There will be no loss of any rare and endangered species.

4.2. There will be no change in sediment pattern due to the construction of the project.

4.3. The project will not displace any families so there will not be any resettlement issue.

4.4. Safe working condition will be provided by the contractor.

4.5. The contractor will need to be responsible for the management given in the litigation and management section.

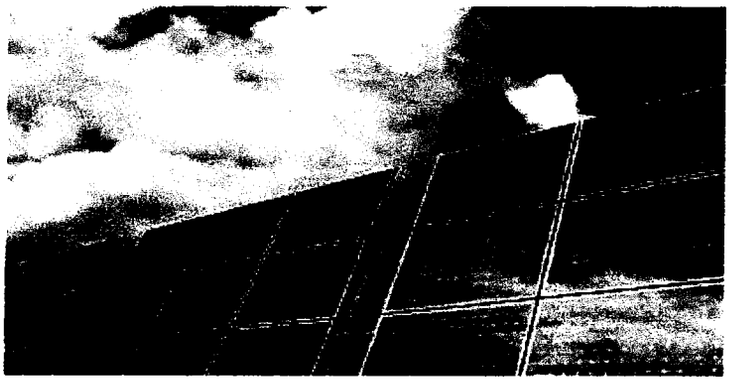
4.6. The project has sustainability as it uses renewable resource and as it is run of river project.

Report No. PPI-93.1-Draft/14

INTERCONNECTION STUDY

For

1 MW Solar Power Project by Blue Star Electric Pvt. Ltd near Pind Dadan Khan, Punjab



Draft Final Report
(07-05-2014)

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Executive Summary

- The study objective, approach and methodology have been described and the plant's data received from the client Blue Star Electric Pvt. Ltd is validated.
- The expected COD of the project is March 2016. Therefore the month of June 2016 has been selected to carry out the study as it will allow the maximum impact of the project to be judged.
- The IESCO system data as available with PPI for other studies have been used.
- The nearest substation of IESCO is Dandot 132/11 kV. The following scheme of interconnection of Solar Power Plant by Blue Star Electric to evacuate its maximum power of 1 MW is envisaged and studied in detail:
    - A direct 11 kV double circuit of 2 km length using Osprey conductor to be laid from 11 kV Bus Bar of Blue Star Electric Solar-PP till Dandot 132/11 kV substation. One circuit to be connected to each Dandot 132/11 kV T-1 and T-2.
    - In this context two 11 kV breaker/line bays need to be added in the 11 kV switchgear hall of Dandot 132/11 kV Substation
- Detailed load flow studies have been carried out for the peak load conditions of June 2016 for the proposed scheme under normal and N-1 contingency conditions to meet the reliability criteria.
- Steady state analysis by load flow reveals that proposed scheme is adequate to evacuate the maximum power of 1 MW of the plant under normal and contingency conditions.
- The short circuit analysis has been carried out to calculate maximum fault levels at the Blue Star Electric Solar Power Plant at 11 kV, and the substations of 132/11kV in its vicinity. We find that the fault currents for the proposed scheme are much less than the rated short circuit capacities of switchgear installed at these substations. There are no violations of exceeding the rating of the equipment due to contribution of fault current from the Blue Star Electric Solar Power Plant.

  The maximum short circuit level of 11 kV bus bar of Blue Star Electric Solar Power Plant 11 kV is 11.25 kA and 10.91 kA for 3-phase and 1-phase faults respectively. Therefore an industry standard switchgear of the short circuit rating

of 25 kA is considered adequate with enough margin for future increase in fault levels due to future reinforcements in this area.

- The dynamic stability analysis of proposed scheme of interconnection has been carried out. The stability check for the worst case of three phase fault right on the 11 kV bus bar of the Blue Star Electric solar power plant substation followed by the final trip of 11 kV circuits emanating from this substation, has been performed for fault clearing of 10 cycles (200 ms) as understood to be the maximum fault clearing time of 11 kV protection system. The system is found strong enough to stay stable and recovered with fast damping. The stability of system for far end faults of 3-phase occurring at Dandot 132 kV bus bar has also been checked. The proposed scheme successfully passed the dynamic stability checks for near and far faults.
- The proposed scheme of interconnection has no technical constraints or problems, it fulfills all the criteria of reliability and stability under steady state load flow, contingency load flows, short circuit currents and dynamic/transient conditions; and is therefore recommended to be adopted.

Report Contents

1. Introduction

1.1 Background

The site of proposed project is near Pind Dadan Khan in Punjab in the concession area of Islamabad Electricity Supply Company (IESCO). The net output planned to be generated from the site is about 1 MW of electrical power which will start commercial operation by March 2016. The electricity generated from this project would be supplied locally to the Dandot 132/11 kV Grid and to the IESCO network through Dandot 132/11 kV grid located in the vicinity of this project. Another 10 MW Solar Power Plant, Tech Access, whose Grid Interconnection report has already been approved by IESCO, is also planned in the vicinity of Blue Star Electric Private Limited Solar Power Plant. Furthermore, additional two Solar Power Plants, Blue Star Hydel (1MW) and Tech-Access Access-Electric (10MW) are also planned in the vicinity of Blue Star Electric Solar Power Plant.

1.2 Objectives

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

1. To develop scheme of interconnections at 11 kV for which right of way (ROW) and space at the terminal substations would be available.
2. To determine the performance of interconnection scheme during steady state conditions of system, normal and N-1 contingency, through load-flow analysis.
3. To check if the contribution of fault current from this new plant increases the fault levels at the adjoining substations at 11kV and 132 kV voltage levels to be within the rating of equipment of these substations, and also determine the short circuit ratings of the proposed equipment of the substation at the Blue Star Electric Solar Power Plant.

4. To check if the interconnection withstands dynamic stability criteria of post fault recovery with good damping after 3-phase faults on the system.

1.3 Planning Criteria

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

Steady State:

Voltage	± 5 %, Normal Operating Condition
	± 10 %, Contingency Conditions
Frequency	50 Hz, Continuous, ± 1% variation steady state
	49.2 - 50.5 Hz, Short Time
Power Factor	0.80 Lagging; 0.9 Leading (for conventional synchronous generators but would not be applicable to solar PP)

Dynamic/Transient:

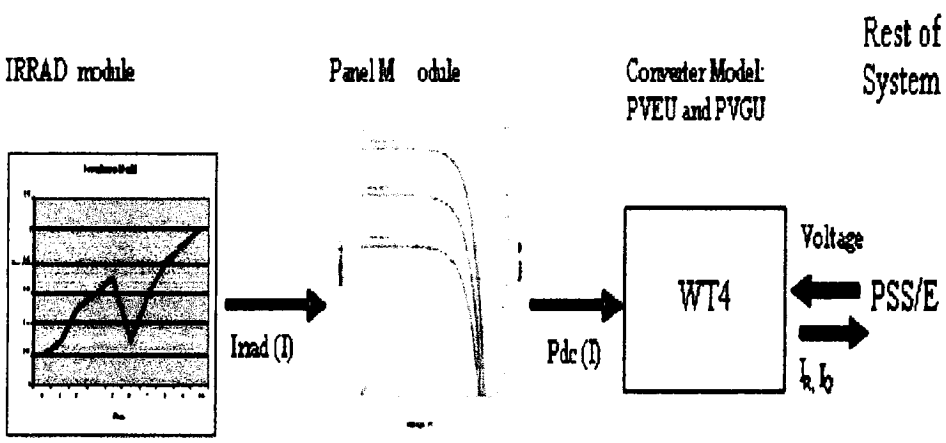
- The system should revert back to normal condition after dying out of transients without loosing synchronism with good damping. For 11 kV the total maximum fault clearing time from the instant of initiation of fault current to the complete interruption of current, including the relay time and breaker interruption time to isolate the faulted element, is equal to 200 ms (10 cycles).
- For the systems of 132 kV and above the total normal fault clearing time from the instant of initiation of fault current to the complete interruption of current, including the relay time and breaker interruption time to isolate the faulted element, is equal to 100 ms (5 cycles).
- For the systems of 132 kV and above, in case of failure of primary protection (stuck breaker case), the total fault clearing time from the instant of initiation of fault current to the complete interruption of current to isolate the faulted element, including the primary protection plus the backup protection to operate and isolate the fault, is equal to 180 ms (9 cycles).

2. Assumptions of Data

The detailed electrical parameters would be designed at the EPC stage. However for the purposes of this study, following assumptions have been made:

2.1 Solar Power Plant data

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



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

Due to the presence of the inverter module, from the point of view of the network, the solar power plant is considered a voltage source convertor.

Dynamic Data:

Converter time constant for IQcmd seconds = 0.02 s

Converter time constant for IQcmd seconds = 0.02 s

Voltage sensor for LVACR time constants = 0.02 s

Voltage sensor time constant = 1.1 s

2.2 Network data

The 11 kV and 132 kV networks available for interconnection to Blue Star Electric Solar Power Plant are as shown in Sketches 1 and 2 in Appendix-A.

The PEPCO/IESCO system data of National Grid have been assumed in the study as already available with PPI.

3. Study Approach and Methodology

3.1 Understanding of the Problem

The 1 MW Solar Power Plant by Blue Star Electric is going to be a Photovoltaic (PV) based solar project embedded in the 11kV distribution network of Dandot. It would run almost all the months of the year though with some variation in its output due to variation in the strength of light in winter and in rainy season.

The existing nearest grid station available for interconnection is Dandot 132/11 kV Substation. The addition of this source of power generation embedded in local distribution network of this area and shall provide relief to Dandot 132 / 11 kV substation feeding the local network and also helps 11 kV network in terms of improving line losses and voltage profile. The 11 kV network surrounding Dandot and Pind Dadan Khan has significant load demand, therefore most of the power from the Blue Star Electric Solar Power Plant will be utilized locally in meeting this load demand.

The adequacy of IESCO network of 132 kV in and around the proposed site of Blue Star Electric Solar Plant would be investigated in this study for absorbing and transmitting this power fulfilling the reliability criteria.

3.2 Approach to the problem

The consultant has applied the following approaches to the problem:

- A base case network model has been prepared for June 2016 , 1 MW Solar PV Plant by Blue Star Electric Private Limited, comprising all 500kV, 220kV and 132 kV system, envisaging the load forecast, the generation additions and transmission expansions for that year particularly in IESCO.
- The project is expected to be completed by March 2016. Therefore the month of June 2016 has been selected to carry out the study as it will allow the maximum impact of the project to be judged.
- Interconnection scheme without any physical constraints, like right of way or availability of space in the terminal substations, have been identified.
- Performed technical system studies for peak load conditions to confirm technical feasibility of the interconnections. The scheme has been subjected to

standard analysis like load flow and short circuit, and transient stability study to check the strength of the plant and the proposed interconnection scheme under disturbed conditions.

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

4. Development of Scheme of Interconnection

4.1 The Existing Network

The nearest existing IESCO interconnection facilities at the time of commissioning of Blue Star Electric Solar Power Project would be as follows:

- Dandot 132/11 kV Substation
- Pinanwal 132/11 kV Substation
- C.S. Shah 132/11 kV Substation

The existing 132 kV network available around these 132 kV grid station is shown in Sketch-1 in Appendix-A.

Given the physical proximity of Dandot to Blue Star Electric solar power plant and that fact that the other facilities are at a considerable distance from the plant, the most feasible interconnection of the Blue Star Electric Solar Power Plant will be with Dandot 132/11 kV substation.

There is strong 220 kV network in the vicinity connecting Chakwal-N 220/132 kV grid station with Chakwal, Rewat and Islamabad 220 kV substations. A strong system helps in stable operation of a power plant.

4.2 The Scheme of Interconnection of Solar Power Plant

Keeping in view of the above mentioned 11 kV and 132 kV network available in the vicinity of the site of the Blue Star Electric Solar Power Plant, the interconnection scheme has been developed as shown in Sketch-2 in Appendix A by laying down double circuit using Osprey conductor of about 2 km from 11 kV Bus Bar of Solar-PP till Dandot 132/11 kV substation. One circuit is to be connected to each at Dandot 132/11 kV T-1 and T-2. Even though one 11 kV circuit using Osprey conductor would be sufficient to evacuate power from Blue Star Electric Solar-PP, an additional circuit has been added to fulfill N-1 contingency criteria.

4.3 Proposed additions at 11 kV in Dandot 132/11 kV Substation

Two breaker/panels of 11 kV along with respective protection equipment would be required to be added in 11 kV switchgear hall of Dandot 132/11kV substation to provide connection to direct 11 kV circuits from this Solar Power Plant.

5. Detailed Load Flow Studies

5.1 Base Case 2016, Without Solar Power Plant

A base case has been developed for the peak load of June 2016, using the network data of Blue Star Electric Solar-PP and IESCO network.

The results of load flow for this base case are plotted in Exhibit 0.0 of Appendix-B. The system plotted in this Exhibit shows 132 kV network feeding Dandot connected to its surrounding substations through C.S. Shah and Pinanwal. Also the 11 kV network emanating from Dandot has been modeled showing each substation as 11 kV bus bars with loads connected to each bus.

The load flow results show that the power flows on all circuits are within their specified normal current carrying rating. The voltages are also within the permissible limits. We see that about 12.17 MW flows from C.S. Shah to Dandot which feeds the loads at the 11 kV bus bars of Dandot 132/11 kV Substation. A further 12.05 MW then flows from Dandot to Pinanwal.

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

Exhibit-0.1	B.ST.Hydel to Dandot T-1 11kV Single Circuit Out
Exhibit-0.2	TA-Solar-PP to Dandot T-1 11kV Single Circuit Out
Exhibit-0.3	TA-EA-Solar to Dandot T-1 11kV Single Circuit Out
Exhibit-0.4	Dandot-T1 132/11kV Single Transformer Out
Exhibit-0.5	Dandot-T2 132/11kV Single Transformer Out
Exhibit-0.6	Chakwal to C.S.Shah 132kV Single Circuit Out
Exhibit-0.7	Chakri to Chakwal 132kV Single Circuit Out

In both cases the power flows on all circuits remain within their ratings. Thus we find that there are no capacity constraints in terms of MW or MVA flow in the 11 kV or 132 kV network available in the vicinity of Blue Star Electric Solar Power Plant for its connectivity under normal and contingency conditions prior to its connection.

5.2 Load Flow with Blue Star Electric Solar Power Plant

We have considered the scenario of June 2016 so that we can judge the maximum impact of the project on the system.

The scheme of interconnection modeled in the load flow for Blue Star Electric Solar Power Plant is developed by laying down double circuit of 11 kV of about 2 km using Osprey conductor from 11 kV Bus Bar of Solar-PP to Dandot 132/11 kV substation. One circuit is to be connected to each of 11 kV bus bars T-1 and T-2 at Dandot 132/11 kV substation. The results of load flow with Blue Star Electric Solar Power Plant interconnected as per proposed scheme are shown in Exhibit 1.0 in Appendix-B. The power flows on the circuits are seen well within the rated capacities and the voltages on the bus bars are also within the permissible operating range of ± 5 % off the nominal.

We find no capacity constraints on 11 kV or 132 kV circuits under normal conditions i.e. without any outages of circuits.

With part of the load at Dandot fed by the Solar-PP locally, the flow from C.S. Shah to Dandot is reduced to 11.16 MW.

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

Exhibit-1.1	B.ST.Elec to Dandot T-1 11kV Single Circuit Out
Exhibit-1.2	B.ST.HY to Dandot T-1 11kV Single Circuit Out
Exhibit-1.3	TA-Solar-PP to Dandot T-1 11kV Single Circuit Out
Exhibit-1.4	TA-EA-Solar to Dandot T-1 11kV Single Circuit Out
Exhibit-1.5	Dandot-T1 132/11kV Single Transformer Out
Exhibit-1.6	Dandot-T2 132/11kV Single Transformer Out
Exhibit-1.7	Chakwal to C.S.Shah 132kV Single Circuit Out
Exhibit-1.8	Chakri to Chakwal 132kV Single Circuit Out

In all the above contingency cases, we find that in the event of outage of any circuit, the intact circuits remain within the rated capacity.

Also the bus bar voltages are well within the rated limits in all the contingency events. Thus there are no constraints in this scheme.

5.3 Conclusion of Load Flow Analysis

From the analysis discussed above, we conclude that the proposed interconnection scheme of a direct 11 kV double circuit of 2 km length using Osprey conductor to be

laid from 11 kV Bus Bar of Blue Star Electric Solar-PP to Dandot 132/11 kV substation ensures its reliability and availability under all events of contingencies i.e. planned or forced outages.

6. Short Circuit Analysis

6.1 Methodology and Assumptions

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

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

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

For evaluation of maximum short circuit levels we have assumed contribution in the fault currents from all the installed generation capacity of hydel, thermal and nuclear plants in the system in the year 2016 i.e. all the generating units have been assumed on-bar in fault calculation's simulations.

6.2 Fault Current Calculations without B.ST.ELEC Solar Power Plant

In order to assess the short circuit strength of the network of 11 kV and 132 kV without the Solar Power Plant for the grid of IESCO in the vicinity of the site of the Plant near Dandot, fault currents have been calculated for balanced three-phase and unbalanced single-phase short circuit conditions. These levels will not only give us the idea of the fault levels without B.ST.ELEC Solar Power Plant and later on how much the contribution of fault current from the Solar Power Plant may add to the existing levels, but also we get a feel of the strength of the proposed node to connect this Power Plant depending on its relative short circuit strength.

The results are attached in Appendix – C.

The short circuit levels have been represented graphically on the bus bars of 11 kV and 132 kV along with fault current contributions from the incoming circuits, which are shown in the Exhibit 2.0 attached in Appendix-C.

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

The tabular output of the short circuit calculations is also attached in Appendix-C for the 11 kV and 132 kV bus bars of our interest i.e. 11 kV and 132 kV circuits lying close to Dandot. The tabular output is the detailed output showing the contribution to the fault current from the adjoining sources i.e. the lines and transformers connected to that bus. The phase currents, the sequence currents and the sequence impedances are shown in detail for each faulted bus bar.

The total maximum fault currents for 3-phase and 1-phase short circuit at these substations are summarized in Table 6.1. We see that the maximum fault currents do not exceed the short circuit ratings of the equipment at these 11 kV and 132 kV substations which normally are 20 kA, 25 kA.

Table - 6.1
Maximum Short Circuit Levels without Blue Star Electric Solar PP

Substation	3-Phase fault current, kA	1-Phase fault current, kA
Blue Star Hydel 11kV	**11.17**	**10.84**
TA-AE-Solar 11kV	**5.02**	**4.95**
TA-Solar-PP 11kV	**5.06**	**4.99**
Dandot T-1 11kV	**12.83**	**12.41**
Dandot T-2 11kV	**10.95**	**10.63**
Pinanwal 132kV	**2.44**	**2.37**
Dandot 132kV	**3.54**	**3.11**
C.S.Shah 132kV	**6.37**	**4.42**
BestWay Cement 132kV	**5.33**	**3.63**
Chakwal 132kV	**11.35**	**8.73**

6.3 Fault Current Calculations with Solar Power Plant interconnected

Fault currents have been calculated for the electrical interconnection of proposed scheme. Fault types applied are three phase and single-phase at 11 kV bus bars of B.ST.ELEC Solar Power Plant itself and other bus bars of the 132 kV substations in

the electrical vicinity of Dandot. The graphic results are indicated in Exhibit 2.1.

The tabulated results of short circuit analysis showing all the fault current contributions with short circuit impedances on 132 kV and 11 kV bus bars of the network in the electrical vicinity of B.ST.ELEC Solar Power Plant are placed in Appendix-C. Brief summary of fault currents at significant bus bars of our interest are tabulated in Table 6.2.

Comparison of Tables 6.1 and 6.2 shows slight increase in short circuit levels for three-phase and single – phase faults due to connection of Solar Power Plant on the 132 kV and 11 kV bus bars in its vicinity. This increase is limited from the point of view of the fact that the Solar Power Plant is a voltage source convertor. We find that even after some increase, these fault levels are much below the rated short circuit values of the equipment installed on these substations. The maximum short circuit level of 11 kV bus bar of Blue Star Electric Solar Power Plant 11 kV is 11.25 kA and 10.91 kA for 3-phase and 1-phase faults respectively. Therefore an industry standard switchgear of the short circuit rating of 12.5 kA should be installed at 11 kV switchyard of the Solar Power Plant leaving enough margin to accommodate fault current contribution from any future reinforcements taking place in that area.

Table-6.2
Maximum Short Circuit Levels with Blue Star Electric Solar PP

Substation	3-Phase fault current, kA	1-Phase fault current, kA
Blue Star Electric 11kV	**11.25**	**10.91**
Blue Star Hydel 11kV	**11.25**	**10.91**
TA-AE-Solar 11kV	**5.03**	**4.96**
TA-Solar-PP 11kV	**5.08**	**5.00**
Dandot T-1 11kV	**13.18**	**12.73**
Dandot T-2 11kV	**11.92**	**11.56**
Pinanwal 132kV	**2.44**	**2.37**
Dandot 132kV	**3.54**	**3.11**
C.S.Shah 132kV	**6.37**	**4.42**
BestWay Cement 132kV	**5.33**	**3.63**
Chakwal 132kV	**11.35**	**8.73**

6.4 Conclusion of Short Circuit Analysis

The short circuit analysis results show that for the proposed scheme of interconnection of B.ST.ELEC Solar Power Plant with the Dandot 11 kV distribution network, we don't find any problem of violations of short circuit ratings of the already installed equipment on the 132 kV and 11 kV equipment of substations in the vicinity of the Solar Power Plant due to fault current contributions from this plant due to three-phase faults as well as single phase faults.

The maximum short circuit level of 11 kV bus bar of Blue Star Electric Solar Power Plant 11 kV is 11.25 kA and 10.91 kA for 3-phase and 1-phase faults respectively. Therefore an industry standard switchgear of the short circuit rating of 12.5 kA should be installed at 11 kV switchyard of B.ST.ELEC Solar Power Plant leaving enough margin to accommodate fault current contribution from any future reinforcements taking place in that area.

7. Transient Stability Analysis

7.1 Assumptions & Methodology

7.1.1 Stability Models

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

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

Generator	PVGU1
Electrical Model	PVEU1
Solar Panel Model	PANELU1

We have done studies with the inverter which has reactive support capability of ± 0.95 PF.

7.1.2 System Conditions

We have used the system conditions of June 2016 because in this season the irradiance from the sun is at its peak and hence the maximum impact of the Solar Power Plant can be judged.

The proposed scheme of laying a direct 11 kV double circuit 2 km length using Osprey conductor to be laid from 11 kV Bus Bar of B.ST.ELEC Solar-PP till Dandot 132/11 kV substation with one circuit to be connected to each 11 kV bus bars of T-1 and T-2 at Dandot 132/11 kV, has been modeled in the stability analysis.

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

7.1.3 Presentation of Results

The plotted results of the simulations runs are placed in Appendix - D. Each simulation is run for its first one second for the steady state conditions of the system prior to fault or disturbance. This is to establish the pre fault/disturbance conditions of the network under study were smooth and steady. Post fault recovery has been

monitored for nine seconds. Usually all the transients due to non-linearity die out within 2-3 seconds after disturbance is cleared in the system.

7.1.4 Worst Fault Cases

Three phase faults are considered as the worst disturbance in the system. We have considered 3-phase fault in the closest vicinity of the Solar Power Plant i.e. right at the 11 kV bus bar of the solar power plant substation, cleared in 10 cycles, as normal clearing time for 11 kV i.e. 200 ms, followed by permanent trip of 11 kV single circuit emanating from this substation.

7.2 Transient Stability Simulations' Results

7.2.1 Fault at 11 kV Near Solar Power Plant

We applied three-phase fault on the B.ST.ELEC Solar Power Plant 11 kV bus bar, cleared fault in 10 cycles (200 ms) followed by trip of 11 kV circuit between the B.ST.ELEC Solar Power Plant and Dandot T-2. We monitored different quantities for one second pre-fault and nine seconds after clearance of fault (post-fault) conditions and plotted the results attached in Appendix – D and discussed as follows;

Fig. 1.1 Bus Voltages

The bus voltages of 11 kV bus bars of B.ST.Elec-Solar-PP , B.ST.HY Solar-PP, , TA-AE Solar-PP, TA-Solar-PP Dandot T-1 and Dandot T-2 are plotted. The results show quick recovery of the voltages after clearing of fault.

Fig. 1.2 Frequency

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

Fig. 1.3 MW/MVAR Output of Solar Power Plant

The pre-fault output of Solar Power Plant was 1 MW and it gets back to the same output quickly after fast damping of the oscillations in its output. However MVAR output acquires equilibrium at a new value.

Fig. 1.4 MW/MVAR Flow on Dandot 132/11 kV Transformer T-1

We plotted the flows of MW and MVAR on the intact transformer T-1 and see that the power flows on this transformer attains to steady state level with power swings damping down fast.

Fig. 1.5 Voltage Sensor for LVACR

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

Fig. 1.6 MW /MVAR Flow from B.ST.Elec Solar Power Plant to Dandot T-1 11 kV

Followed by clearing of fault, the trip of 11 kV circuit between the power plant and Dandot T-2 circuit caused the entire load of that circuit to flow through the intact 11 kV circuit between the Solar-PP and Dandot T-1. We plotted the flows of MW and MVAR on this intact circuit and see that the power flows on this circuit attains to steady state level with power swings damping down fast.

Fig. 1.7 MW/MVAR Output of Units at Mangla 132 kV

The pre-fault output of the units at Mangla 132 kV gets back to the same output quickly after fast damping of the oscillations in its output. However MVAR output acquires equilibrium at a new value.

Fig. 1.8 Rotor Angles

The rotor angles of the generator of Mangla 132 kV are plotted relative to machines at Mangla 220 kV. The results show that the rotor angle of Mangle 132 kV gets back after the first swing and damps down quickly. The system is strongly stable and very strong in damping the post fault oscillations.

7.2.2 Fault at 132 kV Dandot (Far-End Fault)

We applied three-phase fault on far-end 132 kV bus bar of Dandot to study the impact of a disturbance in the grid on the performance of the plant. The fault is cleared in 5 cycles (100 ms) as standard clearing time for 132kV systems, followed by trip of one 132/11 kV TF of Dandot T-2 . We monitored different quantities for one second pre-fault and nine seconds after clearance of fault (post-fault) conditions and plotted the results attached in Appendix – D and discussed as follows;

Fig. 2.1 Bus Voltages

The bus voltages of 11 kV bus bars of B.ST.Elec Solar-PP , B.ST.HY Solar-PP, TA-AE Solar-PP, TA-Solar-PP, Dandot T-1 and 132 kV Bus Bar of Dandot are plotted. The results show quick recovery of the voltages after clearing of fault.

Fig. 2.2 Frequency

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

Fig. 2.3 MW/MVAR Output of Solar Power Plant

The pre-fault output of Solar Power Plant was 1 MW and it gets back to the same output quickly after fast damping of the oscillations in its output. However MVAR output acquires equilibrium at a new value.

Fig. 2.4 MW/MVAR Flow on Dandot 132/11 kV Transformer T-1

Followed by clearing of fault, the trip of the 132/11 kV transformer T-2 caused the entire load of that transformer to flow through the intact 132/11 kV transformer T-1. We plotted the flows of MW and MVAR on this intact transformer and see that these flows attain steady state level with power swings damping down fast.

Fig. 2.5 Voltage Sensor for LVACR

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

Fig. 2.6 MW /MVAR Flow from Solar Power Plant to Dandot T-1 11 kV

We plotted the flows of MW and MVAR on this intact circuit and see that the power flows on this circuit attains to steady state level with power swings damping down fast.

Fig. 2.7 MW/MVAR Output of Units at Mangla 132 kV

The pre-fault output of the units at Mangla 132 kV gets back to the same output quickly after fast damping of the oscillations in its output. However MVAR output acquires equilibrium at a new value.

Fig. 2.8 Rotor Angles

The rotor angles of the generator of Mangla 132 kV are plotted relative to machines at Mangla 220 kV. The results show that the rotor angle of Mangle 132 kV gets back after the first swing and damps down quickly. The system is strongly stable and very strong in damping the post fault oscillations.

7.2.3 Fault at 132 kV Dandot (Far-End Fault with stuck breaker case)

We applied three-phase fault on far-end 132 kV bus bar of Dandot to study the impact of a disturbance in the grid on the performance of the plant. The fault is cleared in 9 cycles (180 ms) to simulate the stuck breaker case, followed by trip of one 132/11 kV TF of Dandot T-2 . We monitored different quantities for one second pre-fault and nine seconds after clearance of fault (post-fault) conditions and plotted the results attached in Appendix – D and discussed as follows;

Fig. 3.1 Bus Voltages

The bus voltages of 11 kV bus bars of B.ST.Elec Solar-PP, B.ST.HY Solar-PP, TA-AE Solar-PP, TA-Solar-PP, Dandot T-1 and 132 kV Bus Bar of Dandot are plotted. The results show quick recovery of the voltages after clearing of fault.

Fig. 3.2 Frequency

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

Fig. 3.3 MW/MVAR Output of Solar Power Plant

The pre-fault output of Solar Power Plant was 1 MW and it gets back to the same output quickly after fast damping of the oscillations in its output. However MVAR output acquires equilibrium at a new value.

Fig. 3.4 MW/MVAR Flow on Dandot 132/11 kV Transformer T-1

Followed by clearing of fault, the trip of the 132/11 kV transformer T-2 caused the entire load of that transformer to flow through the intact 132/11 kV transformer T-1. We plotted the flows of MW and MVAR on this intact transformer and see that these flows attain steady state level with power swings damping down fast

Fig. 3.5 Voltage Sensor for LVACR

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

Fig. 3.6 MW /MVAR Flow from Solar Power Plant to Dandot T-1 11 kV

We plotted the flows of MW and MVAR on this intact circuit and see that the power flows on this circuit attains to steady state level with power swings damping down fast.

Fig. 3.7 MW/MVAR Output of Units at Mangla 132 kV

The pre-fault output of the units at Mangla 132 kV gets back to the same output quickly after fast damping of the oscillations in its output. However MVAR output acquires equilibrium at a new value.

Fig. 3.8 Rotor Angles

The rotor angles of the generator of Mangla 132 kV are plotted relative to machines at Mangla 220 kV. The results show that the rotor angle of Mangle 132 kV gets back after the first swing and damps down quickly. The system is strongly stable and very strong in damping the post fault oscillations.

7.3 Conclusion of Dynamic Stability Analysis

The results of dynamic stability show that the system is very strong and stable for the proposed scheme for the severest possible faults of 11 kV and 132 kV systems near to and far of the Solar Power Plant of Blue Star Electric. Therefore there is no problem of dynamic stability for interconnection of this Solar Power Plant; it fulfils all the criteria of transient stability. The reactive support from the inverter also helps the system stability.

8. Conclusions

- The study objective, approach and methodology have been described and the plant's data received from the client Blue Star Electric Private Ltd. is validated.
- The expected COD of the project is March 2016. Therefore the month of June 2016 has been selected to carry out the study as it will allow the maximum impact of the project to be judged.
- The IESCO system data as available with PPI for other studies have been used.
- The nearest substation of IESCO is Dandot 132/11 kV. The following scheme of interconnection of Solar Power Plant by Blue Star Electric (B.ST.ELEC) to evacuate its maximum power of 1 MW is envisaged and studied in detail:
    - A direct 11 kV double circuit of 2 km length using Osprey conductor to be laid from 11 kV Bus Bar of B.ST.Elec Solar-PP till Dandot 132/11 kV substation. One circuit to be connected to each Dandot 132/11 kV T-1 and T-2.
    - In this context two 11 kV breaker/line bays need to be added in the 11 kV switchgear hall of Dandot 132/11 kV Substation
- Detailed load flow studies have been carried out for the peak load conditions of June 2016 for the proposed scheme under normal and N-1 contingency conditions to meet the reliability criteria.
- Steady state analysis by load flow reveals that proposed scheme is adequate to evacuate the maximum power of 1 MW of the plant under normal and contingency conditions.
- The short circuit analysis has been carried out to calculate maximum fault levels at the B.ST.Elec Solar Power Plant at 11 kV, and the substations of 132/11kV in its vicinity. We find that the fault currents for the proposed scheme are much less than the rated short circuit capacities of switchgear installed at these substations. There are no violations of exceeding the rating of the equipment due to contribution of fault current from the B.ST.Elec Solar Power Plant.

  The maximum short circuit level of 11 kV bus bar of Blue Star Electric Solar Power Plant 11 kV is 11.25 kA and 10.91 kA for 3-phase and 1-phase faults respectively. Therefore an industry standard switchgear of the short circuit rating

of 25 kA is considered adequate with enough margin for future increase in fault levels due to future reinforcements in this area.

- The dynamic stability analysis of proposed scheme of interconnection has been carried out. The stability check for the worst case of three phase fault right on the 11 kV bus bar of the B.ST.Elec solar power plant substation followed by the final trip of 11 kV circuits emanating from this substation, has been performed for fault clearing of 10 cycles (200 ms) as understood to be the maximum fault clearing time of 11 kV protection system. The system is found strong enough to stay stable and recovered with fast damping. The stability of system for far end faults of 3-phase occurring at Dandot 132 kV bus bar has also been checked. The proposed scheme successfully passed the dynamic stability checks for near and far faults.
- The proposed scheme of interconnection has no technical constraints or problems, it fulfills all the criteria of reliability and stability under steady state load flow, contingency load flows, short circuit currents and dynamic/transient conditions; and is therefore recommended to be adopted.

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'COMMITMENT TO EXCELLENCE

O/O Chief Engineer Planning & Engineering

No.13927-32/ CE (P&E) / HT-1477 Dated: 14 /07/ 2014

Mr. Hassan Khalid,
Director Blue Star Electric (PVT) LTd.
36, Sector B, Askari 10,
Lahore Cantt, Pakistan.
Fax No. 042-36500086

Subject: **INTERCONNECTION STUDIES OF 1 MW PV SOLAR POWER PROJECT BY BLUE STAR ELECTRIC PVT. LTD NEAR PIND DADAN KHAN, PUNJAB**

Reference: This Office Letter No. 13789-94/IESCO/CE(P&E)HT-1477 Dated 09-07-2014.

The interconnection studies for the subject PV Solra Power Plant from 132KV Dandot Grid Station has been checked and generally found satisfactory subject to following conditions;

1. Provision of Protective Scheme /Equipment by the sponsor.
2. Testing of equipment and commissioning of the subject plant in the presence of IESCO Engineers.
3. NOC from Environmental Protection Agency, Punjab.
4. Letter of Support (LOS) from AEDB.
5. Clearance of right of way for construction of 11KV Interconnection Lines.

Chief Engineer (P&E)
IESCO, Islamabad

Copy to:

i- CEO IESCO Islamabad.
ii- General Manager Technical, IESCO Islamabad. (Convener Technical Committee)
iii- Finance Director IESCO Islamabad.
iv- Addl. D.G. CSD IESCO Islamabad.
v- S.E GSO Circle Islamabad with advice to insure availability of space for installation of 2 No. 11KV panels at 132Kv Dandot Grid Station for subject project.
- Master File.