

NRTC ENERGIES PRIVATE LIMITED 72 Block, PECO Road, Lahore, Pakistan +92 42 3511 7304 | +92 33 6782 6782 +92 33 NRTC NRTC www.nrtcenergies.com

То

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

#### Subject: APPLICATION FOR GENERATION LICENCE / CONCURRENCE

I, Jawad Anjum, Director NRTC Energies, being the duly authorized representative of NRTC Energies (Private) Limited by virtue of Board Resolution dated 16.12.2024 hereby apply to the National Electric Power Regulatory Authority for the grant of a generation licence / concurrence to NRTC Energies (Private) Limited pursuant to Section 14-B of the Regulation of Generation, Transmission and Distribution of Electric Power Act, 1997.

I hereby 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, Modification, Extension and Cancellation) Procedure Regulations, 2021, 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 no material omission has been made.

A Pay Order in the sum of Rupees 549,787 (Rupees Five Hundred and Forty-Nine Thousand, Seven Hundred and Eighty-Seven only), 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, 2021, is also attached herewith.

Date: 17/3/2025

Jawad Anjum, Director NRTC Energies (Pvt.) Ltd.





|          | Information / Documents required under NEPRA            |   |
|----------|---|---|
| No.      | Licensing (Application, Modification, Extension         | Submitted                               |
|          | and Cancellation) Procedure Regulations, 2021           |   |
| 1        | Application for Generation Licence along with           | Annexure- I                             |
|          | Affidavit, Extract of Minutes Book, Board               |   |
|          | Resolution & Power of Attorney pursuant to              |   |
|          | Regulation 3 (1)  |   |
| 2        | Application Fee pursuant to Regulation 3(1)             | Annexure- II                            |
| 3        | Certificate of Incorporation pursuant to Regulation     | Annexure- III                           |
|          | 3(4)(c)(i) (A)  |   |
| 4        | Memorandum and Articles of Association pursuant to      | Annexure- IV                            |
|          | Regulation $3(4)$ (c)(i) (BJ)                           |   |
| 5        | Evidence of cash balance held in Reserves and bank      | Annexure- V                             |
|          | certificates pursuant to Regulation 3(4)(d)(i)          |   |
| 6.       | Latest Audited Financial Statements of the              | Annexure- VI                            |
|          | Application pursuant to Regulation 3(4)(d)(iii)         |   |
| 7        | Annual Reports of the Company pursuant to               | Annexure- VII                           |
|          | Regulation 3(4)(c)(i)(C)                                |   |
| 8        | Last filed Annual Return pursuant to Regulation         | Annexure- VIII                          |
|          | 3(4)(c)(ii)   |   |
| 9        | The authorized, issued, subscribed and paid-up share    | The Authorized capital of the           |
|          | capital of the Applicant pursuant to Regulation         | company is Rs. 10,000,000 (Ten          |
|          | 3(4)(c)(ii i)   | Million Rupees Only) divided into       |
|          |   | 100,000 (One Hundred Thousand)          |
|          |   | Ordinary shares of Rs. 100 (One         |
|          |   | Hundred Only) each.                     |
| 10       | The shareholding pattern of the Applicant including     | Annexure- IX                            |
|          | list of shareholders pursuant to Regulation 3(4)(c)(iv) |   |
| 11       | Details of charges and encumbrances Attached to         | The Applicant Company does not          |
|          | Applicant's assets pursuant to Regulation 3(4)(d)(ii)   | have any charges or encumbrances        |
| <u> </u> |   | attached to Applicant's assets.         |
| 12       | A prospectus pursuant to Regulation 3(4)(b)             | Annexure- X                             |
| 13       | Expression of interest to provide credit or financing   | Since the Applicant does not intend     |
|          | along with sources and details thereof as required      | to sell electricity to the grid or seek |
|          | pursuant to Regulation 3(4)(d)(iv)                      | a tariff from the Regulators it is      |

|     |  | requested that this condition may please be waived. |
|-----|--|---|
| 14  | Documents describing net worth and equity and debt<br>ratios of the Applicant pursuant to Regulation<br>3(4)(d)(y)                                     |   |
| 15  | Detailed profile and CVs of senior management<br>pursuant to Regulation 3(4)(d)(vi)  |   |
| 16  | Employment records of engineering and technical<br>staff of the Applicant pursuant to Regulation<br>3(4)(d)(vii)                                       |   |
| 17  | Profile of Sub-contractors, if any, along with<br>expression of interest of such sub-contractors as<br>required pursuant to Regulation $3(4)(d)(viii)$ | Annexure- XII                                       |
| 18  | Verifiable references with reference to experience of<br>the Applicant and its sub-contractors as required<br>pursuant to Regulation 3(4)(d)(ix)       | Annexure- X & XII                                   |
| `19 | Environmental Impact Assessment Study pursuant to<br>Regulation $3(4)(a)$ Schedule-III clause A(e)(2)  | Annexure- XIII                                      |
| 20  | Information relating to water source at site for   | Unlike conventional thermal power                   |
|     | maintenance pursuant to Regulation 3(4)(a),  | generation plants, solar power plants               |
|     | Schedule-Ill Clause A(a) (4.) (iii))   | do not require extensive use of water               |
|     |  | since cooling and auxiliary                         |
|     |  | consumption is not required. The                    |
|     |  | only water requirement would be the                 |
|     |  | fortnightly cleaning of panels which                |
|     |  | is done through modern equipment                    |
|     |  | that conserves water. For this                      |
|     |  | purpose, the normal utility water                   |
|     |  | available at the site would be used.                |
| 21  | Information relating to infrastructure(Roads, rail,  | The Ground & rooftop mounted PV                     |
|     | staff colony, amenities) pursuant to Regulation  | facilities will be constructed at MES               |
|     | 3(4)(a) Schedule-Ill clause A(e)(3)(iv)  | sites. No new infrastructural                       |
|     |  | development is part of the scope of                 |
|     |  | this project.                                       |



| 22 | Information relating to Project commencement and          | Annexure- XIV                                   |            |
|----|---|---|------------|
|    | completion schedule (with milestones) pursuant to         |   |            |
|    | Regulation 3(4)(a), Schedule-Ill Clause A(e)(3.)(v))      |   |            |
| 23 | Information relating to Safety and Emergency plans        | Annexure- XV                                    |            |
|    | pursuant to Regulation 3(4)(a) Schedule-III clause        |   |            |
|    | A(c)(3)(vii)  |   |            |
| 24 | Information relating to plant characteristics             | Annexure- XVI                                   | <u> </u>   |
|    | (generation voltage, frequency etc.) pursuant to          |   |            |
|    | Regulation 3(4)(a) clause A(e)(3)(vii)                    |   |            |
| 25 | Feasibility study of the project as required pursuant     |   |            |
|    | to Regulation 3(4)f                                       |   |            |
| 26 | Affidavit stating whether the Applicant has been          | Annexure- XVII                                  |            |
|    | granted any other license under the Act pursuant to       |   |            |
|    | Regulation 3(4)(g)  |   |            |
| 27 | A duly authorized statement stating whether the           |   |            |
|    | applicant has been refused grant of license under the     |   |            |
|    | Act and if so, the particulars of the refused application |   |            |
|    | including date of making the application and the          |   |            |
|    | decision on the application Pursuant to Regulation 3      |   |            |
|    | (4)(h)  |   |            |
| 28 | Bank Guarantee Equivalent to Applicable Annual            |   |            |
|    | License Fee for two years pursuant to Regulation 3(8)     | Bank Guarantee pursuan regulation. However, the |            |
|    |   | has not yet provided an                         | •          |
|    |   | this guarantee.                                 |            |
|    |   | The Applicant pledges to                        | •          |
|    |   | Authority with the Bank                         |            |
|    |   | as soon as a format is p<br>the Regulator.      | rovided by |
| 29 | Technical and financial proposals in reasonable           | <b>0</b>  |            |
|    | details pursuant to Regulation 3(4)(e)                    |   |            |
| 30 | Information relating to control, metering                 | Annexure- XVI                                   |            |
|    | instrumentation and protections pursuant to               |   |            |
|    | Regulation 3(4)(a) Schedule-III clause A(e)(3/(viii)      |   |            |
| 31 | Information relating to technology size of the plant      |   |            |
|    | number of units etc. pursuant to Regulation 3(4)(a)       |   | RGIES (AL  |
|    | Schedule-Ill clause A(e)(3)(ii)                           | /   |            |

| 32 | Interconnection study pursuant to Regulation 3(4)(a)<br>Schedule-III clause A(e)(I).  | Annexure- XVIII |
|----|---|-----------------|
| 33 | Information relating to location (location maps, site<br>maps, land etc.) pursuant to Regulation 3(4)(a),<br>Schedule-III clause A(e)(3)(i) | Annexure- XVI   |
| 34 | Information relating to Degradation Factors.<br>(Regulation 3(4)(a), Schedule-Ill Clause A(e)(3.)(x))                                       | Annexure- XVI   |
| 35 | Information relating to Estimated Capacity Factor at site. (Regulation $3(4)(a)$ , Schedule-III Clause $A(e)(3.)(ix)$ )                     |                 |



į

### <u>Annexure-I</u>

Application for Generation Licence / Concurrence along with Affidavit, Extract of Minutes Book, Board Resolution & Power of Attorney



NRTC ENERGIES PRIVATE LIMITED 72 Block, PECO Road, Lahore, Pakistan +92 42 3511 7304 | +92 33 6782 6782 www.nrtcenergies.com

#### BEFORE THE NATIONAL ELECTRIC POWER REGULATORY AUTHORITY

#### "Application for seeking Generation License"

#### ON BEHALF OF

#### NRTC ENERGIES (PRIVATE) LIMITED

#### AUTHORIZED STATEMENT

I, Mr. Jawad Anjum, holding CNIC No. (42301-7799857-1), Chief Executive Officer, NRTC Energies (Private) Limited hereby solemnly affirm and declare that the contents of the accompanying Application for Generation License (the "License") is true and correct to the best of my knowledge and belief and nothing material has been concealed there from.

I also affirm that all further documentation and information to be provided by me in connection with the accompanying application for Generation License will also be true to the best of my knowledge and belief.

Date: 20-02-2025

Chief Executive Officer

NRTC Energies (Private) Lin



A Premium Energy Brand

### Application for the Grant of Generation License / Concurrence

#### 1. Background

NRTC Energies Private Limited was incorporated on 17.11.2021 under Section- 16 of the Companies Act, 2017 with Corporate Unique Identification No. 0184244. The business office of the company is at 72 Block, PECO Road, Lahore, Pakistan

The Company has completed various Solar projects nationally in a very short span of time. Up till now, the company has over 05 megawatts of solar projects in Pakistan.

NRTC Energies aims to alleviate Pakistan's energy problems by introducing innovative distributed solar and energy management solutions. The Pakistan and the NRTC Energies teams are committed to achieve excellence in every aspect of solar design, construction, and operation & maintenance.

#### 2. Project Rationale

The Military Engineering Services (MES) in Pakistan has a rich history dating back to the British colonial era. After the independence of Pakistan in 1947, the MES was reconstituted to serve the Pakistan Army. The MES is responsible for providing engineering support to the Pakistan Armed Forces, including construction, maintenance, and repair of military infrastructure.

Apart from the strategic importance of activities carried out by MES and their requirement of reliable electric power, MES is committed to play a notable role in reducing carbon footprints of Pakistan. To achieve the endeavor, MES is determined to meet their electric power demand through Solar energy. For aforementioned purpose, MES engaged NRTC Energies and their team conducted surveys to the sites of Military Engineering Services (MES) Pakistan and keeping in view their annual energy consumption, a 3.5 MWp Solar PV Solution at five site in Lahore is proposed. It is anticipated that the project will serve a projected annual production of 5,110,000 kWh/year.

#### 3. Environment Benefits

Almost all conventional methods of energy generation have varying degrees of adverse environmental impact. These methods have far reached detrimental effects on the climate, air, water, land and wildlife of the adjacent vicinities. However, Solar PV energy technology provides significant environmental advantages in comparison to the conventional energy sources while contributing to the sustainable development of human activities. Besides slowing down the depletion of natural resources, the sustainable

environmental advantage is zero air emissions, waste production and eventual reduction in emissions of greenhouse gases (COx, NOx) and toxic gases (SOx).

Solar power plants have zero fuel requirement and hence limit the depletion of natural resources, fossil fuels. Unlike conventional thermal power plants, no water consumption is required for cooling purposes. A very optimized quantity of water is occasionally used for plant maintenance / cleaning.

#### 4. Prayer

NRTC Energies has performed an in-depth technical and financial analysis for proposed 3.5 MWp Solar PV solution at stated five sites of MES. Findings from these analyses suggest that the proposed sites are suitable for installation of Solar PV power plants with substantial benefits for the environment and promotion of distributed grid in Pakistan. Technical details of the sites and system designs (PVSyst simulations) have been attached with this application.

Keeping in view the considerable amount of effort and attention to the minute details put into the Solar PV system designing and diverse experience of solar sector, NRTC Energies is confident that if allowed by the honorable Authority to construct this plant, it will be able to achieve the required results without any problem.

In view of above it is requested that the application of NRTC Energies (Private) Limited may very kindly be processed and placed before the Authority for admission.

NRTC Energies (Private) Limited further requests the honorable Authority to kindly grant the Generation Licence / Concurrence for 3.5 MWp Solar PV plants at sated sites of Military Engineering Services (MES) Pakistan. In case, any further document or information is required then it is requested that same may kindly be communicated.

Sincerely,

Jawad Anjum, Director NRTC Energies (Pvt.) Ltd.







NRTC ENERGIES PRIVATE LIMITED 72 Block, PECO Road, Lahore, Pakistan +92 42 3511 7304 | +92 33 6782 6782 +92 33 NRTC NRTC www.nrtcenergies.com

#### **RESOLUTION BY CIRCULAR**

Date: December 16, 2024

RESOLVED that an application for the Generation License ("The GL Application") be filed by and on behalf of NRTC Energies (Pvt.) Ltd., ("The Company") with the National Electric Power Regulatory Authority ("NEPRA"), in connection with the GL Application for the company in respect of the Military Engineering Services ("MES") ("The Company") for 3.5 MVVp Solar Power Project at four zones spanning over different cities of Pakistan. ("The Project").

Further Resolved that Mr. Jawad Anjum, holding CNIC No.42301-7799857-1, Director of the company, be and is hereby authorized to sign the GL Application, and any documentation ancillary thereto, pay all the filing fees, and provide any information required by NEPRA in respect of the project, and do all acts and things necessary for the processing, completion and finalization of the GL application.

#### **CLARIFICATION**

**CERTIFIED that, the above resolution by circulation** was duly passed by the Board of Directors of **NRTC Energies (Pvt.) Ltd on 16<sup>th</sup> Dec 2024 for** which the quorum of directors was present.

FURTHER CERTIFIED, that the said resolution has not been rescinded and is in operation and that this is the true copy thereof.

Jawad Anjum CEO/Director



Zahid Mehmood Maitla Director





A Premium Energy Brand

## SECURITIES AND EXCHANGE COMMISSION OF PAKISTAN

**Company Registration Office** 

# **CERTIFICATE OF INCORPORATION**

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

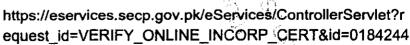
Corporate Unique Identification No. 0184244

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

Given at Islamabad this Seventeenth day of September, Two Thousand and Twenty One

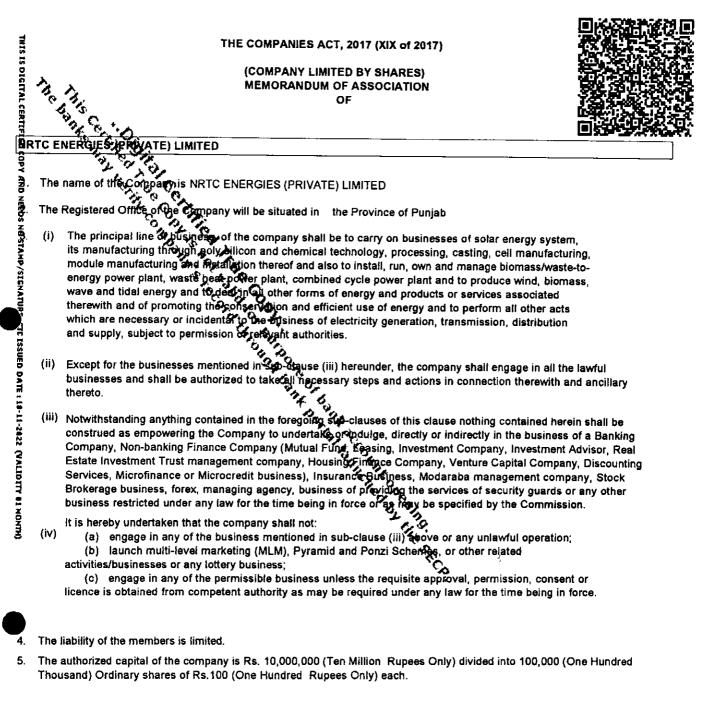
Moeen Rajput Deputy Registrar







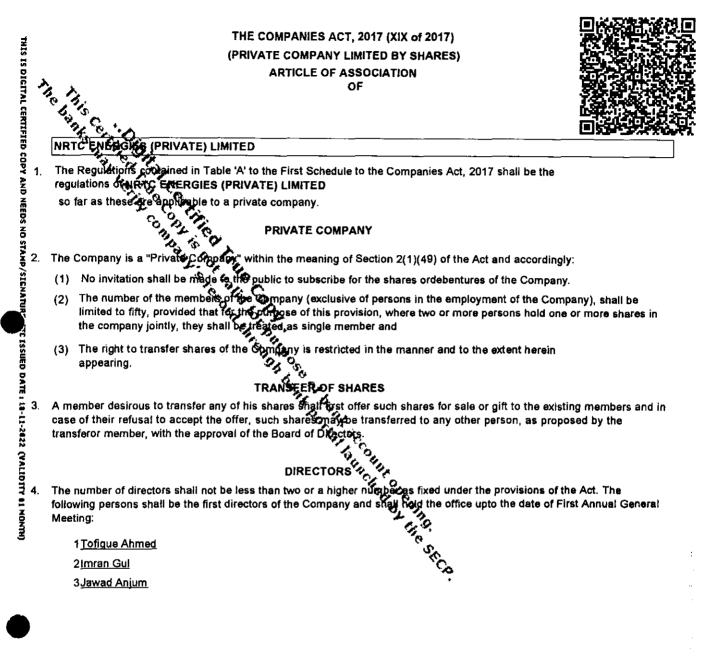






https://eservices.secp.gov.pk/eServices/XFDLControllerServlet?pid=eug6bWtdgeMSaWnAzp0oiw%3D%3D&formid=jOXMo2H%2FnVzaeELAwcINYV... 1/4

MOA









https://eservices.secp.gov.pk/eServices/XFDLControllerServlet?pid=eug6bWidgeMSaWhAzp0oiw%3D%3D&formid=jOXMo2H%2FnVzaeELAwcINYc... 2/4

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

| Name and<br>surnames)  | n the capital of<br>NICHo. (In<br>Assort<br>U foreigner)<br>Hansport Ast   | Enther                                | Nationality                          |  | Usual<br>residential<br>address in full<br>or the  | Number of<br>shares taken<br>by each<br>subscriber (in<br>figures and<br>words) | Signatures    |
|--|--|---------------------------------------|--------------------------------------|--|--|---|---------------|
| Tofique Ahmed  | Action of the second se | Mahaninged<br>Multer LIC<br>ICCOLLING | Pakistan                             | Director NRTC,<br>Director NRTC<br>itech (Pvt) Ltd   | Mohalia Cantt<br>Railway<br>station,<br>Kharian<br>GUJRAT<br>Punjab<br>Pakistan 50070                      | 1   |               |
| imran Gul  | 3420207444589  | Muhammad Git                          | Periatan<br>DI SC OF<br>DI TANI K DA | CEO NRTC<br>Hech (Pvt) Ltd   | House No. B-1,<br>Ghaznawi<br>Street,<br>Garrison Adiala<br>Road<br>RAWALPINDI<br>Punjab<br>Potistan 46606 | 1   |               |
| Jawad Anjum  | 4230177998571  | Anjum Parvez                          | Pakistan                             | Disector M/s<br>OpSign (PVI) Ltd<br>HII (HII)<br>CII (CII)<br>CII (CII)<br>CII<br>CII (CII)<br>CII (CII)<br>CI | Flat No. 43-G<br>Askari 3,<br>School Road<br>KARACHI<br>SOUTH Sindh<br>Pakistan 75530                      | 1   |               |
| The National<br>Radio<br>Felecommunica<br>ion<br>Corporation<br>Pvt) Ltd<br>hrough Imran | 3420207444589  | Muhammad Gui                          | Pakistan                             | CEO NRTC   | T ded T<br>Sofiplex,<br>Hitrigur<br>HAHBUR<br>Khybb<br>Pakhturithwa<br>Pakhturithwa<br>Pakistan 22620      | 74,998  |               |
| DinSun (Pvt)<br>Itd through<br>Iawad Anjum   | 4230177998571  | Anjum Parvez                          | Pakistan                             | Director Ws<br>OnSun (Pvt) Ltd   | Flat No.43-G,<br>Askari 3,<br>School Road<br>KARACHI<br>SOUTH Sindh<br>Pskistan 75530                      | 24,999  |               |
| otal number of   | shares taken (in   | figures and word                      | <b> \$</b> }                         |  | 1  | 00,000 (One Hund  | red Thousand) |
| ated: the 15   |  | day of Sep                            |                                      | 20 21  |  |   |               |

https://eservices.secp.gov.pk/eServices/XFDLControllerServlet?pid=eug6bWtdgeMSaWnAzp0oiw%3D%3D&formid=jOXMo2H%2FnVzaeELAwcINYc... 3/4

ĥ

Address



## A·F·FERGUSON&CO.

February 7, 2024 749

The Board of Directors NRTC Energies (Private) Limited (the Company) Lahore

Dear Sirs

#### FINANCIAL STATEMENTS FOR THE YEAR ENDED JUNE 30, 2023

We enclose three copies of the above referred financial statements with our draft audit report thereon initialed by us for identification purposes. We shall be pleased to sign our report in present or amended form after:

- i) the financial statements have been approved by the Board of Directors (the Board) and signed by the Chief Executive and a director authorized by the Board in this behalf;
- we have seen board's specific approval for items listed in Annexure to this letter, restatement of prior year financial statements as disclosed in note 29 and reclassification of corresponding figures as disclosed in note 30 to the financial statements;
- iii) we have reviewed the Directors report presented to the Board along with the audited financial statements;
- iv) we have reviewed the Company's statement of compliance with the code of public sector entities; and
- v) we have received a representation letter on the lines of the enclosed draft, duly signed by the Chief Executive and the Chief Financial Officer of the Company.

## 2. Responsibilities of the auditors and the management in relation to the financial statements

The responsibilities of the independent auditors, in a usual examination of financial statements, are explained in the International Standard on Auditing – 200 "Overall Objectives of the Independent Auditor and Conduct of an Audit in Accordance with International Standards on Auditing". While the auditors are responsible for forming and expressing their opinion on the financial statements, the responsibility for preparation of the financial statements is primarily that of the Company's management. The management's responsibilities include the maintenance of adequate accounting records and internal controls, the selection and application of accounting policies, safeguarding the assets of the Company and prevention and detection of frauds and irregularities. The audit of financial statements does not relieve the management of its responsibilities. Accordingly, our examination of the books of accounts and records should not be relied upon to disclose all the errors or irregularities in relation to the financial statements.

A. F. FERGUSON & CO., Chartered Accountants, a member firm of the PwC network 74-East, 2nd Floor, Blue Area, Jinnah Avenue, P.O.Box 3021, Islamabad-44000, Pakistan Tel: +92 (51) 2273457-60/2604934-37; Fax: +92 (51) 2277924, 2206473; < www.pwc.com/pk>



"KARACHI "LAHORE "ISLAMABAD

CamScanner



## A.F.FERGUSON&CO.

#### 3. Liabilities and Equity status

We noted that the Company has current liabilities in excess of current assets and also has a negative equity of Rs 17,624,731 as at June 30, 2023. We have been apprised by the management that the entity is in its initial years of operations and foresees a positive outlook in future year. Further the Company has already achieved positive cashflows from operations and the management is confident that the Company will be able to settle its liabilities in normal course of business. We trust that the Board is aware of the aforesaid facts and is in agreement with the management's views in this regard.

#### 4. Public Sector Companies (Corporate Governance) Rules, 2013 (the Code)

The Company is required to report on compliance with requirements of the Code. Whilst the non-compliances are to be reported in the statement of compliance with the Code, yet we feel appropriate in outlining that steps be taken and concerned authorities and officials be pursued for attaining full compliance of the Code. We may caution that besides other penal consequences, same also attract negative implications for group taxation, where opted for, under the requirements of Income Tax Ordinance, 2001 which can have an entity level impact for the Company as well.

#### 5. Records and documents

5.1 We noted certain instances where contracts with customers were not completed within the prescribed timelines. The delay may attract any penalties or damages. We recommend that a dashboard of timelines for customer contracts be maintained and periodically reviewed for deviations and necessary actions are taken to avoid any penalties or damages.

5.2 We noted that purchase requisitions, purchase orders and goods receipt notes are not sequentially numbered. We recommend that the supporting documents are sequentially numbered to ensure completeness and better control over procurement process.

5.3 We noted instances where related supporting documents for vouchers were not attached with the vouchers. Further, in some cases, supporting documents were in the form of pictures captured through a cellular phone and in various instances were not legible as well. Notwithstanding the legible nature of the pictures, we may draw attention to the fact that same does not suffice for the original records as are required to be kept by the Company under the law. We recommend that books of account and underlying records be appropriately maintained and retained per the various statutory requirements attracted towards the Company.

#### 6. Compliance with Human Resource Policy

We noted certain instances where certain documents, such as Human Resource (HR) form, technical interview evaluation form, offer letter, offer acceptance letter, joining letter annual performance review, latest increment letters etc., as required by the HR policy were not available for our review in the personnel files. We recommend that the practices be aligned with the HR policy.

#### 7. Information system

7.1 We observed that the financial management system of the Company is neither computerized / automated nor integrated and the Company is maintaining manual accounting records. Further, the journal entries are posted manually which may pose possibility of revisions.







### A·F·FERGUSON&CO.

We recommend that the use of a secure and automated information system be evaluated as to have better control over financial reporting process. Further, access to general ledgers and other records should be restricted to authorized users only.

7.2 We have been apprised that certain steps have been taken by the Company for protection of records, but the Company is yet to formulate a data protection plan and back up policy for protection and back up of data. We recommend that appropriate contingency plan be drawn for safeguarding of data and robust controls and procedures should be placed for retrieval of data in different mode and forms including assessment of the need for any off site backup. Further, steps may also be taken to guard the data, information, and related records from any possible loss.

#### 8. End of service benefits to employees

We noted that the Company does not offer any service terminal benefits to employees. We recommend that the Company may seek guidance from its legal counsel and take steps to ensure any compliance due, with local laws and regulations. Further, adjustments, if required, are incorporated in books of account.

#### 9. Mechanism for calculation of Expected Credit Losses (ECL) on financial assets

IFRS 9 "Financial Instruments" requires that an entity shall assess and recognise a loss allowance for ECL on all financial assets that are carried at amortised cost model. In this respect, we noted that a formal mechanism for calculation of ECL on financial assets was not in place. We recommend that ECL be evaluated on periodic basis for all financial assets and adjustment, if any required, be adequately incorporated in books of account of the Company to remain in compliance with the statutory reporting framework requirements. Further, key inputs of the ECL model are sourced carefully keeping in view suitability, source data limitations, recent economic trends and their long-term impacts on financial assets of the Company.

#### 10. Fixed assets

10.1 IAS 16 Property, Plant and Equipment requires the items of property and equipment be capitalized when it is probable that the future economic benefits associated with the item will flow to the entity and the cost of item can be measured reliably. However, we noted that the Company does not have a written capitalization policy in place for property and equipment. Given the foregoing, we recommend that the related policy be formulated and assessed for appropriateness by the Company.

10.2 We also observed that the fixed assets are neither coded and tagged nor captured per the fixed assets register requirements outline vide TR 6 prescribed by Institute of Chartered Accountants of Pakistan. In addition, the Company does not have any practice of periodic physical verification of fixed assets. We recommend that fixed assets should be physically verified, properly tagged / coded and captured in the fixed assets register for proper control over assets along appropriate record keeping thereof.

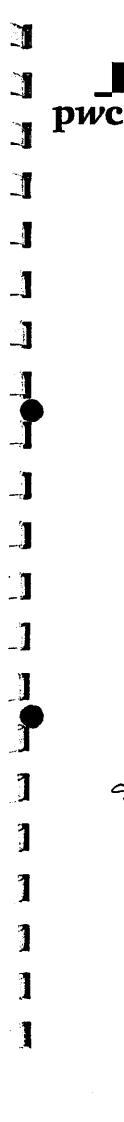
#### 11. Cost allocation

We noted that costs pertaining to employees have been allocated by the Company to direct cost based on a predetermined ratio. Further we also noted that time sheets are not prepared by employees of the Foundation as to determine their accurate effort level allocable





- 3 -



A.F.FERGUSON&CO.

for each activity. We recommend that the activity cost drivers are duly identified, and the basis of allocation thereof be periodically evaluated to arrive at precise margins/operational results of each activity.

#### 12. Facility availed without consideration

We noted that the Company is using various resources and facilities of the parent Company. In this respect, we have been confirmed that the related amounts are insignificant for the Company and neither any amount in this respect is charged by the Company nor would be charged to the Parent Company thus no such amount is recognized as expense by the management of the Company.

We recommend that the related matter be appropriately assessed in light of respective requirements including taxation and accounting covenants. Further, terms of business and support by the Company be formally documented and approved by the concerned.

#### 13. **Restatement and reclassification**

We feel appropriate in drawing attention to the contents of note 29 and 30 of the enclosed financial statements which outline certain prior period reclassifications/restatements. In this respect, we have been apprised that certain of the related matters pertain to error in the prior periods and have now been appropriately addressed by the management. We recommend that related matters be internally deliberated, and steps taken for robust responsiveness to avoid reoccurrence of any such error in the future accounting/reporting matters.

Please note that, in due course of time, we shall also issue a management letter which 14. shall be including our observations on certain internal controls and accounting matters which came to our notice during the course of the audit, together with our recommendations, as considered appropriate in these respect. We may however, add that our audit procedures were designed with a view to expressing an opinion on the financial statements taken as a whole and not to provide an independent assurance on the internal control structure which may be the objective of any related focused examination

We wish to place on record our appreciation of the co-operation and courtesy extended 15. to us by the management and staff of the Company during audit.

Yours truly

ergronze encls







## A.F.FERGUSON&CO.

#### Annexure

1

#### NRTC ENERGIES (PRIVATE) LIMITED FINANCIAL STATEMENTS FOR THE YEAR ENDED JUNE 30, 2023

List of items requiring the Board's specific approval as referred to in our letter 749 dated February 7, 2024:

|       |  | Rupees    |
|-------|--|-----------|
| (i)   | Property and equipment<br>Operating assets   |           |
|       | - Additions at cost during the year  | 3,416,283 |
| (ii)  | Capital work in progress   |           |
|       | <ul> <li>Additions during the year</li> </ul>  | 3,235,725 |
| (iii) | Transactions with related parties as disclosed in note 28 to the financial statements. |           |
| (iv)  | Remuneration of Chief Executive, Directors and Executives as                           |           |

(iv) Remuneration of Chief Executive, Directors and Executives as disclosed in note 26 to the financial statements.

303724.

۰.









#### INDEPENDENT AUDITOR'S REPORT

#### To the Members of NRTC Energies (Private) Limited

#### Report on the Audit of the Financial Statements

#### Opinion

We have audited the annexed financial statements of NRTC Energies (Private) Limited (the Company), which comprise the statement of financial position as at June 30, 2023, and the statement of profit or loss, the statement of comprehensive income, the statement of changes in equity, the statement of cash flows for the year then ended, and notes to the financial statements, including a summary of significant accounting policies and other explanatory information, and we state that we have obtained all the information and explanations which, to the best of our knowledge and belief, were necessary for the purposes of the audit.

In our opinion and to the best of our information and according to the explanations given to us, the statement of financial position, the statement of profit or loss, the statement of comprehensive income, the statement of changes in equity and the statement of cash flows together with the notes forming part thereof conform with the accounting and reporting standards as applicable in Pakistan and give the information required by the Companies Act, 2017 (XIX of 2017), in the manner so required and respectively give a true and fair view of the state of the Company's affairs as at June 30, 2023 and of the loss and other comprehensive loss, the changes in equity and its cash flows for the year then ended.

#### **Basis for Opinion**

We conducted our audit in accordance with International Standards on Auditing (ISAs) as applicable in Pakistan. Our responsibilities under those standards are further described in the Auditor's Responsibilities for the Audit of the Financial Statements section of our report. We are independent of the Company in accordance with the International Ethics Standards Board for Accountants' Code of Ethics for Professional Accountants as adopted by the Institute of Chartered Accountants of Pakistan (the Code) and we have fulfilled our other ethical responsibilities in accordance with the Code. We believe that the audit evidence we have obtained is sufficient and appropriate to provide a basis for our opinion.

#### Information Other than the Financial Statements and Auditor's Report Thereon

Management is responsible for the other information. The other information comprises the information included in the director's report but does not include the financial statements and our auditor's report thereon.

Our opinion on the financial statements does not cover the other information and we do not express any form of assurance conclusion thereon.

In connection with our audit of the financial statements, our responsibility is to read the other information and, in doing so, consider whether the other information is materially inconsistent with the financial statements or our knowledge obtained in the audit, or otherwise appears to be materially misstated. If, based on the work we have performed, we conclude that there is a material misstatement of this other information, we are required to report that fact. We have nothing to report in this regard.



A. F. FERGUSON & CO., Chartered Accountants, a member firm of the PwC network 74-East, 2nd Floor, Blue Area, Jinnah Avenue, P.O.Box 3021, Islamabad-44000, Pakistan Tel: +92 (51) 2273457-60/2604934-37; Fax: +92 (51) 2277924; <www.pwc.com/pk>

\*KARACHI \*LAHORE \*ISLAMABAD



ù



#### Responsibilities of Management and Board of Directors for the Financial Statements

Management is responsible for the preparation and fair presentation of the financial statements in accordance with the accounting and reporting standards as applicable in Pakistan and the requirements of Companies Act, 2017(XIX of 2017) and for such internal control as management determines is necessary to enable the preparation of financial statements that are free from material misstatement, whether due to fraud or error.

- 2 -

In preparing the financial statements, management is responsible for assessing the Company's ability to continue as a going concern, disclosing, as applicable, matters related to going concern and using the going concern basis of accounting unless management either intends to liquidate the Company or to cease operations, or has no realistic alternative but to do so.

Board of directors are responsible for overseeing the Company's financial reporting process.

#### Auditor's Responsibilities for the Audit of the Financial Statements

Our objectives are to obtain reasonable assurance about whether the financial statements as a whole are free from material misstatement, whether due to fraud or error, and to issue an auditor's report that includes our opinion. Reasonable assurance is a high level of assurance, but is not a guarantee that an audit conducted in accordance with ISAs as applicable in Pakistan will always detect a material misstatement when it exists. Misstatements can arise from fraud or error and are considered material if, individually or in the aggregate, they could reasonably be expected to influence the economic decisions of users taken on the basis of these financial statements.

As part of an audit in accordance with ISAs as applicable in Pakistan, we exercise professional judgment and maintain professional skepticism throughout the audit. We also:

- Identify and assess the risks of material misstatement of the financial statements, whether due to fraud or error, design and perform audit procedures responsive to those risks, and obtain audit evidence that is sufficient and appropriate to provide a basis for our opinion. The risk of not detecting a material misstatement resulting from fraud is higher than for one resulting from error, as fraud may involve collusion, forgery, intentional omissions, misrepresentations, or the override of internal control.
- Obtain an understanding of internal control relevant to the audit in order to design audit procedures that are appropriate in the circumstances, but not for the purpose of expressing an opinion on the effectiveness of the Company's internal control.
- Evaluate the appropriateness of accounting policies used and the reasonableness of accounting estimates and related disclosures made by management.
- Conclude on the appropriateness of management's use of the going concern basis of accounting and, based on the audit evidence obtained, whether a material uncertainty exists related to events or conditions that may cast significant doubt on the Company's ability to continue as a going concern. If we conclude that a material uncertainty exists, we are required to draw attention in our auditor's report to the related disclosures in the financial statements or, if such disclosures are inadequate, to modify our opinion. Our conclusions are based on the audit evidence obtained up to the date of our auditor's report. However, future events or conditions may cause the Company to cease to continue as a going concern.

JAXADO







AFFERGUSON& CQ

• Evaluate the overall presentation, structure and content of the financial statements, including the disclosures, and whether the financial statements represent the underlying transactions and events in a manner that achieves fair presentation.

- 3 -

We communicate with the board of directors regarding, among other matters, the planned scope and timing of the audit and significant audit findings, including any significant deficiencies in internal control that we identify during our audit.

#### **Report on Other Legal and Regulatory Reguirements**

Based on our audit, we further report that in our opinion:

- a) proper books of account have been kept by the Company as required by the Companies Act, 2017 (XIX of 2017);
- b) the statement of financial position, the statement of profit or loss, the statement of comprehensive income, the statement of changes in equity and the statement of cash flows together with the notes thereon have been drawn up in conformity with the Companies Act, 2017 (XIX of 2017) and are in agreement with the books of account and returns;
- c) investments made, expenditure incurred and guarantees extended during the year were for the purpose of the Company's business; and
- d) no zakat was deductible at source under the Zakat and Ushr Ordinance, 1980 (XVIII of 1980).

#### **Other Matter**

The financial statements of the Company for the year ended June 30, 2022 were audited by another auditor who expressed an unmodified opinion on those financial statements on January 17, 2024.

The engagement partner on the audit resulting in this independent auditor's report is JehanZeb Amin.

Hergemal.

Chartered Accountants Islamabad Date: October 9, 2024 UDIN: AR202310083nIP7sz2XI





#### NRTC ENERGIES (PRIVATE) LIMITED STATEMENT OF FINANCIAL POSITION AS AT JUNE 30, 2023

|                                     |      | 2023         | 2022       |
|-------------------------------------|------|--------------|------------|
|                                     | Note | Rupees       | Rupees     |
| ASSETS                              |      |              | (Restated) |
| NON-CURRENT ASSETS                  | _    |              |            |
| Property and equipment              | 5    | 6,652,467    | 327,175    |
| Long term deposits                  | 1    | 922,000      | 215,300    |
|                                     | _    | 7,574,467    | 542,475    |
| CURRENT ASSETS                      |      |              |            |
| Stock in trade                      | 7 [  | 80,642,763   | 201,481    |
| Trade and other receivable          | 8    | 40,242,894   | 11,676,881 |
| Advances                            | 9    | 2,287,912    | 8,732,650  |
| Sales tax refundable-net            | 10   | 14,366,237   | 1,952,187  |
| Prepayments                         | 11   | 400,473      | -          |
| Cash and bank balances              | 12   | 100,353,093  | 273,459    |
|                                     | _    | 238,293,372  | 22,836,659 |
| TOTAL ASSETS                        | -    | 245,867,839  | 23,379,134 |
| EQUITY & LIABILITIES                |      |              |            |
| EQUITY AND RESERVES                 | _    |              |            |
| Share capital                       | 13   | 10,000,000   | 10,000,000 |
| Accumulated (losses) / profit       |      | (27,624,731) | 662,134    |
|                                     |      | (17,624,731) | 10,662,134 |
| NON-CURRENT LIABILITIES             |      |              |            |
| Deferred tax liabilities            | 14   | 164,842      | 13,442     |
| CURRENT LIABILITIES                 |      |              |            |
| Loan from Onsun Pvt Ltd - unsecured | 15   | 10,650,654   | 650,654    |
| Trade and other payables            | 16   | 147,414,383  | 11,671,337 |
| Contract liabilities                | 17   | 99,530,132   | -          |
| Provision for taxation              | 18   | 5,732,559    | 381,567    |
|                                     |      | 263,327,728  | 12,703,558 |
| TOTAL EQUITY AND LIABILITIES        |      | 245,867,839  | 23,379,134 |
| CONTINGENCIES AND COMMITMENTS       |      |              |            |

The annexed notes 1 to 32 form an integral part of these financial statements.

CHIEF EXECUTIVE OFFICER

Divector

BRECTOR Cheit Grantine officer





,

.....

#### NRTC ENERGIES (PRIVATE) LIMITED STATEMENT OF PROFIT OR LOSS FOR THE YEAR ENDED JUNE 30, 2023

|                                   | Note | 2023<br>Rupees | 2022<br>Rupees |
|-----------------------------------|------|----------------|----------------|
| Revenue - net                     | 19   | 458,670,733    | 37,335,328     |
| Cost of sales                     | 20   | (423,089,685)  | (27,336,071)   |
| Gross profit                      |      | 35,581,048     | 9,999,257      |
| Selling and distribution expenses | 21   | (7,748,200)    | (1,290,148)    |
| Administrative expenses           | 22   | (50,228,422)   | (7,564,608)    |
| Operating (loss) / profit         |      | (22,395,574)   | 1,144,501      |
| Finance cost                      | 23   | (6,508)        | (2,233)        |
| (Loss) / Profit before taxation   | -    | (22,402,082)   | 1,142,268      |
| Income tax expense                | 24   | (5,884,784)    | (480,134)      |
| (Loss) / Profit for the year      | -    | (28,286,866)   | 662,134        |

The annexed notes 1 to 32 form an integral part of these financial statements.

CHIEF EXECUTIVE OFFICER

DIRECTOR

Cheit Frecutive obsider





ş

\_] 



- 1

- ]

1

Director

#### NRTC ENERGIES (PRIVATE) LIMITED STATEMENT OF COMPREHENSIVE INCOME FOR THE YEAR ENDED JUNE 30, 2023

|   | 2023<br>Rup <del>e</del> es | 2022<br>Rupees |
|---|-----------------------------|----------------|
| (Loss) / Profit for the year                                  | (28,286,866)                | 662,134        |
| Other comprehensive (loss) / income for the year - net of tax | -                           | -              |
| Total comprehensive (loss) / income for the year              | (28,286,866)                | 662,134        |

The annexed notes 1 to 32 form an integral part of these financial statements.  $\Im \mathcal{FIL}$ 

CHIEF EXECUTIVE OFFICER inector

ł

]

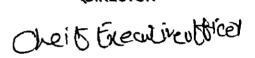
1

1

1

]

DIRECTOR-







#### NRTC ENERGIES (PRIVATE) LIMITED STATEMENT OF CASH FLOWS FOR THE YEAR ENDED JUNE 30, 2023

| Cash flows from operating activities(Loss) / Profit before tax(22,402,082)1,142,268Adjustments for:Depreciation5326,71615,045Operating cash flows before working capital changes7(80,441,282)(201,481)Changes in operating activities7(80,441,282)(201,481)Stock in trade7(80,441,282)(201,481)Trade and other receivable86,444,738(8,732,650)Advances96,444,738(8,732,650)Sales tax refundable-net10(12,414,050)(1,952,187)Prepayments11(400,473)-Long term deposits11(706,700)(215,300)Trade and other payables16135,743,04611,671,337Contract liabilities1799,530,132-Cash generated from operating activities89,614,034(2,449,850)Cash generated / (used) from operating activities89,231,642(2,534,975)Cash flows from investing activities5(6,652,008)(342,220)Net cash used in investing activities5(6,652,008)(342,220)Cash flows from financing activities137,500,000(2,500,000)Loen from Onsun (Private) Limited - unsecured15(10,000,000)(650,654)Net cash used in investing activities137,500,000(2500,000)Cash and cash equivalents at beginning of the year273,459-Cash and cash equivalents at edigon the year273,459- <t< th=""><th></th><th>Note</th><th>2023<br/>Rupees</th><th>2022<br/>Rupees</th></t<>   |   | Note | 2023<br>Rupees | 2022<br>Rupees |
|---|---|------|----------------|----------------|
| Adjustments for:5326,71615,045Depreciation5326,71615,045Operating cash flows before working capital changes5(22,075,366)1,157,313Changes in operating activities8(36,066,013)(4,176,881)Advances96,444,738(8,732,650)Sales tax refundable-net10(12,414,050)(8,732,650)Prepayments11(400,473)-Long term deposits11(400,473)-Contract liabilities16135,743,04611,671,337Contract liabilities16135,743,04611,671,337Cash generated from operating activities111,689,399(3,607,163)Taxes paid(9,530,132)Net cash generated / (used) from operating activities89,211,034(2,449,850)Cash flows from investing activities89,211,642(2,534,975)Cash flows from investing activities5(6,652,008)(342,220)Net cash used in investing activities5(6,652,008)(342,220)Cash flows from financing activities137,500,000(350,654)Net cash generated form financing activities137,50  | Cash flows from operating activities                |      |                |                |
| Depreciation<br>Operating cash flows before working capital changes         5         326,716         15,045           Changes In operating activities         (22,075,366)         1,157,313           Changes In operating activities         (36,0441,282)         (201,481)           Trade and other receivable         8         (36,066,013)         (4,176,881)           Advances         9         6,444,738         (12,414,050)         (12,52,187)           Prepayments         10         (12,414,050)         (215,300)         (215,300)           Long term deposits         (706,700)         (215,300)         (215,300)           Trade and other payables         16         (35,743,046)         (3,607,163)           Contract liabilities         17         99,530,132         -           Cash generated from operating activities         89,614,034         (2,449,850)           Taxes paid         (382,392)         (85,125)           Net cash generated / (used) from operating activities         89,231,642         (2,534,975)           Cash flows from investing activities         5         (6,652,008)         (342,220)           Net cash used in investing activities         13         7,500,000         (6,50,654)           Net cash used in investing activities         13         7,500,0 | (Loss) / Profit before tax                          |      | (22,402,082)   | 1,142,268      |
| Operating cash flows before working capital changes(22,075,366)1,157,313Changes in operating activitiesStock in trade7(80,441,282)(201,481)Trade and other receivable8(36,066,013)(4,176,881)Advances96,444,738(8,732,650)Sales tax refundable-net10(12,414,050)(1,952,187)Prepayments11(400,473)-Long term deposits11(400,473)-Trade and other payables16135,743,04611,671,337Contract liabilities1799,530,132-Cash generated from operating activities111,689,399(3,607,163)Taxes paid(used) from operating activities89,614,034(2,449,850)Taxes paid(used) from operating activities89,231,642(2,534,975)Cash flows from investing activities5(6,652,008)(342,220)Cash flows from financing activities137,500,0002,500,000Cash generated from financing activities137,500,0002,500,000Cash flows from financing activities137,500,0002,500,000Net cash used in investing activities1510,0079,634273,459Net cash generated from financing activities1510,0079,634273,459Net cash generated from financing activities1510,0079,634273,459Net cash generated from financing activities1510,0079,634273,459  | Adjustments for:                                    |      |                |                |
| Operating cash flows before working capital changes(22,075,366)1.157,313Changes In operating activitiesStock in trade7(80,441,282)(201,481)Trade and other receivable8(36,066,013)(4,176,881)Advances96,444,738(8,732,650)Sales tax refundable-net10(12,414,050)(1,952,187)Prepayments11(400,473)-Long term deposits11(400,473)-Trade and other payables16135,743,04611,671,337Contract liabilities1799,530,132-Cash generated from operating activities111,689,399(3,607,163)Taxes paid(2,449,850)(2,449,850)Net cash generated / (used) from operating activities89,614,034(2,449,850)Cash flows from investing activities89,231,642(2,534,975)Cash flows from financing activities5(6,652,008)(342,220)Net cash used in investing activities137,500,0002,500,000Cash flows from financing activities1510,000,0002,500,000Net cash generated from financing activities152,500,0003,150,654Net cash generated from financing activities1510,0079,634273,459Cash flows from financing activities1510,0079,634273,459Net cash generated from financing activities100,079,634273,459-   | Depreciation  | 5    | 326,716        | 15.045         |
| Stock in trade       7       (80,441,282)       (201,481)         Trade and other receivable       8       (36,066,013)       (4,176,881)         Advances       9       6,444,738       (12,414,050)       (1,952,187)         Prepayments       10       (12,414,050)       (1,952,187)       -         Long term deposits       11       (400,473)       -       (215,300)         Trade and other payables       16       135,743,046       11,671,337       -         Contract liabilities       17       99,530,132       -       -         Cash generated from operating activities       89,614,034       (2,449,850)       11,671,337         Taxes paid       (382,392)       (35,125)       -         Net cash generated / (used) from operating activities       89,614,034       (2,449,850)         Cash flows from investing activities       89,614,034       (2,449,850)         Cash flows from investing activities       89,231,642       (2,534,975)         Cash flows from financing activities       5       (6,652,008)       (342,220)         Net cash used in investing activities       15       (10,00,000)       (2,500,000)         Loan from Onsun (Private) Limited - unsecured       15       (10,000,000)       (550,654)   | Operating cash flows before working capital changes | -    |                |                |
| Trade and other receivable       8       (36,066,013)       (4,176,881)         Advances       9       (36,066,013)       (4,176,881)         Sales tax refundable-net       10       (1,2414,050)       (1,952,187)         Prepayments       11       (400,473)       -         Long term deposits       11       (400,473)       -         Trade and other payables       16       135,743,046       11,671,337         Contract liabilities       17       99,530,132       -         Cash generated from operating activities       89,614,034       (2,449,850)         Taxes paid       (382,392)       (85,125)         Net cash generated / (used) from operating activities       89,231,642       (2,534,975)         Cash flows from investing activities       (6,652,008)       (342,220)         Additions in property and equipment       5       (6,652,008)       (342,220)         Net cash used in investing activities       13       7,500,000       (35,0654)         Loan from Onsun (Private) Limited - unsecured       15       17,500,000       3,150,654         Net increase in cash and cash equivalents       100,079,634       273,459       273,459  | Changes in operating activities                     |      |                |                |
| Trade and other receivable       8       (36,066,013)       (4,176,881)         Advances       9       6,444,738       (8,732,650)         Sales tax refundable-net       10       (12,414,050)       (1,952,187)         Prepayments       11       (400,473)       -         Long term deposits       11       (400,473)       -         Trade and other payables       16       135,743,046       11,671,337         Contract liabilities       17       99,530,132       -         Cash generated from operating activities       111,689,399       (3,607,163)       -         Cash generated / (used) from operating activities       89,614,034       (2,449,850)       -         Net cash generated / (used) from operating activities       89,231,642       (2,534,975)         Cash flows from investing activities       6(,652,008)       (342,220)         Net cash used in investing activities       13       7,500,000       (342,220)         Cash flows from financing activities       13       7,500,000       (2,500,000         Loan from Onsun (Private) Limited - unsecured       15       10,000,000       (650,654)         Net cash generated from financing activities       17,500,000       3,150,654         Net increase in cash and cash equivalents  | Stock in trade                                      | 7    | (80,441,282)   | (201,481)      |
| Sales tax refundable-net10(12,414,050)(1,952,187)Prepayments11(400,473)-Long term deposits11(400,473)-Trade and other payables16135,743,04611,671,337Contract liabilities1799,530,132-Cash generated from operating activities1799,530,132-Taxes paid17(3,607,163)(3,607,163)Net cash generated / (used) from operating activities89,614,034(2,449,850)Cash flows from investing activities(382,392)(85,125)Cash flows from investing activities5(6,652,008)(342,220)Cash flows from financing activities5(6,652,008)(342,220)Cash generated from financing activities137,500,0002,500,000Loan from Onsun (Private) Limited - unsecured1510,007,63427,3,459Net increase in cash and cash equivalents100,079,634273,459-Cash and cash equivalents at beginning of the year273,459  | Trade and other receivable                          |      |                |                |
| Prepayments11(400,473)-Long term deposits16(35,743,046)(215,300)Trade and other payables16135,743,04611,671,337Contract liabilities1799,530,132-Cash generated from operating activities1799,530,132-Taxes paid111,689,399(3,607,163)-Net cash generated / (used) from operating activities89,614,034(2,449,850)Cash generated / (used) from operating activities89,231,642(2,534,975)Cash flows from investing activities5(6,652,008)(342,220)Cash flows from financing activities137,500,000(342,220)Cash flows from financing activities137,500,0002,500,000Loan from Onsun (Private) Limited - unsecured1510,000,000650,654Net cash generated from financing activities100,079,634273,459Net increase in cash and cash equivalents100,079,634273,459Cash and cash equivalents at beginning of the year273,459-  | Advances  | 9    |                | •              |
| Long term deposits<br>Trade and other payables<br>Contract liabilities(706,700)<br>135,743,046<br>99,530,132(215,300)<br>11,671,337Cash generated from operating activities<br>Taxes paid<br>Net cash generated / (used) from operating activities16<br>135,743,046<br>99,530,13211,671,337<br>   | Sales tax refundable-net                            | 10   | (12,414,050)   | (1,952,187)    |
| Trade and other payables<br>Contract liabilities16135,743,04611,671,337Cash generated from operating activities1799,530,132-Cash generated from operating activities111,689,399(3,607,163)Taxes paid89,614,034(2,449,850)Net cash generated / (used) from operating activities89,231,642(2,534,975)Cash flows from investing activities89,231,642(2,534,975)Cash flows from investing activities5(6,652,008)(342,220)Net cash used in investing activities5(6,652,008)(342,220)Cash flows from financing activities137,500,000(342,220)Cash flows from financing activities137,500,000(550,654)Net cash generated from financing activities137,500,000(550,654)Net increase in cash and cash equivalents100,079,634273,459273,459Cash and cash equivalents at beginning of the year273,459  |   | 11   | (400,473)      | -              |
| Contract liabilities1799,530,132-Cash generated from operating activities111,689,399(3,607,163)Taxes paid89,614,034(2,449,850)Net cash generated / (used) from operating activities89,231,642(2,534,975)Cash flows from investing activities89,231,642(2,534,975)Cash flows from investing activities5(6,652,008)(342,220)Net cash used in investing activities5(6,652,008)(342,220)Cash flows from financing activities137,500,000(342,220)Cash flows from financing activities137,500,000(342,220)Cash flows from financing activities137,500,000(350,654)Net cash generated from financing activities1510,000,000(550,654)Net increase in cash and cash equivalents100,079,634273,459273,459Cash and cash equivalents at beginning of the year273,459  | · · ·   |      | (706,700)      | (215,300)      |
| Cash generated from operating activities111,689,399(3,607,163)Taxes paid89,614,034(2,449,850)Net cash generated / (used) from operating activities(382,392)(85,125)Cash flows from investing activities89,231,642(2,534,975)Cash flows from investing activities5(6,652,008)(342,220)Net cash used in investing activities(6,652,008)(342,220)Cash flows from financing activities137,500,0002,500,000Cash flows from financing activities137,500,0002,500,000Loan from Onsun (Private) Limited - unsecured1510,000,000650,654Net cash generated from financing activities100,079,634273,459273,459Cash and cash equivalents at beginning of the year273,459  |   | 16   | 135,743,046    | 11,671,337     |
| Cash generated from operating activities89,614,034(2,449,850)Taxes paid(382,392)(85,125)Net cash generated / (used) from operating activities89,231,642(2,534,975)Cash flows from investing activities5(6,652,008)(342,220)Net cash used in investing activities5(6,652,008)(342,220)Net cash used in investing activities137,500,000(342,220)Cash flows from financing activities137,500,000(350,654)Net cash generated from financing activities137,500,000(350,654)Net cash generated from financing activities137,500,000(3,150,654)Net increase in cash and cash equivalents100,079,634273,459273,459Cash and cash equivalents at beginning of the year273,459-  | Contract liabilities                                | 17   | 99,530,132     | -              |
| Cash generated from operating activities89,614,034(2,449,850)Taxes paid(382,392)(85,125)Net cash generated / (used) from operating activities89,231,642(2,534,975)Cash flows from investing activities5(6,652,008)(342,220)Net cash used in investing activities5(6,652,008)(342,220)Net cash used in investing activities137,500,000(342,220)Cash flows from financing activities137,500,000(350,654)Net cash generated from financing activities137,500,000(350,654)Net cash generated from financing activities137,500,000(3,150,654)Net increase in cash and cash equivalents100,079,634273,459273,459Cash and cash equivalents at beginning of the year273,459-  |   |      |                | (2.607.462)    |
| Taxes paid(382,392)(85,125)Net cash generated / (used) from operating activities89,231,642(2,534,975)Cash flows from investing activities5(6,652,008)(342,220)Net cash used in investing activities5(6,652,008)(342,220)Cash flows from financing activities137,500,000(342,220)Cash flows from financing activities137,500,0002,500,000Loan from Onsun (Private) Limited - unsecured1510,000,000650,654Net cash generated from financing activities17,500,0003,150,654Net increase in cash and cash equivalents100,079,634273,459Cash and cash equivalents at beginning of the year273,459-  | Cash generated from operating activities            |      |                |                |
| Net cash generated / (used) from operating activities89,231,642(2,534,975)Cash flows from investing activities5(6,652,008)(342,220)Net cash used in investing activities5(6,652,008)(342,220)Cash flows from financing activities6(6,652,008)(342,220)Cash flows from financing activities137,500,0002,500,000Loan from Onsun (Private) Limited - unsecured1510,000,000650,654Net cash generated from financing activities17,500,0003,150,654Net increase in cash and cash equivalents100,079,634273,459Cash and cash equivalents at beginning of the year273,459-  |   |      |                | • • •          |
| Cash flows from investing activities5(6,652,008)(342,220)Net cash used in investing activities5(6,652,008)(342,220)Cash flows from financing activities6,652,008)(342,220)Cash flows from financing activities137,500,0002,500,000Loan from Onsun (Private) Limited - unsecured1510,000,000650,654Net cash generated from financing activities17,500,0003,150,654Net increase in cash and cash equivalents100,079,634273,459Cash and cash equivalents at beginning of the year273,459-  | •   |      |                |                |
| Net cash used in investing activities(6,652,008)(342,220)Cash flows from financing activities137,500,0002,500,000Proceeds from issue of share137,500,0002,500,000Loan from Onsun (Private) Limited - unsecured1510,000,000650,654Net cash generated from financing activities17,500,0003,150,654Net increase in cash and cash equivalents100,079,634273,459Cash and cash equivalents at beginning of the year273,459-   | -   |      |                | (              |
| Cash flows from financing activitiesProceeds from issue of share137,500,0002,500,000Loan from Onsun (Private) Limited - unsecured1510,000,000650,654Net cash generated from financing activities17,500,0003,150,654Net increase in cash and cash equivalents100,079,634273,459Cash and cash equivalents at beginning of the year273,459-  | Additions in property and equipment                 | 5    | (6,652,008)    | (342,220)      |
| Proceeds from issue of share137,500,0002,500,000Loan from Onsun (Private) Limited - unsecured1510,000,000650,654Net cash generated from financing activities17,500,0003,150,654Net increase in cash and cash equivalents100,079,634273,459Cash and cash equivalents at beginning of the year273,459-  | Net cash used in investing activities               |      | (6,652,008)    | (342,220)      |
| Loan from Onsun (Private) Limited - unsecured1510,000,000650,654Net cash generated from financing activities17,500,0003,150,654Net increase in cash and cash equivalents100,079,634273,459Cash and cash equivalents at beginning of the year273,459-  | Cash flows from financing activities                |      |                |                |
| Net cash generated from financing activities17,500,0003,150,654Net increase in cash and cash equivalents100,079,634273,459Cash and cash equivalents at beginning of the year273,459-  | Proceeds from issue of share                        | 13   | 7,500,000      | 2,500,000      |
| Net increase in cash and cash equivalents100,079,634273,459Cash and cash equivalents at beginning of the year273,459-   | • ·   | 15   | 10,000,000     | 650,654        |
| Cash and cash equivalents at beginning of the year 273,459  | Net cash generated from financing activities        |      | 17,500,000     | 3,150,654      |
|   |   |      | 100,079,634    | 273,459        |
| Cash and cash equivalents at end of the year <u>100,353,093</u> <u>273,459</u>  |   |      |                | <u> </u>       |
|   | Cash and cash equivalents at end of the year        |      | 100,353,093    | 273,459        |

The annexed notes 1 to 32 form an integral part of these financial statements.

CHIEF EXECUTIVE OFFICER Vector







#### NRTC ENERGIES (PRIVATE) LIMITED STATEMENT OF CHANGES IN EQUITY FOR THE YEAR ENDED JUNE 30, 2023

|   | Share<br><u>capital</u><br>Ordinary<br>shares | Accumulated<br>(losses) / profit | Total        |
|---|---|----------------------------------|--------------|
|   |   | Rupees                           |              |
| Balance at September 17, 2021             | -   | -                                | -            |
| Total comprehensive income for the period |   |                                  |              |
| Profit for the period                     | - 1   | 662,134                          | 662,134      |
| Other comprehensive income for the period |   |                                  | •            |
| Total comprehensive income for the period |   | 662,134                          | 662,134      |
| Transactions with owners                  |   |                                  |              |
| Issue of share                            | 10,000,000                                    | -                                | 10,000,000   |
| Balance at June 30, 2022                  | 10,000,000                                    | 662,134                          | 10,662,134   |
| Balance at July 1, 2022                   | 10,000,000                                    | 662,134                          | 10,662,134   |
| Total comprehensive income for the year   |   |                                  |              |
| Loss for the year                         |   | (28,286,866)                     | (28,286,866) |
| Other comprehensive income for the year   |   | -                                | -            |
| Total comprehensive income for the year   |   | (28,286,866)                     | (28,286,866) |
| Balance at June 30, 2023                  | 10,000,000                                    | (27,624,731)                     | (17,624,731) |

The annexed notes 1 to 32 form an integral part of these financial statements.

CHIEF EXECUTIVE OFFICER inectiv

DIRECTOR

Cheit Elecative officer





#### NRTC ENERGIES (PRIVATE) LIMITED NOTES TO THE FINANCIAL STATEMENTS FOR THE YEAR ENDED JUNE 30, 2023

#### 1. LEGAL STATUS AND OPERATIONS

NRTC Energies (Private) Limited is a Company registered under the Companies Act, 2017. The Company was incorporated in Pakistan on September 17, 2021 under the Companies Ordinance, 1984 (repealed by the Companies Act, 2017). The Company's registered office is located at Nasralla Link Road, Mumtaz City, Islamabad, Pakistan. The principal activity of the Company is to carry on business of import and trading of solar energy system and promotion of green energy. The Company is the subsidiary of National Radio Telecommunication Corporation (Private) Limited (NRTC).

The prior period financial statements cover the period from September 17, 2021 to June 30, 2022 for comparative information and therefore, are not entirely comparable in respect of statement of profit or loss, statement of comprehensive income, statement of cashflow, statement of changes in equity, and notes to and forming part of the financial statements.



#### BASIS OF PREPARATION

#### Statement of compliance

These financial statements have been prepared in accordance with the accounting and reporting standards as applicable in Pakistan. The accounting and reporting standards applicable in Pakistan comprise of:

- International Financial Reporting Standards (IFRS Standards) issued by the International Accounting Standards Board (IASB) as notified under the Companies Act, 2017; and
- Provisions of and directives issued under the Companies Act, 2017.

Where provisions of and directives issued under the Companies Act, 2017 differ from the IFRS Standards, the provisions of and directives issued under the Companies Act, 2017 have been followed.

#### 2.2 Accounting Convention

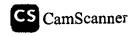
These financial statements have been prepared on the basis of 'historical cost convention' using accrual basis of accounting except as otherwise stated in the respective accounting policies notes.

#### 2.3 Critical accounting estimates and judgements

The preparation of financial statements in conformity with approved accounting standards requires the use of certain critical accounting estimates. It also requires management to exercise its judgment in the process of applying the Company's accounting policies. Estimates and judgments are continually evaluated and are based on historic experience, including expectations of future events that are believed to be reasonable under the circumstances. The areas involving a higher degree of judgment or complexity, or areas where assumptions and estimates are significant to the financial statements, are as follows:

- i) Estimated useful life of property and equipment (note 4.5)
- ii) Impariment of non financial assets (note 4.6)





- iii) Provision for stock in trade (note 4.7)
- iv) Expected credit losses (note 28)
- v) Provision for current and deferred tax (note 4.1)
- vi) Contingencies (note 4.4)

### 3 Adoption of new and amended standards and interpretations

3.1 Standards, interpretations and amendments to published approved accounting standards that are effective but not relevant

Standards, amendments and interpretations to existing standards that are not yet effective and have not been adopted early by the Company.

|         |  | Effective date<br>(annual periods<br>beginning on or<br>after) |
|---------|--|--|
| IAS 1   | Presentation of financial statements (Amendments)    | January 1, 2023  |
|         |  | & January 1, 2024  |
| IAS 7   | Statement of Cash Flows (Amendments)                 | January 1, 2024  |
| IAS 8   | Accounting policies, changes in accounting estimates | ·  |
|         | and errors (Amendments)                              | January 1, 2023  |
| IAS 12  | Income Taxes (Amendments)                            | January 1, 2023  |
| IFRS 4  | Insurance contracts (Amendments)                     | January 1, 2023  |
| IFRS 7  | Financial Instrument Disclosures (Amendments)        | January 1, 2024  |
| IFRS 16 | Leases (Amendments)                                  | January 1, 2024  |

The management anticipates that the adoption of the above standards, amendments and interpretations in future periods, will have no material impact on the financial statements other than in presentation / disclosures.

Further, the following new standards and interpretations have been issued by the International Accounting Standards Board (IASB), which are yet to be notified by the Securities and Exchange Commission of Pakistan, for the purpose of their applicability in Pakistan:

| IFRS 1   | First-time Adoption of International Financial Reporting Standards |
|----------|--|
| IFRS 17  | Insurance Contracts  |
| IFRIC 12 | Service concession arrangements                                    |

#### 4 SUMMARY OF SIGNIFICANT ACCOUNTING POLICIES

#### 4.1 Income tax

The tax expense for the year comprises current and deferred income tax, and is recognized in the statement of profit or loss, except to the extent that it relates to items recognized in other comprehensive income or directly in the equity. In this case, the tax is also recognized in other comprehensive income or directly in equity, respectively.

30371*0.* 



#### Current

The current income tax charge is calculated on the basis of the tax laws enacted or substantively enacted at the statement of financial position date. Management periodically evaluates positions taken in tax returns with respect to situations in which applicable tax regulation is subject to interpretation and establishes provisions where appropriate on the basis of amounts expected to be paid to the tax authorities.

#### Deferred

Deferred income tax is recognized, using the balance sheet liability method, on temporary differences arising between the tax bases of assets and liabilities and their carrying amounts in the financial statements.

Deferred income tax liabilities are recognized for all taxable temporary differences and deferred tax assets are recognized to the extent that it is probable that taxable profits will be available against which the deductible temporary differences, unused tax losses and tax credits can be utilized.

Deferred income tax is calculated at the rates that are expected to apply to the period when the differences reverse, based on tax rates that have been enacted or substantively enacted by the statement of financial position date.

Deferred income tax assets and liabilities are offset when there is a legally enforceable right to offset current income tax assets against current tax liabilities and when the deferred income tax assets and liabilities relate to income tax levied by the same taxation authority on either the same taxable entity or different taxable entities where there is an intention to settle the balance on a net basis.

#### 4.2 Trade and other payables

Liabilities for trade and other amounts payable are carried at cost, which is the fair value of the consideration to be paid in future for goods and services received, whether or not billed to the Company.

#### 4.3 Provisions

A provision is recognized in the financial statements when the Company has a legal or constructive obligation as a result of past events and it is probable that an outflow of resources embodying economic benefits will be required to settle the obligation and a reliable estimate can be made of the amount of obligation.

#### 4.4 Contingent liabilities

A contingent liability is disclosed when the Company has a possible obligation as a result of past events, the existence of which will be confirmed only by the occurrence or non-occurrence, of one or more uncertain future events, not wholly within the control of the Company; or when the Company has a present legal or constructive obligation, that arises from past events, but it is not probable that an outflow of resources embodying economic benefits will be required to settle the obligation, or the amount of the obligation cannot be measured with sufficient reliability.



#### 4.5 Property and equipment

All operating fixed assets are stated at cost less accumulated depreciation and impairment loss, if any except for capital work in progress which is stated at cost less impairment loss, if any. The cost of operating fixed assets includes its purchase price and non-refundable purchase taxes and any directly attributable costs of bringing the asset to its working condition and location for its intended use.

Depreciation on additions to property and equipment is charged, using reducing balance method, on pro rata basis from the month in which the relevant asset is acquired or capitalized, upto the month in which the asset is disposed off. Impairment loss, if any, or its reversal, is also charged to income for the year. Where an impairment loss is recognized, the depreciation charge is adjusted in future periods to allocate the asset's revised carrying amount, less its residual value, over its estimated useful life.

Maintenance and normal repair costs are expensed out as and when incurred. Major renewals and improvements are capitalized and assets so replaced, if any are retired.

Gains and losses on disposal of fixed assets, if any, are recognized in statement of profit or loss.

#### 4.6 Impairment of non-financial assets

Assets that are subject to depreciation are reviewed for impairment on the date of the statement of financial position, or whenever events or changes in circumstances indicate that the carrying amount may not be recoverable. An impairment loss is recognized, equal to the amount by which the asset's carrying amount exceeds its recoverable amount. An asset's recoverable amount is the higher of its fair value less costs to sell and value in use. For the purposes of assessing impairment, assets are grouped at the lowest levels for which there are separately identifiable cash flows. Non financial assets that suffered an impairment, are reviewed for possible reversal of the impairment at each statement of financial position date. Reversals of the impairment loss are restricted to the extent that asset's carrying amount does not exceed the carrying amount that would have been determined, net of depreciation, if no impairment loss has been recognized. An impairment loss, or the reversal of an impairment loss, are both recognized in the statement of profit or loss.

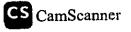
#### 4.7 Stock-in-trade

Inventories are stated at the lower of cost and net realizable value. Cost is calculated using the weighted average method. Cost comprises invoice value and other cost incurred for bringing the stock at their present location and condition for intended use. Net realizable value is the estimated selling price in the ordinary course of business, less cost of completion and costs necessary to be incurred to make the sale.

#### 4.8 Trade debts and other receivables

Trade debts and other receivables are recognised initially at the amount of consideration that is unconditional, unless they contain significant financing component in which case such are recognised at fair value. The Company holds the trade debts with the objective of collecting the contractual cash flows and therefore measures the trade debts subsequently at amortised cost using the effective interest method.

SA7781.



#### 4.9 Cash and cash equivalents

Cash and cash equivalents include cash in hand and cash at banks. For the purpose of the statement of cash flows, cash and cash equivalents are bank balances and cash in hand.

#### 4.10 Revenue from contracts with customers

The Company measures progress of satisfaction of performance obligation for its revenue from Contracts with customers under IFRS 15 'Revenue from Contracts with Customers'. The Company measures its revenue by determining stage of completion when the customer obtains control over the relevant products or services. Costs incurred are recognised as cost of sales in the statement of profit or loss when the related revenue is recognised in the statement of profit or loss.

Variations in contract work, claims/damages and incentive payments are included to the extent that they have been agreed with the customer. When it is probable that total contract costs will exceed total contract revenue, the expected loss is recognized as an expense immediately.

Revenue from sale of goods is recognized on transfer of goods to customers. Revenue from maintainance services and other contracts is recognized when services are rendered to the

No element of financing is deemed present as the sales are made with a credit term of up to 120 days, which is consistent with the market practice.

#### 4.11 Contract liabilities

Contract liability relates to amounts that are paid by or due to customers for which performance obligations are unsatisfied or partially satisfied.

#### 4.12 Functional and presentation currency

Items included in the financial statements are measured using the currency of the primary economic environment in which the Company operates. The financial statements are presented in Pakistan (Rupees) which is the Company's functional and presentation currency. All financial information presented in Pakistan Rupees has been rounded to the nearest rupee unless otherwise stated.

#### 4.13 Foreign currency transactions

Foreign currency transactions are translated into the functional currency using the exchange rate prevailing on the date of the transaction. Monetary assets and liabilities denominated in foreign currencies are translated into functional currency using the exchange rate prevailing at the statement of financial position date. Foreign exchange gains and losses resulting from the settlement of such transactions and from the translation at year-end exchange rates are recognised in the statement of profit or loss.







#### 4.14 Financial instruments

#### Initial recognition

All financial assets and liabilities are initially measured at cost which is the fair value of the consideration given or received. These are subsequently measured at fair value, amortised cost or cost as the case may be.

#### **Classification of financial assets**

The Company classifies its financial assets in the following categories:

- at fair value through profit or loss ("FVTPL"),
- at fair value through other comprehensive income ("FVTOCI"), or
- at amortised cost.

The Company determines the classification of financial assets at initial recognition. The classification of instruments (other than equity instruments) is driven by the Company's business model for managing the financial assets and their contractual cash flow characteristics.

Financial assets that meet the following conditions are subsequently measured at amortised cost:

- the financial asset is held within a business model whose objective is to hold financial assets in order to collect contractual cash flows; and
- the contractual terms of the financial asset give rise on specified dates to cash flows that are solely payments of principal and interest on the principal amount outstanding.

Financial assets that meet the following conditions are subsequently measured at FVTOCI:

- the financial asset is held within a business model whose objective is achieved by both collecting contractual cash flows and selling the financial assets; and
- the contractual terms of the financial asset give rise on specified dates to cash flows that are solely payments of principal and interest on the principal amount outstanding.

By default, all other financial assets are subsequently measured at FVTPL.

#### **Classification of financial liabilities**

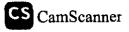
The Company classifies its financial liabilities in the following categories:

- at fair value through profit or loss ("FVTPL"), or
- at amortised cost.

Financial liabilities are measured at amortised cost, unless they are required to be measured at FVTPL (such as instruments held for trading or derivatives) or the Company has opted to measure them at FVTPL.

AR700





#### Subsequent measurement

#### i) Financial assets at FVTOCI

Investments elected to be as equity instruments at FVTOCI are initially recognised at fair value plus transaction costs. Subsequently, they are measured at fair value, with gains or losses arising from changes in fair value recognised in other comprehensive income / (loss).

#### II) Financial assets and liabilities at amortised cost

Financial assets and liabilities at amortised cost are initially recognised at fair value, and subsequently carried at amortised cost, and in the case of financial assets, less any impairment.

#### iii) Financial assets and liabilities at FVTPL

Financial assets and liabilities carried at FVTPL are initially recorded at fair value and transaction costs are expensed in the statement of profit or loss. Realised and unrealised gains and losses arising from changes in the fair value of the financial assets and liabilities held at FVTPL are included in the statement of profit or loss in the period in which they arise.

#### Impairment of financial assets

The Company recognises loss allowance for Expected Credit Loss (ECL) on financial assets measured at amortised cost, at an amount equal to life time ECLs except for the following, which are measured at 12 months ECLs:

- Cash and bank balances for whom credit risk (the risk of default occurring over the expected life of the financial instrument) has not increased since the inception
- Other receivables that have not demonstrated any increase in credit risk since inception

Life time ECLs are the ECLs that results from all possible default events over the expected life of a financial instrument. 12 months' ECL are portion of ECL that result from default events that are possible within 12 months after the reporting date.

ECLs are a probability weighted estimate of credit losses. Credit losses are measured as the present value of all cash shortfalls (i.e. the difference between cash flows due to the entity in accordance with the contract and cash flows that the Company expects to receive).

The gross carrying amount of a financial asset is written off when the Company has no reasonable expectation of recovering a financial asset in its entirety or a portion thereof.





#### Derecognition

The Company derecognises financial liabilities when, and only when, the Company's obligations are discharged, cancelled or they expire.

#### i) Financial assets

The Company derecognises financial assets only when the contractual rights to cash flows from the financial assets expire or when it transfers the financial assets and substantially all the associated risks and rewards of ownership to another entity. On derecognition of a financial asset measured at amortised cost, the difference between the asset's carrying value and the sum of the consideration received and receivable is recognised in profit or loss. In addition, on derecognition of an investment in a debt instrument classified as FVTOCI, the cumulative gain or loss previously accumulated in the investments revaluation reserve is reclassified to profit or loss. In contrast, on derecognition of an investment in equity instrument which the Company has elected on initial recognition to measure at FVTOCI, the cumulative gain or loss previously accumulated in the investments revaluation reserve is not reclassified to profit or loss, but is transferred to statement of changes in equity.

#### ii) Financial liabilities

The Company derecognises financial liabilities only when its obligations under the financial liabilities are discharged, cancelled or expired. The difference between the carrying amount of the financial liability derecognised and the consideration paid and payable, including any non-cash assets transferred or liabilities assumed, is recognised in the statement of profit or loss.

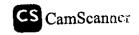
#### Offsetting of financial assets and financial liabilities

Financial assets and liabilities are offset and the net amount is reported in the statement of financial position if the Company has legally enforceable right to set-off the recognised amounts and the Company intends to settle on a net basis or realise the asset and settle the liability simultaneously.

#### Write-off

The gross carrying amount of a financial asset is written off when the Company has no reasonable expectations of recovering a financial asset in its entirety or a portion thereof. The Company individually makes an assessment with respect to the timing and amount of write-off based on whether there is a reasonable expectation of recovery. The Company expects no significant recovery from the amount written off. However, financial assets that are written off could still be subject to enforcement activities in order to comply with the Company's procedures for recovery of amounts due.





## 4.15 Fair value measurement

Fair value is the price that would be received to sell an asset or paid to transfer a liability in an orderly transaction between market participants at the measurement date. The fair value measurement is based on the presumption that the transaction to sell the asset or transfer the liability takes place either:

- In the principal market for the asset or liability; or
- In the absence of a principal market, in the most advantageous market for the asset or liability

The principal or the most advantageous market is accessible by the Company. The fair value of an asset or a liability is measured using the assumptions that market participants would use when pricing the asset or liability, assuming that market participants act in their economic best interest.

A fair value measurement of a non-financial asset takes into account a market participant's ability to generate economic benefits by using the asset in its highest and best use or by selling it to another market participant that would use the asset in its highest and best use.

The Company uses valuation techniques that are appropriate in the circumstances and for which sufficient data are available to measure fair value, maximizing the use of relevant observable inputs and minimizing the use of unobservable inputs.

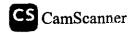
All assets and liabilities for which fair value is measured or disclosed in the financial statements are categorized within the fair value hierarchy, described as follows, based on the lowest level input that is significant to the fair value measurement as a whole:

- Level 1 Quoted (unadjusted) market prices in active markets for identical assets or liabilities;
- Level 2 Valuation techniques for which the lowest level input that is significant to the fair value measurement is directly or indirectly observable; and
- Level 3 Valuation techniques for which the lowest level input that is significant to the fair value measurement is unobservable

For assets and liabilities that are recognized in the financial statements at fair value on a recurring basis, the Company determines whether transfers have occurred between levels in the hierarchy by re-assessing categorization (based on the lowest level input that is significant to the fair value measurement as a whole) at the end of each reporting period.

The Company determines the policies and procedures for both recurring fair value measurement and for non-recurring measurement. For the purpose of fair value disclosures, the Company determines classes of assets and liabilities on the basis of the nature, characteristics and risks of the asset or liability and the level of the fair value hierarchy, as explained above.





| 5 |                          | Note | 2023<br>Rupe <del>e</del> s | 2022<br>Rupees |
|---|--------------------------|------|-----------------------------|----------------|
|   | Operating fixed assets   | 5.1  | 3,416,742                   | 327,175        |
|   | Capital work in progress | 5.2  | 3,235,725                   |                |
| ÷ |                          |      | 6,652,467                   | 327,175        |

-10-

5.1 Operating fixed assets

| Operating fixed assets           | Furniture and fixture                  | Computer<br>equipment         | Electrical<br>equipment | Motor<br>vehicles                      | General<br>equipment                   | Total     |
|----------------------------------|--|-------------------------------|-------------------------|--|--|-----------|
| An 14 Parts - 47 1994            |  |                               | Rupees                  |  |  |           |
| As at September 17, 2021<br>Cost |  | -                             |                         | -                                      | -                                      | -         |
| Accumulated depreciation         | -                                      | • –                           | -                       | •                                      | -                                      | -         |
| let book value                   |  |                               | ······                  |  |  | •         |
| 'ear ended June 30, 2022         |  |                               |                         |  |  |           |
| pening net book value            | •                                      | •                             | -                       | -                                      | -                                      | -         |
| dditions                         | 48,500                                 | 136,120                       | 38,700                  | 108,900                                | 10,000                                 | 342,220   |
| lisposals                        |  |                               |                         |  | ······································ | ·······   |
| Cost<br>Accumulated depreciation |  | - ((                          | - []                    | - [[                                   | • [[                                   | -         |
| Accumulated depreciation         |  | l                             | l                       | الــــــــــــــــــــــــــــــــــــ | <u>-</u> L                             |           |
| isposals                         |  |                               |                         |  |  |           |
| Cost                             |  | · · · ·                       | • }                     | -                                      |  |           |
| Accumulated depreciation         |  | l                             | i                       |  |  | <u> </u>  |
| otraciation about                | -                                      | -                             | -                       | •                                      | •                                      | -         |
| epreciation charge               | (1,213)                                | (9,459)                       | (1,401)                 | (2,723)                                | (250)                                  | (15,045)  |
| et book value                    | 47,288                                 | 126,661                       | 37,299                  | 106,178                                | 9,750                                  | 327,175   |
| s at July 1, 2022                |  |                               |                         |  |  |           |
| Cost                             | 48,500                                 | 136,120                       | 38,700                  | 108,900                                | 10,000                                 | 342,220   |
| ocumulated depreciation          | (1,213)                                | (9,459)                       | (1,401)                 | (2,723)                                | (250)                                  | (15,045)  |
| let book value                   | 47,288                                 | 126,661                       | 37,299                  | 106,178                                | 9,750                                  | 327,175   |
| ear ended June 30, 2023          |  |                               |                         |  |  |           |
| pening net book value            | 47,288                                 | 126,661                       | 37,299                  | 106,178                                | 9,750                                  | 327,175   |
| dditions<br>isposals             | 816,013                                | 1,766,100                     | -                       | **                                     | 834,170                                | 3,416,283 |
| Cost                             | [                                      |                               | r                       |  |  |           |
| Accumulated depreciation         |  | -                             | -                       |  |  | -         |
| Net book value                   | ······································ |                               |                         |  |  | •         |
| epreciation charge               | (21,506)                               | (241,744)                     | (11,290)                | (16,127)                               | (36,049)                               | (326,716) |
| et book value                    | 841,795                                | 1,651,017                     | 26,009                  | 90,051                                 | 807.871                                | 3,416,742 |
| ost                              | 864,513                                |                               |                         |  |  | 3,758,503 |
| counulated depreciation          | (22,7 <u>19)</u>                       | 1,902,220                     | 38,700                  | 108,900                                | 844,170                                | (341.761) |
| losing net book amount           | <u> </u>                               | <u>(251,203)</u><br>1,651,017 | (12,691)<br>26,009      | ( <u>18,850)</u> _<br>90,051           | (36,299)                               | 3,416,742 |
| Innual rate of depreciation %    | 15%                                    | 30%                           | 30%                     | 15%                                    | 30%                                    |           |



**CS** CamScanner

-----

|   |      |   | 2023<br>Rupees                               | 2022<br>Rupees      |
|---|------|---|--|---------------------|
| 5 | .2   | CAPITAL WORK-IN-PROGRESS  |  | (Restated)          |
|   |      | Balance at beginning of the year<br>Additions during the year   | 3,235,725<br>3,235,725                       | -<br>               |
| 6 | ;    | Long term deposits  |  |                     |
|   |      | This represent security deposit paid to vendor in respect of fuel purchases.  |  |                     |
| _ | _    |   | 2023<br>Rupees                               | 2022<br>Rupees      |
|   | 7    | STOCK IN TRADE  |  |                     |
| - |      | Solar panel<br>Inverter<br>Wire   | 42,217,630<br>31,439,322<br><u>6,985,811</u> | 201,481             |
|   |      |   | 80,642,763                                   | 201,481             |
|   | 8    | TRADE AND OTHER RECEIVABLE  |  |                     |
|   |      | Trade receivable - unsecured<br>Retention money - unsecured<br>Capital subscribed by the National Radio Telecommunication | 26,737,021<br>13,505,874                     | 4,176,881<br>-      |
|   |      | Corporation<br>Less: Impairment loss on trade debts   | -  | 7,500,000           |
|   |      |   | 40,242,894                                   | 11,676,881          |
|   | 9    | ADVANCES  |  |                     |
| - |      | Advances - considered good  |  |                     |
|   |      | - against business expenses   | 569,474                                      | 71,912              |
| _ |      | - to suppliers<br>- to employees - secured  | 190,000<br>1,120,139                         | 8,602,738<br>58,000 |
| 1 |      | Others  | 408,299                                      |                     |
| - |      |   | 2,287,912                                    | 8,732,650           |
| P | ) 10 | SALES TAX REFUNDABLE-NET<br>This mainly includes the sales tax paid for the purchase of batteries and                     | invotor ota                                  |                     |
| _ |      | This many mondees the sales tax paid for the parenase of ballenes and   | inventer etc.                                |                     |
|   | 11   | PREPAYMENTS   | 2023<br>Rupees                               | 2022<br>Rupees      |
|   |      | Insurance premium   | 400,473                                      | -                   |
| 1 |      | 50,772L   |  |                     |
| ] |      |   | AGIES (AL                                    | 8                   |

]

]

| 11 | PREPAYMENTS       | 2023<br>Rupees | 2022<br>Rupees |
|----|-------------------|----------------|----------------|
|    | Insurance premium | 400,473        | -              |





|      |                              |                |   | 2023<br>Rupees           | 2022<br>Rupees     |
|------|------------------------------|----------------|---|--------------------------|--------------------|
| 12   | CASH AND BAN                 |                | <b>B</b>  | ·                        |                    |
|      | With Bank<br>Current account | - local currer | псу   | 100,136,060              | 1,006              |
|      | Cash in hand                 |                |   | 217,033<br>100,353,093   | 272,453<br>273,459 |
| 13   | SHARE CAPITAL                |                |   |                          |                    |
| 13.1 | Authorized share             | e capital      |   |                          |                    |
|      | 100,000 (2022: 1)<br>each    | 00,000) ordin  | ary shares of Rs. 100                                     | <u>    10,000,000   </u> | 10,000,000         |
| 13.2 | Issued and subs              | cribed capit   | al  |                          |                    |
|      | 2023                         | 2022           |   | 2023                     | (Restated)<br>2022 |
|      | Number                       | Number         | Ordinary shares   | Rupees                   | Rupees             |
|      | 100,000                      | 100,000        | Ordinary shares of Rs. 100 each<br>paid / payable in cash | 10,000,000               | 10,000,000         |
|      | 100,000                      | 100,000        | -   | 10,000,000               | 10,000,000         |
| 13.3 | Paid up capital              |                |   |                          |                    |
|      | 100,000 (2022: 2             | 5,000) ordina  | ary shares of Rs. 100                                     | 10,000,000               | 2,500,000          |

- each paid in cash
- 13.3.1 National RadioTelecommunication Corporation (NRTC), holds 75,000 (2022: 75,000) and Onsun (Private) Limited, holds 25,000 (2022: 25,000) ordinary shares of the Company at the year end.
- 13.3.2 All ordinary shares rank equally with regard to the Company's residual assets. Holders of these shares are entitled to dividends as declared from time to time and are entitled to one vote per share at general meetings of the Company.
  SUFFL





|      |   |                                    | 2023<br>Rupees                     | 2022<br>Rupees                      |
|------|---|------------------------------------|------------------------------------|-------------------------------------|
| 14   | DEFERRED TAX LIABILITIES                    |                                    | <u> </u>                           | 13,442                              |
| 14.1 | The movement in deferred tax is as follows: |                                    |                                    |                                     |
|      | 2023  | Opening<br>Balance as<br>on July 1 | Recognized<br>in profit or<br>loss | Closing<br>balance as on<br>June 30 |
|      | Taxable temporary difference                |                                    | Rupees                             |                                     |
|      | Property and equipment                      | <u> </u>                           | 151,400<br>151,400                 | <u> </u>                            |
|      | 2022  |                                    |                                    |                                     |
|      | Taxable temporary difference                |                                    |                                    |                                     |
|      | Property and equipment                      | -                                  | 13,442                             | 13,442                              |
|      |   |                                    | 13,442                             | 13,442                              |

14.2 Deffered tax assest, the potential tax benefit of which amounts Rs 12,376,266 has not been recognized on balance representing tax credits as at June 30, 2023 as utilization of these tax credit is not certain. The tax losses and tax credits expire on follows:

|                                   | Tax year | Amount     |
|-----------------------------------|----------|------------|
| Tax credit related to minimum tax | 2026     | 5,733,384  |
| Business losses                   | 2028     | 6,491,482  |
|                                   |          | 12,224,866 |

## 15 LOAN FROM ONSUN PVT LTD - UNSECURED

This represents the amount received from Onsun (Pvt) Ltd, the associate, in order to meet the working capital requirements of the Company. The loan is unsecured, interest free and payable on demand.

| 16 | TRADE AND OTHER PAYABLES   | 2023<br>Rupees | 2022<br>Rupees<br>(Restated) |
|----|----------------------------|----------------|------------------------------|
|    | Creditors                  | 142,293,827    | 11,084,445                   |
|    | Salaries and wages payable | 166,000        | •                            |
|    | Withholding tax payable    | 4,017,945      | 189,412                      |
|    | Other liabilities          | 936,611        | 397,480                      |
|    |                            | 147,414,383    | 11,671,337                   |
|    |                            |                |                              |

## 17 CONTRACT LIABILITIES

This represents advances received from customers in the ordinary course of business.

| 18 | PROVISION FOR TAXATION  |   | 2023<br>Rupees                                 | 2022<br>Rupees                 |
|----|---|---|--|--------------------------------|
|    | Opening balance<br>Provision for taxation<br>Tax deducted at source | ACTC ENER<br>DIT ACTC ENER<br>DIT ACTC ENER<br>DIT ACTC | 381,567<br>5,733,384<br>(382,392)<br>5,732,559 | 466,692<br>(85,125)<br>381,567 |



| 19 | REVENUE - NET   | Note | 2023<br>Rupees             | 2022<br>Rupees  |
|----|---|------|----------------------------|-----------------|
|    | Revenue from contract with customers<br>Less: Sales tax |      | 460,736,789<br>(2,066,056) | 37,335,328<br>- |
|    |   |      | 458,670,733                | 37,335,328      |

**19.1** As at June 30, 2022, no contract liabilities were carried, ,no revenue has been recognised during the year which would have been carried from amongst the contract liabilities at the beginning of the year.

|      |                                |              |      | 2023         | 2022                |
|------|--------------------------------|--------------|------|--------------|---------------------|
|      |                                |              |      | Rupees       | Rupees              |
| 20   | COST OF SALES                  |              |      |              |                     |
|      | Cost of goods sold             |              | 20.1 | 403,667,830  | 24,611,505          |
|      | Civil work and other related a | expenses     | 20.1 | 13,844,255   | 1,844,611           |
|      | Salaries, wages and other be   |              |      | 5,577,600    | 879,955             |
|      |                                |              |      | 423,089,685  | 27,336,071          |
| 20.1 | Cost of goods sold             |              |      |              |                     |
|      | Add: Opening stock in t        | rade         |      | 201,481      | -                   |
|      | Purchased                      |              |      | 484,109,112  | 24, <b>8</b> 12,986 |
|      | Less: Closing stock in tra     | ade          | 7    | (80,642,763) | (201,481)           |
|      | Cost of goods sold             |              | ·    | 403,667,830  | 24,611,505          |
| 21   | SELLING AND DISTRIBUT          | ION EXPENSES |      |              |                     |
|      | Salaries, wages and other b    | enefits      |      | 7,168,600    | 1,130,961           |
|      | Advertisement and promotio     |              |      | 579,600      | 159,187             |
|      |                                |              |      | 7,748,200    | 1,290,148           |
| 22   | ADMINISTRATIVE EXPENS          | SES          |      |              |                     |
|      | Salaries, wages and other b    | enefits      |      | 18,427,502   | 2,907,232           |
|      | Utilities                      |              |      | 56,872       | 29,153              |
|      | Consultancy fee                |              |      | 1,355,825    | 600,000             |
|      | Rent, rate and taxes           |              |      | 802,553      | -                   |
|      | Printing, postage and station  | nery         |      | 541,351      | 105,239             |
|      | Travelling and Conveyance      |              |      | 5,456,589    | 947,412             |
|      | Legal and professional fees    |              |      | 42,140       | -                   |
|      | Health Insurance fee           |              |      | 110,457      | -                   |
|      | Entertainment expenses         |              |      | 2,927,598    | 251,350             |
|      | Commissions and fees           |              |      | 113,174      | 1,300,000           |
|      | Repair and maintenance ch      | arges        |      | 12,192,703   | 288,702             |
|      | Auditor's remuneration         |              | 22.1 | 700,000      | 225,000             |
|      | Freight charges                |              |      | 2,288,560    | 14,320              |
|      | IT Expenses                    |              |      | 656,313      | 57,631              |
|      | Insurance expenses             |              |      | 170,979      | -                   |
|      | Depreciation expense           |              |      | 326,716      | 15,045              |
|      | Miscelleneous expenses         |              |      | 4,059,090    | 823,524             |
|      | SA7760                         |              |      | 50,228,422   | 7,564,608           |
|      | Miscelleneous expenses         |              |      | 4,059,090    | 82                  |



CS CamScanner

-14-

ł

|      |  | Note | 2023<br>Rup <del>ees</del> | 2022<br>Rupees |
|------|--|------|----------------------------|----------------|
| 22.1 | Auditor's remuneration   |      |                            |                |
|      | Annual audit of standalone financial statements  |      | 550,000                    | 225,000        |
|      | Reporting on compliance of Public Sector<br>Companies (Corporate Governance Rules), 2013 |      | 100,000                    | -              |
|      | Out of pocket expenses   |      | 50,000                     | -              |
|      |  |      | 700,000                    | 225,000        |
| 23   | FINANCE COST   |      |                            |                |
|      | Bank charges   |      | 6,508                      | 2,233          |
| 24   | INCOME TAX EXPENSE   |      |                            |                |
|      | Current  |      |                            |                |
|      | For the year   |      | 5,733,384                  | 466,692        |
|      | Prior year   |      | · · ·                      |                |
|      |  |      | 5,733,384                  | 466.692        |
|      | Deferred tax expense   | 14.1 | 151,400                    | 13.442         |
|      |  |      | 5,884,784                  | 480,134        |
|      | Accounting (loss) / profit for the year  |      | (22,402,082)               | 1.142.268      |
|      | Applicable tax rate for companies (%)  |      | 29%                        | 2155           |
|      | Income tax at applicable rate  |      | (5,496,604)                | 239,876        |
|      | Income taxed at lower rate   |      | 5,733,384                  | 240.258        |
|      | Deferred tax not recognized  |      | 6,642,882                  | -              |
|      | Change of rate of tax  |      | 5,121                      |                |

## 25 CASH AND CASH EQUIVALENTS

Cash, cash equivalents (used for cash management purposes) include the following for the purposes of statement of cash flows.

|                        | Note | 2023        | 2022      |
|------------------------|------|-------------|-----------|
|                        |      | Rupees      | Rupees    |
| Cash and bank balances | 12 ' | 100,353,093 | 2.305,633 |



5,884,784

480,134



đ,

## 26 REMUNERATION OF CHIEF EXECUTIVE, DIRECTORS AND EXECUTIVES

The aggregate amounts recognized during the year on account of remuneration, including benefits and perquisites, are as follows:

|                         | Chief Ex  | ecutive | Executi     | ve   |
|-------------------------|-----------|---------|-------------|------|
|                         | 2023      | 2022    | 2023        | 2022 |
|                         |           | Rup     | ee <b>s</b> |      |
| Managerial remuneration | 5,302,964 | -       | 5,846,734   | -    |
| Bonus                   | 949,908   | -       | 888,595     | -    |
|                         | 6,252,872 |         | 6,735,329   | -    |
| Number of persons       | 1         | -       | 1           | -    |

26.1 Chief Executive and Executive are provided with Company rented cars.

26.2

6.2 No remuneration were paid to Chief Executive and directors in previous period.

## 27 FINANCIAL INSTRUMENTS - FAIR VALUES AND RISK MANAGEMENT

Fair value is the amount that would be received on sale of an asset or paid on transfer of a liability in an orderly transaction between market participants at the measurement date. Consequently, differences can arise between carrying values and fair value estimates. Underlying the definition of fair value is the presumption that the Company is a going concern without any intention or requirement to curtail materially the scale of its operations or to undertake a transaction on adverse terms.

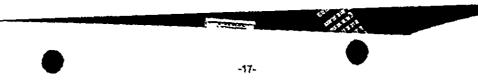
The fair value of financial assets and liabilities traded in active markets i.e. listed equity shares are based on the quoted market prices at the close of trading on the period end date. The quoted market prices used for financial assets held by the Company is current bid price. A financial instrument is regarded as quoted in an active market if quoted prices are readily and regularly available from an exchange, dealer, broker, industry group, pricing service or regulatory agency, and those prices represent actual and regularly occurring market transactions on an arm's length basis.

IFRS 13 'Fair Value Measurements' requires the Company to classify fair value measurements using a fair value hierarchy that reflects the significance of the inputs used in making the measurements. The fair value hierarchy has the following levels:

- Quoted prices (unadjusted) in active markets for identical assets or liabilities (level 1).
- Inputs other than quoted prices included within level 1 that are observable for the asset or liability, either directly (that is, as prices) or indirectly (that is, derived from prices) (level 2).
- Inputs for the asset or liability that are not based on observable market data (that is, unobservable inputs) (level 3).







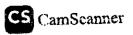
| The following table shows the carrying amounts and<br>On-balance sheet financial instruments | Note |                   | rying amount                          |             |          | Fair value  | Level 3 | Total      |
|--|------|-------------------|---------------------------------------|-------------|----------|-------------|---------|------------|
| As at June 30, 2023  | -    | Amortized<br>Cost | FVTPL                                 | Total       | Level 1  | Level 2     |         |            |
| Financial assets not measured at fair value  | -    |                   |                                       |             | Rupees   |             |         |            |
|  |      |                   |                                       |             | _        |             | 922,000 | 922,000    |
| Long term deposits   |      | _                 | 922,000                               |             |          | •           | 922,000 | 40,242,894 |
| Trade and other receivable   | 8    | 40,242,894        | 322,000                               | 922,000     | •        | 40,242,894  | -       | 100,353,09 |
| Cash and bank balances   | 12   | 100,353,093       | -                                     | 40,242,894  | •        | 100.353,093 |         | 141,517,98 |
|  |      | 140,595,987       | 922.000                               | 100,353,093 |          | 140,595,987 | 922,000 |            |
|  |      |                   |                                       | 141,317,307 |          |             |         |            |
| Financial liabilities not measured at fair value   |      |                   |                                       |             |          |             |         |            |
| Loan from Onsun Pvt Ltd - unsecured  | 15   | 10,650,654        |                                       | 10,650,654  |          | 10,650,654  | -       | 10,650,65  |
| Trade and other payables   | 16   | 147,414,383       | -                                     | 147,414,383 | -        | 147.414.383 | -       | 147,414,38 |
| Provision for taxation   | 18   | 5,732,559         | •                                     | 5,732,559   | -        | 5,732,559   | -       | 5,732,55   |
|  |      | 163,797,596       |                                       | 163,797,596 |          | 163,797,596 |         | 163,797,5  |
|  |      |                   |                                       |             |          |             |         |            |
| As at June 30, 2022  |      |                   |                                       |             |          |             |         |            |
| Financial assets not measured at fair value  |      |                   |                                       |             |          |             |         |            |
| Long term deposits   |      | -                 | 215,300                               | 215,300     | -        | -           | 215,300 | 215,30     |
| Trade and other receivable   | 8    | 11,676,881        | -                                     | 11,676,881  | -        | 11,676,881  | •       | 11,676,88  |
| Cash and bank balances   | 12   | 273,459           |                                       | 273,459     | <u>`</u> | 273,459     | -       | 273,45     |
|  |      | 11,950,340        | 215,300                               | 12,165,640  |          | 11,950,340  | 215,300 | 12,165,6   |
| Financial liabilities not measured at fair value   |      |                   |                                       |             |          |             |         |            |
| Loan from Onsun Pvt Ltd - unsecured  | 15   | 650,654           | -                                     | 650,654     | •        | 650,654     | -       | 850 6      |
| Trade and other payables   | 16   | 11,671,337        | -                                     | 11,671,337  | -        | 11,671,337  | -       | 650,6      |
| Provision for taxation   | 18   | 381,567           |                                       |             | <u>-</u> | 381,567     | -       | 11,671,3   |
|  | -    | 12,703,558        | · · · · · · · · · · · · · · · · · · · | 12,703,558  |          | 12,703,558  |         | 381,50     |

SAFFL



ſ





- 27.2 The Company has not disclosed the fair value for these financial assets and financial liabilities, as these are either short term in nature or repriced periodically. Therefore, their carrying amounts are a reasonable approximation of their fair values.
- 27.3 The Company has exposure to the credit risk, market risk and liquidity risk from its use of financial

The Board of Directors has overall responsibility for the establishment and oversight of the Company's risk management framework. The Board is also responsible for developing and monitoring the Company's risk management policies.

## 27.4 Credit risk

Credit risk is the risk of financial loss to the Company if a customer or counterparty to a financial instrument fails to meet its contractual obligations, and arises principally from trade debts, advances, deposits, other receivables, margin on letter of guarantee, short tern investments and bank balances. The carrying amount of financial assets represents the maximum credit exposure.

The Company's credit risk exposure is categorized under the following headings:

#### Trade debts and other receivables

The Company's exposure to credit risk is influenced mainly by the individual characteristics of each customers. The Company has established a credit policy under which each new customer is analyzed individually for creditworthiness before the Company's standard payment terms and conditions are offered. Credit limits are established for each customer, which are regularly reviewed and approved by the management. Customers that fail to meet the Company's benchmark creditworthiness may transact with the Company only on a prepayment basis.

## Concentration of credit risk

Geographically there is no concentration of credit risk. The maximum exposure to credit risk for financial assets at the reporting date by type of counter party is as follows:

|                                  | 2023        | 2022    |
|----------------------------------|-------------|---------|
|                                  | Rupees      | Rupees  |
| Banks and financial institutions | 100,136,060 | 1,006   |
| Others                           | 217,033     | 272,453 |
|                                  | 100,353,093 | 273,459 |

#### Credit quality of financial assets

The credit quality of the Company's financial assets have been assessed below by reference to external credit rating of counterparties determined by the VIS Credit Rating Company Limited (formerly JCR - VIS Credit Rating Company Limited). The counterparties for which external credit ratings were not available have been assessed by reference to internal credit ratings determined based on their historical information for any default in meeting their obligations.

| Trade receivables  | 2023<br>Rupees | 2022<br>Rupees |
|--|----------------|----------------|
| Counterparties without external credit ratings with no default in the past |                | 11,676,881     |





### Impairment loss

The aging of trade debts at the reporting date was:

|                      | 2023       |            | 20        | 22         |
|----------------------|------------|------------|-----------|------------|
|                      | Gross      | Impairment | Gross     | Impairment |
|                      | Ruj        | Dees       | Rup       | ees        |
| Past due 1-30 days   | 8,011,000  |            | 1,726,881 |            |
| Past due 31-60 days  | •          | -          | 900,000   | •          |
| Past due 61-90 days  | 15,712,821 | -          | 1,550,000 | •          |
| Past due 91-120 days | •          | -          | •         | -          |
| Over 120 days        | 3,013,200  | -          | •         | -          |
|                      | 26,737,021 | -          | 4,176,881 |            |

Based on past experience, the management believes that no impairment allowance is necessary in respect of carrying amount of trade debts. The Company expects no material expected credit loss under IFRS 9 'Financial Instruments' on trade debts at the year end.

The allowance account in respect of trade debts is used to record impairment losses unless the Company is satisfied that no recovery of the amount owing is possible at which point the amount considered irrecoverable is written off against the financial asset directly.

#### Exposure to credit risk

The carrying amount of financial assets represents the maximum credit exposure. The maximum exposure to credit risk at the reporting date was:

|                            | Note | 2023<br>Rupees | 2022<br>Rupees |
|----------------------------|------|----------------|----------------|
| Long term deposits         |      | 922,000        | 215,300        |
| Trade and other receivable | 8    | 40,242,894     | 11,676,881     |
| Bank balances              | 12   | 100,136,060    | 1,006          |
|                            |      | 141,300,954    | 11,893,187     |

Geographically there is no concentration of credit risk.

The maximum exposure to credit risk for trade debts at the reporting date is with end - user customers and represents debtors within the country.

The Company's most significant customer is an end user from whom Rs. 11,943,440 (2022: Rs. 1,400,000) was outstanding and which is included in total carrying amount of trade debtors as at June 30, 2023.

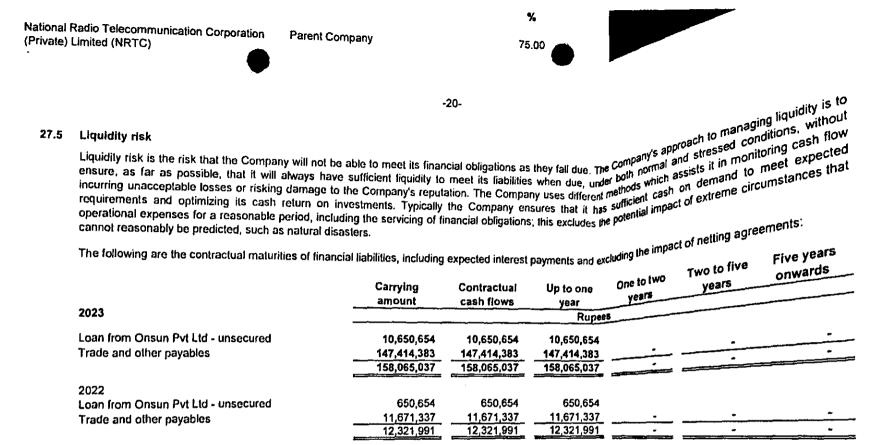
The Company limits its exposure to credit risk by placing funds with banks that have high credit rating. Management actively monitors credit ratings and given that the Company only has placed funds in the banks and financial institutions with high credit ratings, management does not expect any counter party to fail to meet its obligations.

| Long torm deposite  |                         |                     |                      | 2023<br>Rupees | 2022<br>Rupees |
|---|-------------------------|---------------------|----------------------|----------------|----------------|
| Long term deposits<br>Counterparties without externa          | al credit ratings       |                     |                      | 922,000        | 215,300        |
| Trade and other receivables<br>Counterparties without externa |                         |                     |                      | 40,242,894     | 11,676,881     |
| Bank balances   | Credit rating<br>agency | Long term<br>rating | Short term<br>rating |                |                |
| Meezan Bank Limited   | VIS                     | AAA                 | A-1+                 | 100,136,060    | 1,006          |





S CamScanner



It is not expected that the cash flows included in the maturity analysis could occur significantly earlier or at significantly different amounts.

### 27.6 Markot risk

Markot risk Market risk is the risk that the value of the financial instrument may fluctuate as a result of changes in market interest rates or the market price due to change in credit rating of the issuer or the instruments' supply and demand of securities and liquidity in the market. The Company is not exposed to any market risk.







## 28 RELATED PARTY TRANSACTIONS AND BALANCES

Related parties comprise of directors, entities over which the directors are able to exercise significant influence, entities with common directors, major shareholders and key management personnel which include Chief Executive Officer (CEO), Chief Operating officer (COO) and Chief Financial Officer (CFO).

| Related party  | Basis of relationship | Percentage of<br>shareholding<br>% |
|--|-----------------------|------------------------------------|
| National Radio Telecommunication Corporation<br>(Private) Limited (NRTC) | Parent Company        | 75.00                              |
| Onsun (Private) Limited  | Associated Company    | 25.00                              |

Balances and transactions with related parties are disclosed in notes to the financial statements. Transactions and balances with related parties other than those disclosed elsewhere in these financial statements are as follows:

| Transactions and balances with related parties                        | 2023<br>Rupees          | 2022<br>Rupees         |
|---|-------------------------|------------------------|
| National Radio Telecommunication Corporation (Private) Limited (NRTC) |                         |                        |
| - Investment<br>- Sale  | 7,500,000<br>89,295,960 | -                      |
| Onsun (Private) Limited   |                         |                        |
| <ul> <li>Loan received</li> <li>Loan repayment</li> </ul>             | 10,530,000<br>530,000   | 2,435,654<br>1,785,000 |
| Others  |                         |                        |
|   |                         |                        |

- Remuneration to key management personnel (other than Chief Executive) 6,735,329

## **RESTATEMENT OF PRIOR YEAR FINANCIAL STATEMENTS**

In accordance with the requirements of IFRS 9 "Financial Instruments" "advances" and "Trade and other payables" were understated by Rs 8,602,738 respectively. These have been adjusted retrospectively and prior period financial have been restated. The effects of the restatement are summarized below:

| Statement of financial position                     | 2022<br>Rupees           |
|---|--------------------------|
| Assets and liabilities<br>Increase / (decrease) in: |                          |
| Advances<br>Trade and other payables                | 8,602,738<br>(8,602,738) |
| SARTHE.   | SES (PL)                 |
|   |                          |





₹4

### 30 CORRESPONDING FIGURES

ا ع**اد** 

Corresponding figures have been reclassified as per the details given below to reflect more appropriate presentation of the related transactions in the financial statements. These reclassifications have no effect on previously reported net income or shareholders' equity.

| From  | То                                     | Rupees          |
|---|--|-----------------|
| Administrative expenses   | Selling and distribution expenses      | 1,290,148       |
| Administrative expenses   | Cost of sales                          | 879,955         |
| Advances, deposits and prepayments -<br>Securities - Current assets | Long term deposit - Non-Current assets | 215,300         |
| Advances, deposits and prepayments - Sales tax refundable           | Sale tax refundable                    | 1,952,187       |
| Accrued and other liabilities                                       | Trade and other payable                | 811,892         |
|   | 2023<br>Numbers                        | 2022<br>Numbers |

## 31 Number of persons employed

| Total employees of the Company at year end       | 31 | 23 |
|--|----|----|
| Average employees of the Company during the year | 25 | 15 |

## 32 DATE OF AUTHORISATION OF FINANCIAL STATEMENTS

These financial statements were authorized for issue by the Board of Directors of the Company in their meeting held on \_\_\_\_\_\_

302721.

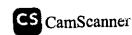
م بر ۱

CHIEF EXECUTIVE OFFICER

ivector

Cheit Etecutie attices





311



A Premium Energy Brand

# **Company Profile**





## National Radio and Telecom Corporation (NRTC)

►NRTC is a Federal Govt entity of Ministry of Defence Production (MoDP)

- Established in 1965
- Local Offices: Haripur, Isb, Rwp, Lhr, Pswr, Qta, Khi, Multan, Turbat
- Intl Offices: UAE and KSA
- Radar, Communication Equipment, Jammer, EW, IT Eqpt, NW Eqpt, Renewable Energy, Security & Surveillance/ Safe Cities





# **NRTC ENERGIES**



**Established as a dedicated division to deal in energy and power projects** 

□ Subsidiary of NRTC

## Services

- Utility Scale Solar System
- Commercial and Industrial Scales
- Residential Solar System
- Solar Water Pump
- > Car Parking Solar sheds
- Solar Street Lights
- Solar Parks
- Building Electrifications

- Mini Grid Stations
- Supply and Installation of Generations & Transformers
- Energy Audis
- Power Purchase Agreements
- Energy Selling Model
- Leasing/Financing Support
- Designing and Consultancy Services





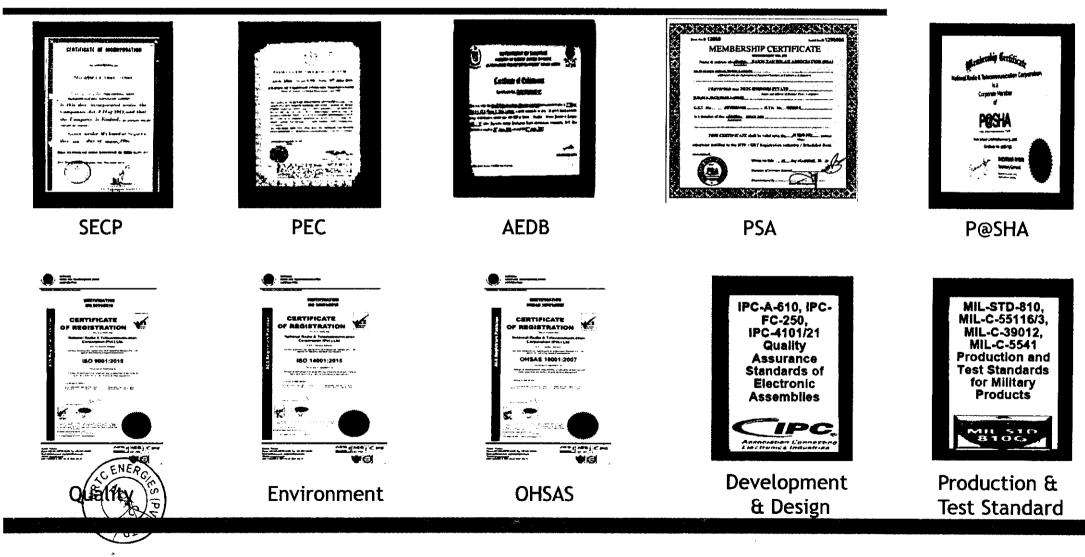


# **REGISTRATIONS / CERTIFICATIONS -**

| CECD                                     |   |  |  |
|--|---|--|--|
| SECP                                     |   |  |  |
| Security Exchange Commission of Pakistan |   |  |  |
| PEC                                      | C-A   | No Limit   |  |
| (Pakistan Engineering Council)           | ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~   |  |  |
| AEDB C-1                                 |   | Upto 1 MW Net-Metering   |  |
|  |   |  |  |
|  |   |  |  |
| · · · · · · · · · · · · · · · · · · ·    |   | ······································   |  |
|  |   |  |  |
| Quality Assurance                        | ISO 9001-2015   |  |  |
| Environmental Assurance                  | ISO 14001-2015  |  |  |
| OHSAS                                    | OHSAS 18001-2007  |  |  |
| Development & Design                     | IPC-A-610, IPC-FC-250, IPC-4101/21  |  |  |
| Production & Test Standard               | MIL-STD-810, MIL-C-55116/3, MIL-C-39012, MIL-C-5541   |  |  |
|  | PEC<br>(Pakistan Engineering Council)<br>AEDB<br>(Alternate Energy Development Board)<br>PSA<br>Pakistan Solar Association<br>P@SHA<br>Pakistan Software House Association<br>Quality Assurance<br>Environmental Assurance<br>OHSAS<br>Development & Design | PEC<br>(Pakistan Engineering Council)       C-A         AEDB<br>(Alternate Energy Development Board)       C-1         PSA<br>Pakistan Solar Association       PSA         Pakistan Solar Association       P@SHA         Quality Assurance       ISO 9001-2015         Environmental Assurance       ISO 14001-2015         OHSAS       OHSAS 18001-2007         Development & Design       IPC-A-610, IPC-FC-250, IPC-A-610 |  |

# **REGISTRATION & CERTIFICATIONS**



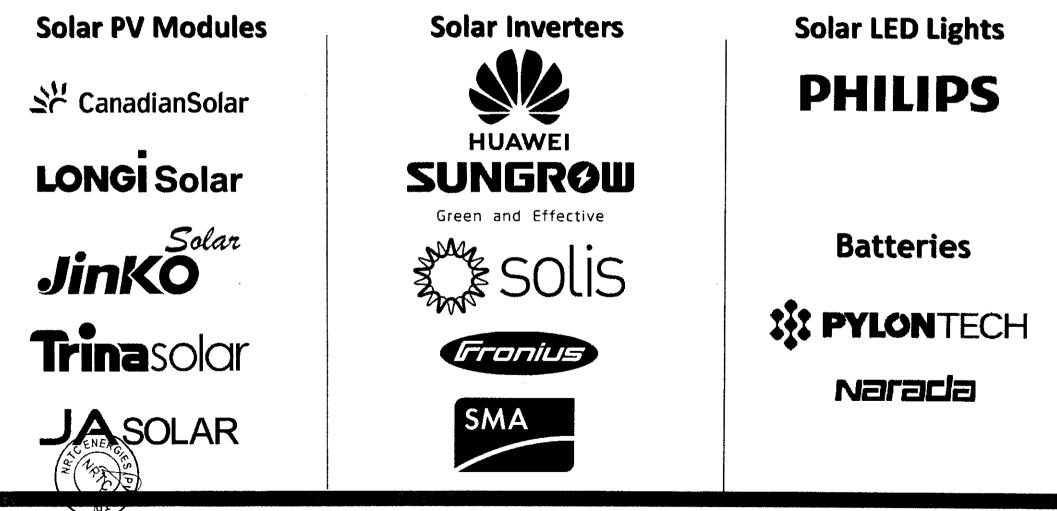


# **BUSINESS PARTNERS**



## **BUSINESS PARTNERS**

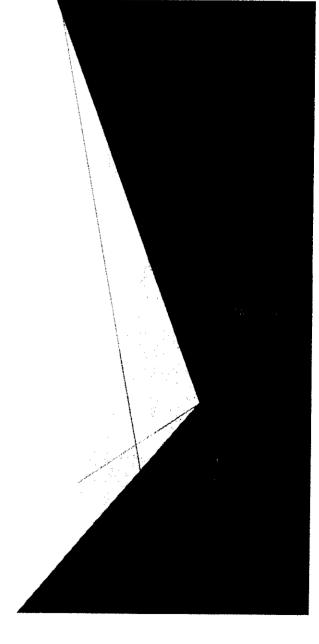




# CLIENTS & PROJECTS

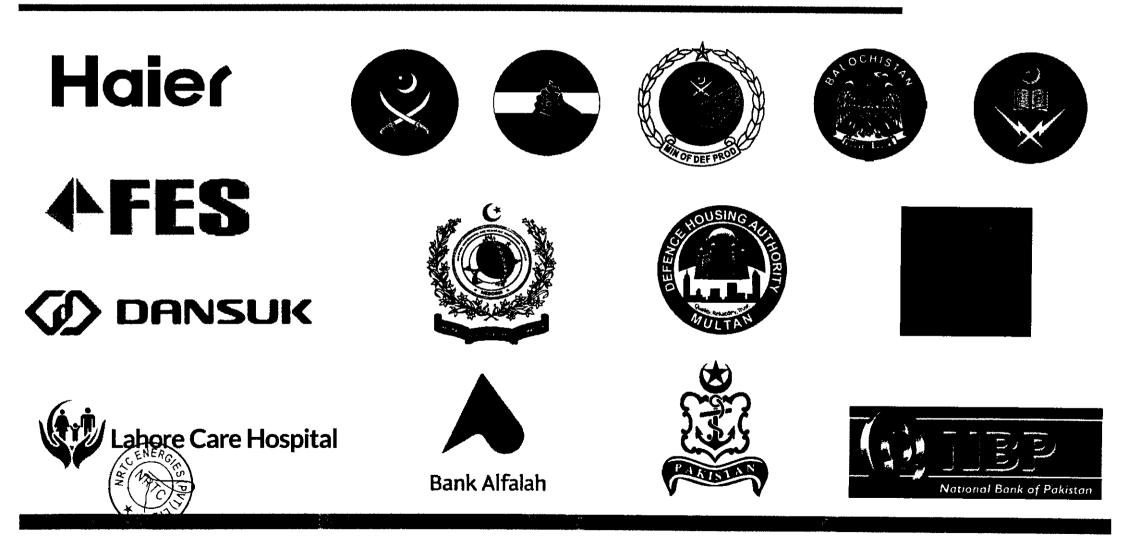


9



Clients





# WHY NRTC ENERGIES





# WHY NRTC ENERGIES

- Highly trained Engineers / Professional Staff
- Regional Offices
- Strategic relationship with all major OEMs/ brands
- Premium Quality Equipment
- > Wears both hats govt and corporate
- Speedy installation and net-metering services





## **NRTC ENERGIES BENEFITS**



➢ 0&M

 $\geq$ 

- FOC for 2 Yrs. (Extendable up to entire project life)
- Direct OEM (Extended Warranties)
- Performance Warranties Undertakings supported by simulations & software reports
- Documentary proof/ evidence furnishing authenticity & genuineness of eqpt / products
- On-site spares
- In-situ technical teams

**Product Warranties** 

- NOC
- SLA / FOC Training

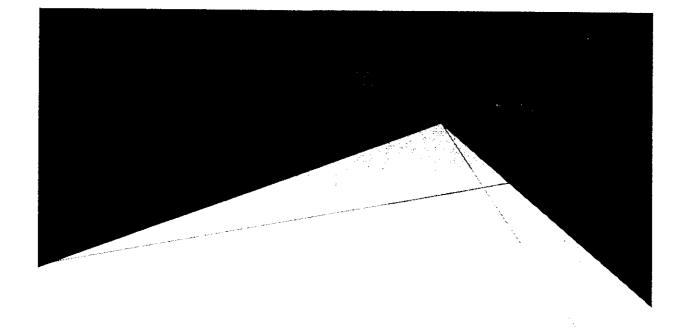


## **NRTC** Energies

# **NRTC ENERGIES**

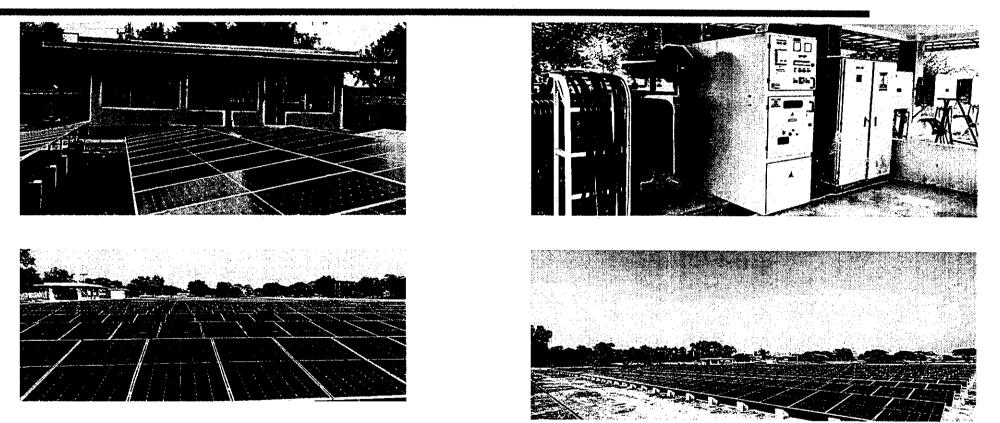
- Utility / Commercial / Industrial Scales
- Power Purchase Agreements
- Residential / Offices/ Mosques Solar System / DHA Housing Schemes / Villas
- Car Parking Solar Sheds
- Solar Parks
- Solar Water Pump
- Solar Street Lights
- Building Electrifications
- Mini Grid Stations Supply and Installation of Generations & Transformers
- Energy Audits / Designing / Consultancy Services





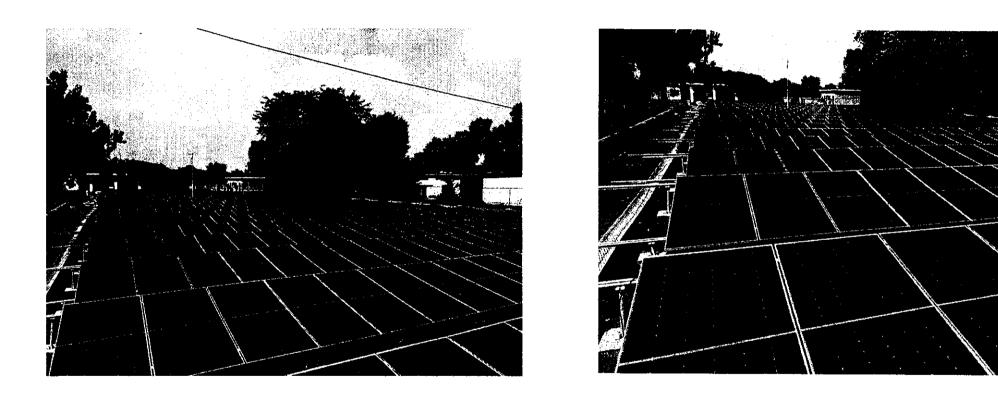






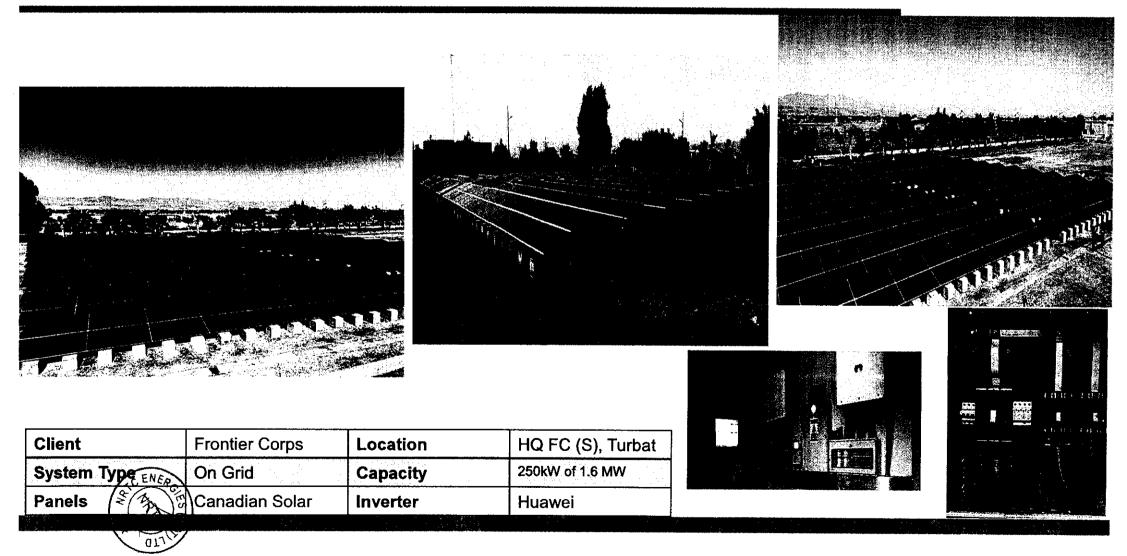
| Client         | 4 Corps        | Location | New Mazhar Line, Cantt, Lahore |
|----------------|----------------|----------|--------------------------------|
| System Type    | On Grid        | Capacity | 1.0 MW                         |
| Panels C ENERG | Canadian Solar | Inverter | Huawei                         |
|                |                |          |                                |





| Client             | 4 Corps           | Location | Chitral Lines, Cantt, Lahore |  |
|--------------------|-------------------|----------|------------------------------|--|
| System Type, ENERC | On Grid           | Capacity | 0.5 MW                       |  |
| Panels (*          | Canadian Bifacial | Inverter | Huawei                       |  |
|                    |                   |          |                              |  |

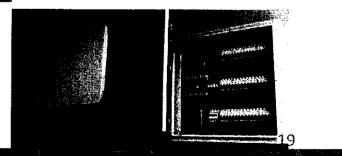




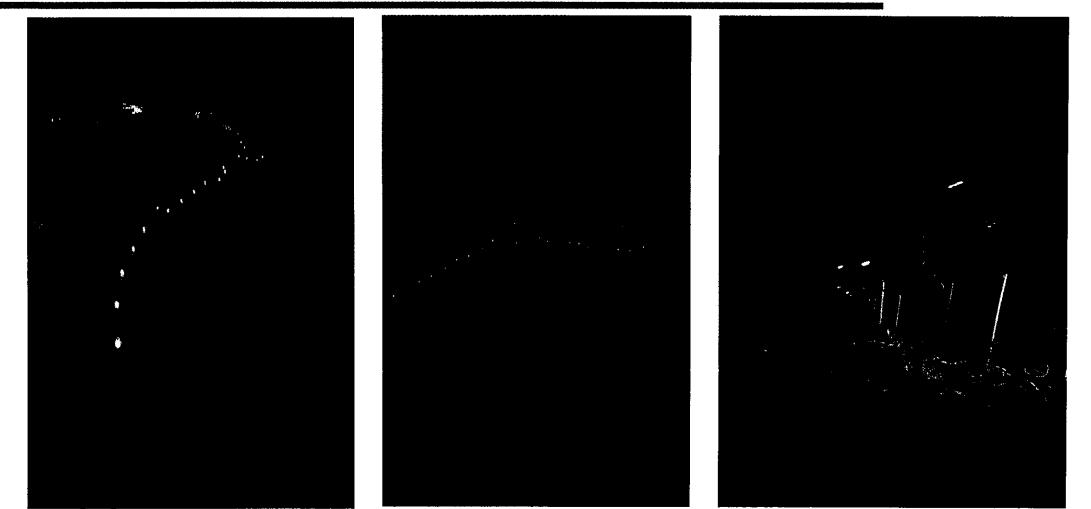




| Client           | Haier Pakistan  | Location | Zalmi House, Raiwind   |
|------------------|-----------------|----------|--|
| System Type ENER | On Grid         | Capacity | 320 kW   |
| Panels (*()*     | ∯¢anadian Solar | Inverter | Huawei   |
|                  |                 |          | tradition of the second s |

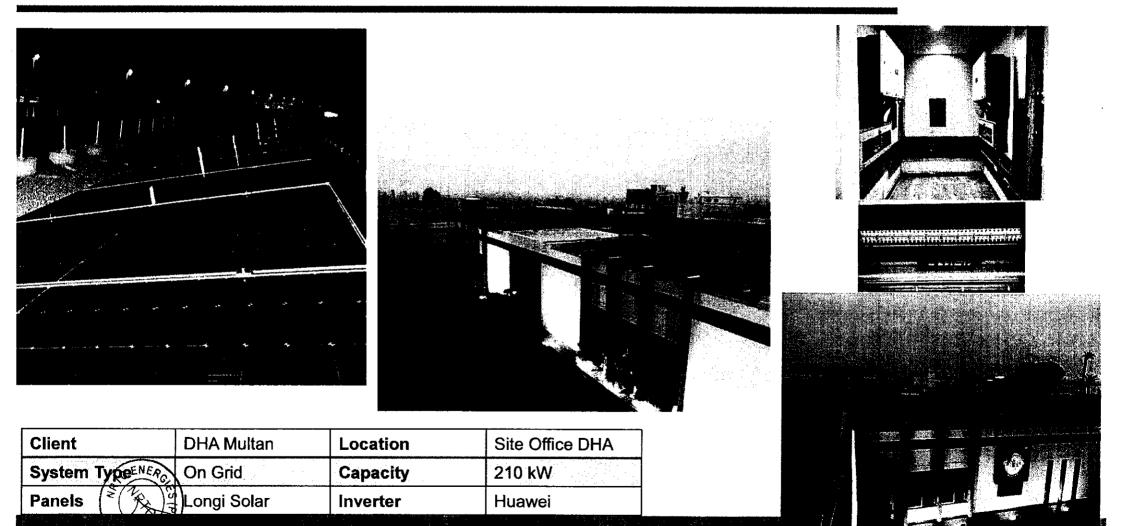




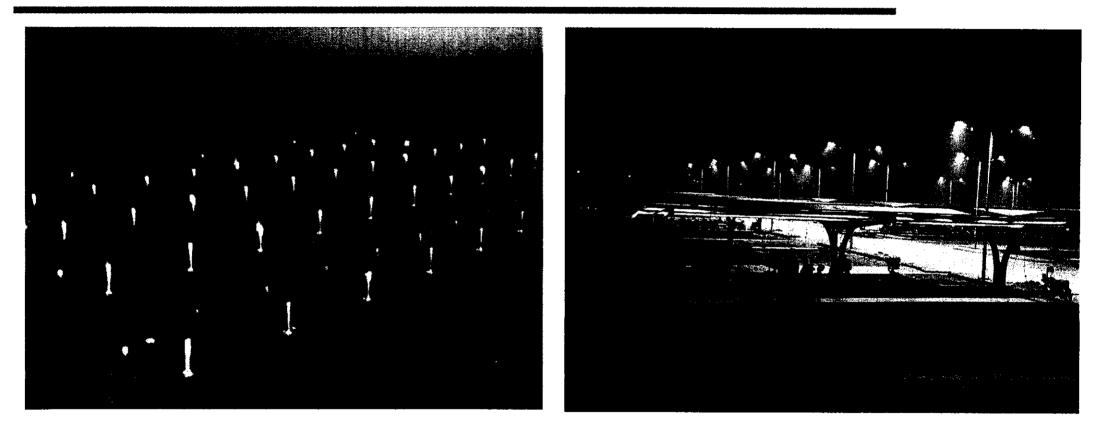












| Client      | DHA Multan     | Location | Romanza Golf Club |  |
|-------------|----------------|----------|-------------------|--|
| System Type | On Grid        | Capacity | 430 kW of 1.2 MW  |  |
| Panels      | Canadian Solar | Inverter | Huawei            |  |
| * 01712     |                |          |                   |  |

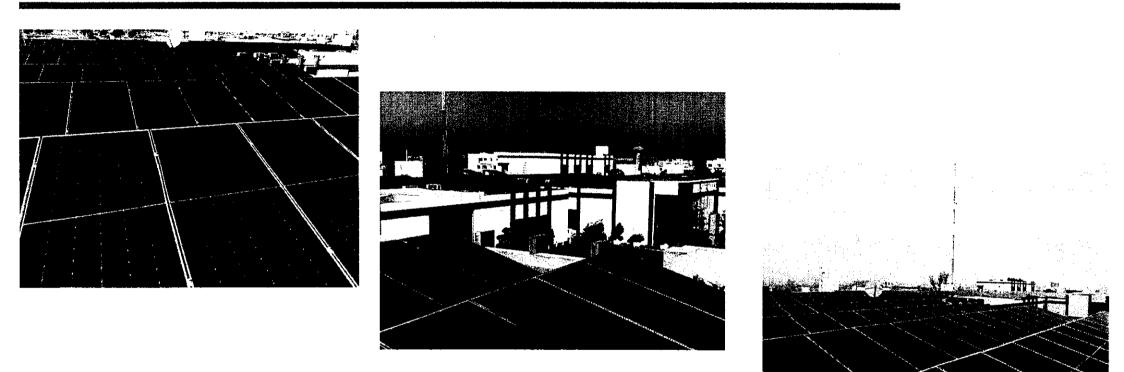


23



| Client      | DHA Multan     | Location | Romanza Golf Club |
|-------------|----------------|----------|-------------------|
| System Type | On Grid        | Capacity | 430 kW of 1.2 MW  |
| Panels      | Canadian Solar | Inverter | Huawei            |
| C Tory      |                |          |                   |



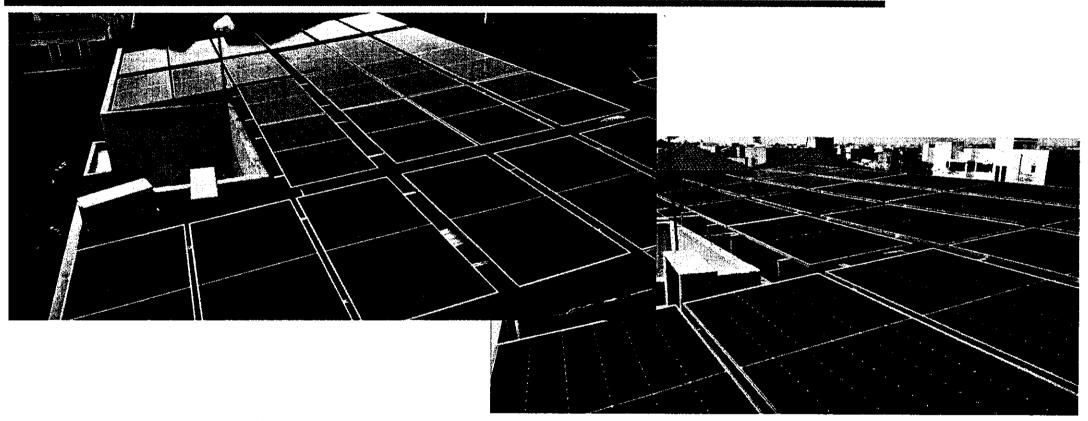


| Client      | DHA Multan     | Location | Site Office DHA |    |
|-------------|----------------|----------|-----------------|----|
| System Type | On Grid        | Capacity | 465             |    |
| Panels      | Canadian Solar | Inverter | Huawei          | 24 |
| 01711       |                |          |                 |    |

UN

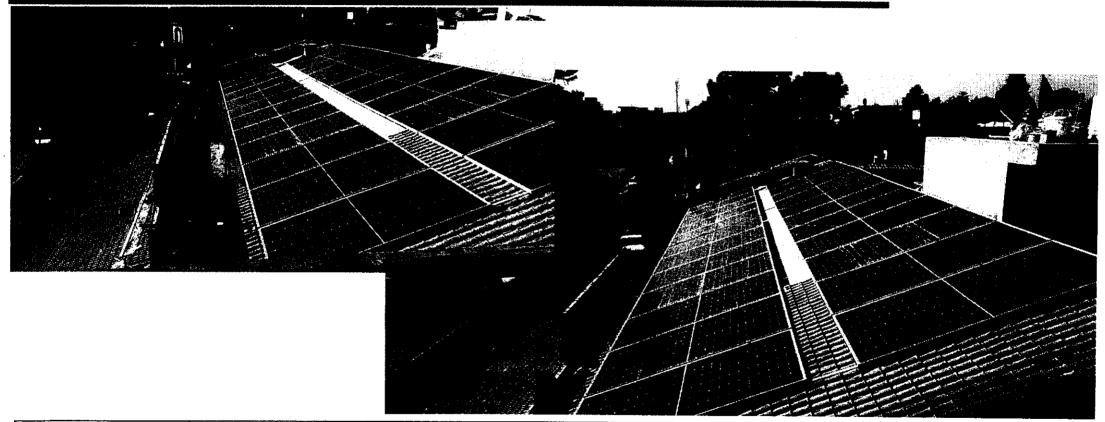


25



| Client      | DHA Lahore  | Location | Phase 8 |  |
|-------------|---|----------|---------|--|
| System Type | On Grid   | Capacity |         |  |
| Panels      | Canadian Solar  | Inverter | Huawei  |  |
|             | and the second secon |          |         |  |





| Capacity |          |  |
|----------|----------|--|
|          |          |  |
| Inverter | Huawei   |  |
|          |          |  |
|          | Inverter |  |





Solar Office: 72 Block, Maulana Shaukat Ali Rd, Quaid e Azam Industrial Estate, Lahore - Pakistan

> Head Office: NRTC, Haripur - Pakistan

PTCL : 042-5117304 Info@nrtcenergies.com.pk www.nrtcenergies.com.pk



#### PAGE1

THE COMPANIES ACT, 2017 THE COMPANIES (GENERAL PROVISIONS AND FORMS) REGULATIONS, 2018 [Section 197 and Regulations 4 and 20] PARTICULARS OF DIRECTORS AND OFFICERS, INCLUDING THE CHIEF EXECUTIVE, SECRETARY, CHIEF FINANCIAL OFFICER, AUDITORS AND LEGAL ADVISER OR OF

PART-

PART-I

| ा हा के अने २०१४ विद्युप्तिने ता राज्ये अभवते हो। देवे १४ | 出一些 \$P\$ \$P\$ \$P\$ \$P\$ \$P\$ \$P\$ \$P\$ \$P\$ \$P\$ \$P |              |        |
|---|---|--------------|--------|
| 1.1 CUIN (Incorporation Number)                           | 0184244   |              |        |
| 1.2 Name of Company                                       | NRTC ENERGIES (PRIVATE) LIMITED                               |              |        |
| 1.3 Fee Payment Details                                   |   |              |        |
| 1.3.1 Challan Number                                      | E-2022-1319269  | 1.3.2 Amount | 4000.0 |

2. Particulars\*:

2.1. New Appointment/Election

Nature of NIC No. or Date of Mode of Business Usual Residential directorship Father / Passport No. in Present Appointement / Present Name in Full Occupation<sup>1</sup> Designation Nationality case of Foreign sband Name Address ominee/indep Appointment change / any (a) (e) \* (if any) (1) (c) (d) ident/additional/ National or Change other remarks (g) other) (b) (h) (i) (i) 28/10/2022 Muhammad Gul House No. B-1, Pakistan Imran Gul 3420207444585 Chief Re Ghaznawi Street, Appointment / Executive Garrison Adiata Road RAWALPIND Punjab Pakistan 28/10/2022 H.No 284, Street No. 14 Township Chaudhary Director Pakistan Director Appointed / Nominee luhammad Asim 3520270242921 NRTC Muhammad haque Ishaque Sector A1, Lahore 4230177998571 Anjum Parvez 28/10/2022 Fiat No. 43-G, Director Pakistan Chief Elected / Nominee Jawad Anjum Askari 3, School Executive Officer Road, Karachi South 3420207444585 Muhammad Gul House No. B-1, Pakistan Director 28/10/2022 Elected / Nominee Directo: Imran Gul NRTC Ghaznawi Street, Garrison Adiala Road, Rawatpindi 28/10/2022 Auditor Appointed / 74-East , 2nd Floor, Pakistan A.F.Ferguson and Co. Auditor Blue Area, P.O Box Chartered Accountants 3021, Islamabad-44000, Pakistan

2.2. Ceasing of Officer/Retirement/Resignation

| Present Name in Ful<br>(a) | NIC No. or<br>Passport No. in<br>case of Foreign<br>National<br>(b) | Father /<br>Husband Name<br>(0) | Usual Residential<br>Address<br>(d)   | Designation<br>(e) | Nationality**<br>(1) | Business<br>Occupation**<br>* (if any)<br>(g) | Date of<br>Present<br>Appointment<br>or Change<br>(h) | Mode of<br>Appointement /<br>change / any<br>other remarks<br>(i) | Nature of<br>directorship<br>(nominee/indepe<br>ndent/additional/<br>other)<br>(j) |
|----------------------------|---|---------------------------------|---|--------------------|----------------------|---|---|---|--|
| Jawad Anjum                | 4230177998571   | Anjum Parvez                    | Flat No.43-G, Askari<br>3, School Road<br>KARACHI SOUTH<br>Sindh Pakistan<br>75530          | Director           | Pakistan             | Chief<br>Executive<br>Officer                 | 28/10/2022  | Retired /   |  |
| Imran Gul                  | 3420207444589   | Muhammad Gul                    | House No. B-1,<br>Ghaznawi Streel,<br>Garrison Adiala<br>Road RAWALPINDI<br>Punjab Pakistan | Director           | Pakistan             | Director<br>NRTC                              | 28/10/2022  | Retired /   |  |
| Tofique Ahmed              | 3420238740021   | Mubammad                        | Mohalia Cantt   | Director           | Pakistan             | Director                                      | 28/10/2022  | Resigned /  | <u> </u>   |



FORM 29

#### 10/23/23, 12:58 PM

| ·····                        |                   |   |          | IAUL     |  |            |            |      |
|------------------------------|-------------------|---|----------|----------|--|------------|------------|------|
| Tofique Ahmed 13420238740021 | Muhammad<br>Munir | Mohalia Cantt<br>Railway station,<br>Kharian GUJRAT<br>Punjab Pakistan<br>50070 | Director | Pakistan | Director<br>NRTC,<br>Director<br>NRTC (tech<br>(Pvt) Ltd | 28/10/2022 | Resigned / |      |
|                              |                   |   |          |          |  |            |            | <br> |

PACE1

2.3. Any other change in particulars relating to columns (a) to (g) above

|  | NIC No. or<br>Passport No. in<br>case of Foreign<br>National<br>(b) | Father /<br>Husband Name<br>(C) | Usual Residential<br>Address<br>(d) | Designation<br>(e) | Nationality**<br>(f) | Business<br>Occupation*<br>** (if any)<br>(g) | Appointment | Nature of<br>directorship<br>(nominee/indepen<br>dent/additional/oth<br>er) |
|--|---|---------------------------------|-------------------------------------|--------------------|----------------------|---|-------------|---|
|  |   |                                 |                                     |                    |                      |   |             |   |

\* In the case of a firm, the full name, address and above mentioned particulars of each partner, and the date on which each became a partner.

\*\* In case the nationality is not the nationality of origin, provide the nationality of origin as well.

\*\*\* Also provide particulars of other directorships or offices held, if any.".

\*\*\*\*\* In case of resignation of a director, the resignation letter and in case of removal of a director, member's resolution be attached

\*\*\*\*\* In case of a director nominated by a member or creditor the name of such nominating or appointing body shall also be mentioned in column (i), and a copy of resolution from the nominating or appointing body be attached.

#### **3.1 Declaration:**

3 Signature

PART-III

I do hereby solemnly, and sincerety declare that the information provided in the form is:
(i) true and correct to the best of my knowledge, in consonance with the record as maintained by the Company and nothing has been concealed and
(ii) hereby reported after complying with and fulfilling all requirements under the relevant provisions of law, rules, regulations, directives, circulars and notifications whichever is applicable.

2 Name of Authorized Officer with designation/ Authorized Intermediary

| imran Gul                          | Chief Executive |
|------------------------------------|-----------------|
| Electronically signed by Imran Gul |                 |
| 21/10/2023                         | ]               |
|                                    |                 |

3.4 Date (DD/MM/YYYY)

3.5 Registration No of Authorized Intermediary, if applicable



PAGE1

#### Form A THE COMPANIES ACT, 2017 THE COMPANIES (GENERAL PROVISIONS AND FORMS) REGULATIONS, 2018 [Soction 130(1) and Regulation 4] ANNUAL RETURN OF COMPANY HAVING SHARE CAPITAL

| PART | 4 |
|------|---|
|      |   |

(Please complete in typescript or in bold block capitals)

| 1.1 CUIN ( Registration Number)  | 0184244   |                                 |                              |  |
|--|---|---------------------------------|------------------------------|--|
| 1.2 Name of the Company  | NRTC ENERGIES (PRIVATE) LI                          | MITED                           |                              |  |
| 1.3 Fas payment details  | 1.3.1 Challen No E-2022-13                          | 19269 1.3.2. Amount             | 4000.0                       |  |
| 1.4 Form A made upto   | dd mm уууу<br>28/10/2022                            |                                 |                              |  |
| 1.5 Date of AGM  | 28/10/2022  |                                 |                              |  |
| Section A  | PART - H  |                                 |                              |  |
| 2.1 Registered Office Address  | , Nasralle, Unk Roed Mumtaz C<br>Ravalpindi, Punjeb | ity, Near leiemabad internation | hal Airport,                 |  |
| 2.2 Email Address  | imran.gui@nrtc.com.pk                               |                                 |                              |  |
| 2.3 Office Tel. No.  | 518431995   |                                 |                              |  |
| 2.4 Office Fax No.   |   |                                 |                              |  |
| 2.5 Principle line of business   | -ALTERNATE ENERGY                                   |                                 |                              |  |
| 2.6 Mobile No. of Authorized officer<br>(Chief Executive/Director/<br>Company Secretary/<br>Chief Finencial Officer) | 03145064833   |                                 |                              |  |
| 2.7 Authorized Share Capital   |   |                                 |                              |  |
| Classes and kinds of Shares  | No. of Shares                                       | Amount                          | Face Value                   |  |
| Ordinary Shares  |   | 10,000,000.00                   |                              |  |
|  |   |                                 |                              |  |
|  |   |                                 |                              |  |
| 2.8 Paid up Share Capital  |   |                                 |                              |  |
| Classes and kinds of Shares  | No. of Shares                                       | Amount                          | Face Value                   |  |
| Ordinary Shares  |   | 10.000,000.00                   |                              |  |
|  |   |                                 |                              |  |
|  |   |                                 |                              |  |
| 2.9 Particulars of the holding /subsidiary company, if any   |   |                                 |                              |  |
| Name of Company  |   | Holding/Subsidiary              | % Shares Held                |  |
| The National Radio Telecommunication (   | Corporation (Pvt) Ltd.                              |                                 | 75                           |  |
|  |   |                                 |                              |  |
| 2.10 Chief Executive   |   |                                 |                              |  |
| Name   | imren Gul   |                                 |                              |  |
| Address  |   |                                 |                              |  |
| runa opa   | House No. B-1, Ghaznawi Stree                       | t, Garrison Adiala Road RAWA    | LPINDI Punjab Pakisten 46606 |  |
|  | House No. B-1, Gheznawi Stree<br>3420207444589      | t, Garrison Adials Road RAWA    | LPINDI Punjab Pakisten 46606 |  |



| 2.11 Chief Financial Officer |   |
|------------------------------|---|
| Name                         |   |
| Address                      |   |
| NIC No                       |   |
| 2.12 Secretary               | ·   |
| Name                         |   |
| Address                      |   |
| NIC No                       |   |
| 2.13 Legal Advisor           | ( <u> </u>  |
| Name                         |   |
| Address                      |   |
| NIC No                       |   |
| 2.14 Particulars of Auditors |   |
| Name                         | A.F.Ferguson and Co. Chartered Accountanti                              |
| Address                      | 74-East , 2nd Floor, Blue Area, P.O Box 3021, Islamabad-44000, Pakistan |

2.16 Particulars of Shares Registrar (if applicable)

| Name    |  |
|---------|--|
| Address |  |
| Email   |  |

#### Section-B

# 2.16 List of Directors on the date Annual return is made

| S# | Name of Director      | Realdential Address   | Nationality | NIC (Pasaport No. if foreigner) | Date of appointment<br>/election | Name of Member/Creditors<br>nominating/appointing |
|----|-----------------------|---|-------------|---------------------------------|----------------------------------|---|
| 1  | Muhammad Asim Ishaque | H.No 284, Street No. 14, Township<br>Sector A1, Lahore              | Pakistan    | 3520270242921                   | 28/10/2022                       | The National Radio Telecomm                       |
| 2  | Jawad Anjum           | Flat No. 43-G, Askari 3, School Road,<br>Karachi South              | Pakistan    | 4230177998571                   | 28/10/2022                       | Onsun (Pvt) Ltd.                                  |
| 3  |                       | House No. B-1, Ghaznawi Street,<br>Garrison Adiala Road, Rawalpindi | Pakistan    | 3420207444589                   | 28/10/2022                       | The National Radio Telecomm                       |



# .MAJOR (R) ENGR. JAWAD ANJUM, psc, CMILT(UK)

+92-333-4677-166

jawadanjum1@gmail.com

362-F. Askari-10, Airport Road, Lahore Cantt



- PROFILE A multi-skilled professional with a proven history of managing complex functional assignments in constrained environments for 18 years in Army as a result-oriented project manager, effective administrator and a seasoned HR manager. I am a self-driven individual who enjoys dynamic and diverse roles in multi-functional settings. Leveraging my sharp learning potential and adaptability, I can thrive working with experts from any industry. A natural leader and team player who generates excellent spirit and inspires people around him being a gifted speaker with an analytical mind set. I am always willing to go an extra mile looking for innovative solutions to achieve remarkable results. Seeking a challenging role in Rohde & Schwarz Pakistan, where I can grow professionally & personally and demonstrate my skills whilst benefiting the organization.
- SKILL SETS Leadership/ Team Building Operations Continuity

• ICT

Service Delivery

- Project Management
- Telecommunication

- Strategy & Planning
- Analytical Thinking
- Stakeholder Management

- Organisation
- Persuasion & Negotiation 
   HRM
- PROFESSIONAL EXPERIENCE HIGHLIGHTS

# **PROJECT MANAGEMENT**

Planned, directed and co-ordinated activities of following organisational projects in areas of IT, Telecom, Software Development and Systems Integration. Allocated technical and human resources, resolved issues while managing clients/ end-users and vendors.

#### Shifting of Army School of Technician from Barian to Kohat 2020

- Developed feasibility and implementation plan with a cost effect of PKR 290 Mn .
- Achieving consensus by all major stake holders

#### Corps of Signals Training 1

- Developed concept paper to restructure Corps of Signals Trades in line with the latest and futuristic induction plan of technical equipment.
- Planned and directed expansion of STC to achieve 25% capacity enhancement to train 3000 new and experienced soldiers attending various technical courses every year.
- Established technical labs (OFC, microwave, radio, computer, networking & driving simulator)
- HR development of functional staff (training, operations, management and administration).

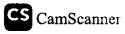
# **Renovation of GHQ Army Museum**

- As a special project, renovated GHQ Army Museum Signals Gallery. Incorporated latest visual & interactive technologies like hyper-vision, holograms and interactive displays. •

# ✓

- Enhanced coverage of Suno FM Radio Network to outreach remote areas of Baluchistan, FATA & Kashmir region by establishing 85 self-sustained (500 – 2500 Watts) new stations. As controlling body for Suno FM network, handled regulatory affairs, rendered guidelines for
- content development and devised strategy to increase listenership.





2019 - 20

2019 - 20

2016

CamScanner

## **Deta Visualisation and Analytics**

Concerved, developed and implemented customised data visualisation and analytics software to share actionable data for informed decision making by stakeholders across Pakistan.

# **Cloud-based Smart Verification System**

implemented a pilot project "Smart Verification and Alert System" to automate and speed-up screening process of returning TDPs/ individuals at key entry points in South Waziristan. System significantly reduced waiting time by 50 %. Project received appreciation at the inchest level and was extended to all military garrisons

### Solarization of Highly Remote Communication Hubs

Coordinated and supervised installation of solar systems at 27 remotely located communication nodes in difficult terrain of Washristan.

### **Central Monitorine System**

Established a joint monitoring & control centre for civil administration, police and army to monitor security situation of DI Khan, Tank, Lakki Marwat and Bannu. System encompassed comprehensive monitoring, self-healing automation, policy-based configuration management, detailed reporting, integrated AV, patch, backups and remote control.

### **Pakistan Army Office Automation System (OAS)**

- Supervised installation and configuration of Karachi Data Centre server rooms.
- Directed deployment of fibre optic and wi-max networks in Karachi and Malir, to extend OAS to over 120 establishments in a record time of 8 months. Subsequently worked as project in charge for OEM of OFAN & wi-max siles.
- Developed programs to support organisation's transition to new system.
- Worked as a local point for customers and vendors management.
- Remained part of development teams of various enterprise applications and software.

### Pakistan Army Telepresence System (PATS)

Implemented state of the art telegresence systems at Karachi (2011) and Kohat (2020)

### CHIEF COMMUNICATION OFFICER

During my illustrious career in Pakistan Army I have managed large scale telecom systems.

- Planned, deployed and maintained communication and data services for a large number of civilian, army and FC subscribers, by integrating PTCL and own MW & OFC systems in Waziristan.
- Deployed and maintained PBX Systems MD-110 Ericsson in Labore, Murree, SWA and Kohat.
- Due Kashmir Earthquake 2005, complete communication infrastructure got destroyed, Restored communication network of over 70 sites spread in complete Kashmir Region.
- Established new OFC network, deployed DAMA/ VSat systems (Hughes/Polar Sat/Paksat1-R) and NERA Microwave systems in hostile terrains.

#### **Radio Communications**

- AF Planning and optimization to effectively manage HF, VHF and UHF radio networks (Harris, Aselsan, Ericsson, Motorola, R&S) for large size forces.
- Liaison with Frequency Allocation Board and Pakistan Telecommunication Authority.
- Cross-Border communication planning/ coordination with NATO/ ISAF.
- Effectively managed the information Operations Campaign in conflict zone and countered hostile radio networks both cis-frontier and trans-frontier. Judiciously employed 18 electronic warfare detachments comprising PR - 100 terminals, suppression transmitters and FM transmitters.

#### **JOINT INFORMATION OPERATIONS COMMITTEE (JIOC)**

HOC is joint forum for tri-services, ISI & SPD for technical projects.





#### 2016

2014.15

2014

2013

2010 - 11

2011/20

2018-20

2011.12

2002 - 20

- Member of core team designing new training regime for junior leaders of Army.
- Army, PAF, Police, Rangers and FC. 2016 - 18
- Psychological and Motivational Training (PMT)
  - Organised PMT for Army/ FC employees going to, deployed in & coming from high threat zones. Also conducted PMT for PAF, Police and Rangers employees in various cities
- Junior Leaders Academy (JLA), Shinklari
  - Lanka) at HA. My squads got 1st position out of 40 squads in two consecutive courses.
  - delegates.

#### SECURITY AND SAFETY

- Remained part of security management teams, providing security for top-level dignitaries like President, Prime Minister and COAS,
- Carried out threat, risk and vulnerability assessment of sites, programs and projects. Devised and issued response strategies accordingly.

#### **DISASTER MANAGEMENT**

- **Electoral Process** 
  - Supervision of General Elections 2018 in the most befitting manner in Kohat District.
  - Maintained close liaison with chill administration and facilitated during the entire process
  - Managing the security of over 17 polling stations.
- Tent Village for TDPs in Bannu
  - Assisted in establishing tent willage to accommodate 20,000 temporarily displaced people.
  - Carried out registration & profiling ensuing camp security while giving due consideration to local culture and traditions.

#### 1 **Flood Relief Operations**

- Establishment of flood relief camps in remote areas of Sindh catering over 30,000 personal
- Personally supervising the smooth functioning and establishment of medical camps on more than 22 sites within a short span of 3 days.
- Voluntary gathering of funds and judicious distribution in close hanon with Red Cross representatives.

#### Earth Quake Relief Operations

- Voluntarily initiated relief and rescue effort in my area of responsibility
- Utdising limited available resources established refiel camp to sustant 5000 people
- Later on acted as lead facilitator for teams employed in Kashmir.

Advisor to top management of Army on technical matters of JRAC. Handled projects like COP for tri-services. OFC laying along west bank, tri-services mobile phone network, industrial & Jechnical evaluation of advanced communication systems and secure systems 1082 - 20

#### HUMAN RESOURCE MANAGEMENT

18 years of progressive experience in Human Resource Management. Remained responsible for

- Supplies of rations, clothing & ammunition and maintenance of weapons, vehicles & technical equipment to ensure smooth operations of the organisation
- Training & evaluations; career planning & promotions, discipline, and leave of employees.
- Affairs related to pay & benefits; accommodation; bealth & safety, medical; and welfare
- Providing consultation to superior management on related issues of organization

#### COACHING AND MENTORING

- Signal Training Centre, Kohat

  - Training need analysis to design training programs of telecommunication cadres of troops of

# Coached and groomed soldiers of Pakistan and foreign armies (KSA, Bahrain, UAE and Srr

- Prepared and organised demonstrations of training activities for top management and foreign

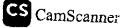
2018

2014

#### 2010

2005





 Ensured security management and humanitarian field skills training programs by maintaining close liaison with UNHCR teams operating in the area.

|  | MSc (Art and Science of Warfare), National Defence University, Islamabad | 2014 - 16       |
|--|--|-----------------|
|  | BE (Computer Software Engineering), NUST, Islamabad                      | 20 <b>06</b> 10 |
|  | PGD (Wire Communication Engineering), PLAUST, Nanjing, China             | 2012 - 13       |
|  | EMBA (Candidate), LUMS, Lahore   | 2021 - 23       |

COURSES AND Command and Staff Course, Command and Staff College, Quetta CERTIFICATIONS Mid-Career Signals Course, Military College of Signals, Rawalpindi Junior Staff Course (Signals), Military College of Signals, Rawalpindi Electronic Warfare Course, Military College of Signals, Rawalpindi Young Officers Telecommunication Course, Military College of Signals, Rawalpindi Project Management Course, OSP International LLC Certification in Cabling Engineering, Nanjing College of Information Technology, China Olploma in Cisco based Network Training, Harris Corporation Certification in DSSS Telemetry and Auto Tracking System, COMTEC, Wah Army Master Trainer in Information Assurance, Military College of Signals, Rawalpindi Certified Secure Computer User, EC-Council UN Military Observers Course, Centre for International Peace and Stability, Islamabad

PROFESSIONAL Pakistan Engineering Council, Pakistan MEMBERSHIPS The Institute of Engineers, Pakistan Charted Institute of Logistics and Transport, UK Project Management Institute, USA AXELOS, UK

INETERESTS Reading, Travelling, Bridge, Hunting

**REFERENCES** Available on request





# HOD (Accounts & Finance)& Member ICMAP (SAP B1, QUICK BOOKS, ERP)

An Experienced Accounts and Finance person with a demonstrated history of working experience of 10 years in the Manufacturing and Trading industry. Skilled in Financial Management, FP&A, Budgeting, Cost Controls, Accounting Cycle, Taxation Laws, and Decision Making.

# SHOAIB BUTT

# Contact

Phone: +92 322 4332430

E-Mail: buttacma@yahoo.com

Skype ID: shoaib.butt32

Address: House no 5, street no.4, Boston Colony, Qainchi Stop Ferozepur Road Lahore Cantt. Pakistan.

# Personal Info

DOB: 10<sup>th</sup> August 1987 teligion: Islam Marital Status: Married Membership / Reg. No.: A-6243 Father Name: Waheed Azam Butt

# **Skill Highlights**

- Microsoft Office (Word, Excel, PowerPoint)
- Peachtree Accounting
- Typing Speed 40 wpm
- SAP B1, QUICK BOOKS, ERP

# Experience

03/2022 to Present

HOD (Accounts & Finance) - The Punjab Club Lahore, Pakistan. The Punjab Club was established in 1884 and was exclusively used by British and Europeans. The club was transferred to Pakistan in 1962. It is private social club that has elected members consisting of high ranking civil, leading industrialists, entrepreneurs and executives.

- Responsible for overall accounts, finance and taxation matters.
- Annual Budget, costing, insurance, Provident Fund management.
- Managing Investment Portfolio with Banks.

04/2020 to 02/2022

# **Group CFO:**

- 1- Siraj Din Energy (Pvt.) Ltd. (FMCG), Lahore, Pakistan
- 2- Solargy (Pvt.) Ltd.
- 3- Qazafi Batterier

Siraj Din Energy (Pvt.) Ltd & Solargy (Pvt.) Ltd. deal in retail and wholesale of commercial batteries (i.e., AGS, OSAKA, EXIDE, PHOENIX, TREET, BRIDGE POWER, MILLAT) for UPS, Autos and Solar Panels System. It has distribution network all over Pakistan.

- Lam responsible for all financial planning, financial analysis, drafting financial Strategy, Cash Flow tracking & Taxation.
- Finalization of Annual/Periodic Financial Statements and Audited accounts from external auditors.
- Ensuring proper accounting practices, book keeping, Internal audit, claim audit, financial audit, and other MIS reports.
- Comparative statements analysis and presenting reports to CEO.
- Preparing financial budgets, financial models for decision making.
- Compliance of business processes and finding ways of Improvements.
- Supervision of All Taxation maters with coordination of consultant.
- Supervision of All SECP, PRA & FBR filing.

# 12/2014 to 03/2020

# Manager Accounts - Element (Pvt.) Ltd., Lahore, Pakistan Elmetec (Electrical & Mechanical Technologies) Pvt. Ltd., manufactures

11 KV Distribution Transformers from 10 KVA to 640 KVK as per WAPDA specifications and all other capacities up to 5000 KVA. In addition to that, it also manufactures medium and low voltage switchgear incorporating Vacuum Circuit Breakers, Oil Circuit Breakers and Load Break Switches, Low & Medium Voltage Instrument Transformers. It has annual turnover Rs. 02 billion.

- Preparation of Financial Statements (Monthly, Quarterly, & Annual)
- Fixed Assets Management (Recording, Revaluation and Disposal of Assets). Liaison with External Auditor for annual audit of financials.
- Bank & GL Reconciliation Statements, AP, AR, Sales and Purchase Invoices, Internal Management Reporting.
- Compliance with FBR Notices (Rule 44(4)/161(1A) Monitoring)
- Notice u/s 161, Notice u/s 122 (Assessment), Notice u/s 177 Audit (Information and Evidence with supporting documents)
- Compliance with Sales Tax Audit. Supervision of Leasing of Assets.
- Costing Imported Materials.
- Bill Discounting and other Supervision of financing activities with banks

02/2012 to 11/2014

# Account Officer - Rupall Group, Lahore, Pakistan

- Preparation of all kind of vouchers, GRN, costing of Imported Materials.
- Audit of Stores and Spares.
- Conducting Monthly Stock taking.
- Compilations of General Entries to accounts.

# Education

|   | 2012       |
|---|------------|
| CMA (Cost & Management Accountant)                          |            |
| ICMAP – Institute of Cost & Management Accountants o        | f Pakistan |
| Financial & Managerial, Accounting, Auditing, Companies Law |            |
| Reporting   |            |
|   | 2007       |
| B. Com (IT) (Bachelor of Commerce)                          | 2007       |
| University of the Punjab, Lahore, Pakistan                  |            |
|   |            |
| Financial Accounting, Cost Accounting and Taxation          | 2005       |
|   | 2005       |
| I.Com (Commerce)  |            |
| BISE, Lahore, Pakistan                                      |            |
| Accounting, B. Math and Commerce.                           |            |
|   | 2003       |
| Matric (Science)  |            |
| BISE, Lahore, Pakistan                                      |            |
| Math, Physics, Bio, and Chemistry                           | NES (PL)   |
|   |            |
| Certifications  | AGIES (ALM |
|   |            |
|   |            |
| MS Office Diploma (6month) NAVTIC program                   | 2007       |
| Typing Certificate  | 2007       |
|   |            |

#### 1

eron analise in hearing and the second second and the second second second Called The Work of the Work Section Proside and the first state of the former 1. 1. 1. 1. and in the 21.53

TTHE -

1999 B # 59 8 8 8 8

And Andrewson a

1. 19 19

S + 2

ALC: IOS

antionantegrating

nameunal readiness

A State of the second second second

Sec. Sec.

States ka Ali seleka katalogi yang Ponta pontasi dala Man EX IS 

1. 34

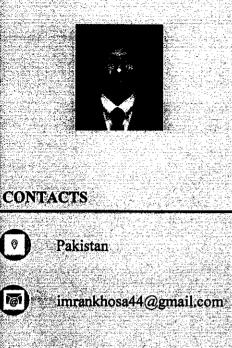
Company Co S. A. C. Sala i chan i a and a second A second A second s

an ann anna ann an Aire d An Aire ann an Aire an A A. F. Wards 

an an an ann a' ann a' stàirtean an Aonaichtean ann an Aonaichtean ann an Aonaichtean ann an Aonaichtean an Aon An an Aonaichtean ann an Aonaichtean an Aonaichtean an Aonaichtean an Aonaichtean an Aonaichtean an Aonaichtean - HO ST elevisite in all the second hadina kanada en parte an a 

ः स्टब्स्यन Paratra Sec. . مرتبط مانتان در باز این از تاریخ از این از تاریخ See groups to be

Street Street B Standar str sty or 1912 Satures



# PAK: +923332876332

+923332876332

# CAREER OBJECTIVE

Looking for an opportunity in the field of Power Plant Operation & Maintenance, Testing & Commissioning and Renewable (Solar) Project Executions in a romable organization.

https://www.linkedin.com/in/engr-imran-khosa-12b63a189/

# SOFT SKILLS

|                           | 1 (A. 11)  |  |  | eg roong 🗗   |
|---------------------------|--|--|--|--|
|                           |  |  |  |  |
| Minros                    | oft Projec   | 1 S  |  | 6  |
| an nai na                 | airt ialar   | (1. <sup>34</sup>  |  | and the second   |
|                           | 장소가 아이는 것  | n film an strawer.   | めいためたた   | 다 같다. 전 영상   |
| 12.                       | in statute sector and  | ar e des test.   |  | and the second states of the states of the second s |
|                           |  |  | an Altais  |  |
| The second                | ANIA   | 2.4 C  |  | and the second   |
| EIVHCFUS                  | oft Word   | 841 <del></del>  | ,  | in starte st   |
|                           |  | WC 135 NRS   | i ke databah Polen   |  |
|                           | a standard and   |  | the second pro-  | لى ودائمة المتنا   |
| Sh/inens                  | oft Excel  | 11.5   | 1999 - P. 201 - 199 - 19 |  |
| TATIATOS                  | ATT TWART  | la a grand a grand a grada.<br>A companya a grada a gr | ا بیون کر اور ایر ایران کرد.<br>مرکز ایران در میتر مرکز کرد  | 1.   |
|                           |  | de a fritikaj e  |  |  |
|                           |  |  |  |  |
| Heliosc                   | one  |  |  |  |
| Alex of the second second |  | a second a second  | 1  |  |
|                           | بر المحمد و المحرة المراجع المراجع .<br>محمد المحمد المحمد المحمد المراجع .  |  | 5  |  |
| A                         | A TS   | i i de la companya de                                | · · · · · · · · · · · · · · · · · · ·  |  |
| AutoC                     | NU ZU  | a da seren esta esta esta esta esta esta esta esta   |  | ••••••••••••••••••••••••••••••••••••••   |
| Strate Land               | 1993년 1997년 1997년<br>1997년 - 1997년 19<br>1997년 1997년 199 |  |  |  |
| 4.000                     | 1.89 X 1.69 S  |  | a di bata dest   |  |
| Sketch                    |  | 1.1  |  | ا الإسلامية ( المحمد عليه الما الم<br>الم  |
| EQACIVIII                 | +P   |  |  |  |
|                           | an a   |  |  |  |
|                           | 「そうてい」「日本のなってい」」。<br>「「あたない」を「「いない」」、「いってい」  |  |  |  |
| PVsyst                    |  | E _ 1  |  | n suuri nän tuures".<br>Ula  |
|                           |  |  | 100  | 9.997 L.C.C.M  |
|                           |  |  |  |  |
|                           |  |  |  |  |
| Service Service           | Same Charles   |  |  | S. Carlo Vara  |
|                           |  |  |  |  |
| 2                         |  |  |  |  |
|                           | the state of the second  | an an an an an an Anna Anna Anna<br>An an Anna Anna  | and a straight and and a straight a   |  |
|                           |  | د منافقه با مراجع بازم<br>مراجع المراجع المراجع المراجع  | A second second provide the second  | an an an ann an ann an an an an an an an   |
| 290 (*****)               |  |  |  |  |
|                           |  |  |  |  |

# Engr. Imran Khan Electrical Engineer

# **PROFESSIONAL BACKGROUND**

Foundation Solar Engery Private Limited.

Projects Manager since 15<sup>th</sup> March 2022.

Sky Electric Private Limited

Project Engineer 1<sup>st</sup> august 2018 till 13<sup>th</sup> march 2022.

# **KEY EXPERTISE**

# **Project Management**

- Execution of Megawatt Level Renewable energy projects.
- Microsoft project
- Ability of Team Management, Implementation, Project Planning, Project Pricing, Time Management, Problem Solving, Negotiation Skills, Managing Vendors, Defining Project RFP's, Conducting Technical Surveys and Dealing with Clients. **Testing and inspection**
- Done SAT and FAT's for MV panels (short circuit test, high voltage test, earth fault test) and transformers (turn ratio test, insulation resistance test, no load losses and full load losses tests).
- Cables and conductor's tests (high pot, megger & continuity test).
- Reviewing the engineering design changes and resolving quality related problems associated with the design.
- Reviewing manufacture drawings.

# Maintenance and trouble shooting

- Planning and effective preventive maintenance schedules of various machineries and instruments to increase machine up time and equipment reliability.
- Troubleshooting of the fault using engineering logic and testing.
- Routine inspections and monitoring of working equipment's.
- Preparing R&D based data to check the performance of motors, generators and transformers.
- Overhead and underground cable laying.

# WORK EXPERIENCE

# Projects Manager (Permanent/Fulltime)

EPC renewable energy (solar) projects upto 45 (precution and commissioning from initial surveys to the vendor menaging and technical evaluations.

# **CERTIFICATES & APPRECIATIONS**

- 1. Fusion Solar Service Certificate
- 2. Installation and Manufacturing of PV module

# MANAGERIAL SKILLS

- a. Project Scheduling
- b. Planning of material resources
- c. Managing vendors
- d. Management Reporting
- e. Dealing with the client
- f. Managing timeline
- g. Controlling project pricing

# GUAGES

- English
- Good
- Urdu

Excellent

Punjabi

Hindi

Good

Excellent

Core responsibilities: Leading overall execution activities of the project.

- 1. Making RFQ's for the Project and Leading site surveys along with sub-contractors.
- 2. Prepare cost estimations for the different scopes of the project.
- 3. Prepared project implementation plans, helping draft man in design documents.
- 4. Managing vendors and ensuring of onsite implementation as per design.
- 5. Leading technical meetings and taking approval of design from client.
- 6. Reporting to the higher management regarding daily progress.
- 7. Assisting HOD in technical evaluations of the subcontractor's and costing negotiations.
- 8. Keeping record of line item and required ones.
- Lead installation and testing of 3100KVA Transformers, Central Inverter installation, hot and cold commissioning, DC terminations and MV cable laying, MV terminations 6.3KV at ABB/Schneider MV Switch Gears.

# **On-going Projects:**

7.5 MW: Fauji Cement Company Pvt ltd DG Khan.

5.5 MW: Beacon implex Faisalabad.

1MW: Fauji Akber Portia Marine Port Qasim Karachi.

# **Projects**

6 MW: Rafhan Maize Product co. Mehran Plant Kotri.

# 11.25 MW: (Fauji Cement Company Limited Nizampur)

surveyed, designed, prepared project implementation plan and system layout, lead execution activities including mechanical, civil and electrical, carried outtesting and commissioning of the site

# 8.8 MW: Solar Plant at Askari Cement Company Limited.

1MW: Solar Power Plant at Ashraf sugar Mill Bahawalpur, designed and executed

**500KW or below:** Solar Power Plant in south Punjab flour mills and cotton industries, designed and executed.



# PERSONAL PROFILE DOB: 01/03/1995 Nationality: Pakistan Marital Status: married Passport Number: QY4141651 **.** 1.1.1.

# Project Engineer (Permanent/Full time)

# Sky electric Pvt Limited

# (56 months) 1<sup>st</sup> august 2018 to 14<sup>th</sup> march 2022

Operation and maintenance of residential system in South Punjab and based at Multan office. Leading the project execution team and complete the targets within the stipulated time frame.

# **Core Responsibilities:**

- 1. Meeting client before work execution & formulation of SOW document.
- 2. Inspect residential/industrial facilities and analyze electrical data
- 3. BOQ verification, Procurement and Team Administration for residential/SME sites
- 4. Compile estimates for technical and material requirements for project development
- 5. Suggest process and technical design changes to improve performance and efficiency.
- 6. Monitor project progress, compliance with design specifications and safety standards.
- 7. Create work schedules and adjust as needed to meet project deadlines.
- 8. System Commissioning and handovering the project to client.

# **EDUCATION**

| Sr.No | Name of Course  | Institute Name                                | Completion date |
|-------|---|---|-----------------|
|       | Bachelors of Science in<br>Electrical Engineering               | Islamia University of Bahawalpur              | 20142018        |
| 2     | Higher Secondary School<br>Certificate<br>(FSc.Pre-Engineering) | Muslim College science and technology, Multan | 20122014        |
| 3     | Secondary School<br>Certificate<br>(Matriculation)              | Shaheen Froce Public School Muzaffargarh.     | 2010 2012       |
|       |   | •   |                 |





 $\mathbf{X}$ 

# Lt Col (Retd) Sibtain Naseer

Siddiqui, PMP®, P.E, MIE(Pak)

# Program Manager, Civil Engineer

♥ House No 107, Street No 7, Safari Valley Usman D Block Phase 8 Bahria Town Rawalpindi, Pakistan

+923365369331

Email: sibtain.naseer1@gmail.com

Linkedin: www.linkedin.com/in/sibtain-naseer-siddiqui-62625515b Sex: Male | Date of birth 21/12/1983 | Nationality Pakistani

With 17+ years of experience as a General Manager/ Program/ Project/ Construction Manager and Civil Engineer, I possess the expertise and skills necessary to lead effectively. I am dedicated to optimizing operations, minimizing costs, and drivingorganizational efficiency, reflecting my commitment in achieving success. Safety is of paramount importance to me, and I maintain an unwavering focus on ensuring the well-being of all personnel involved in construction activities. Throughout my career, I have built a solid reputation for making independent decisions and exercising sound judgment, resulting in positive contributions to company performance. By consistently applying my problem-solving abilities and leadership acumen, I have been able to drive the overall success of the organizations I have worked with.



# Work History

| 10-2024-<br>Current | Frontier Works Organization, Rawalpindi  |
|---------------------|--|
|                     | Program Manager Operations   |
|                     | Frontier Works Organization is today's most versatile and vibrant construction firm of Pakistan, was established on 31 October 1966. I was employed as Program Manager to oversee different projects executed by FWO.    |
|                     | Responsibilities and Achievements:   |
|                     | Managed operations of Headquarters Frontier Works Organization   |
|                     | Oversaw construction and maintenance of Motorways by concerned Project Managers     as per scope, schedule and cost.   |
|                     | Coordinated with all project managers for timely completion of projects.   |
|                     | <ul> <li>Collaborated with contractors, suppliers, and other stakeholders to meet project<br/>requirements and specifications</li> </ul>   |
|                     | Conducted rates verification and analysis of contracts, ensuring compliance with local market standards.   |
|                     | <ul> <li>Conducted constructability analysis of contracts, identifying discrepancies and providing<br/>actionable recommendations for successful project execution in coordination with<br/>project managers.</li> </ul> |
|                     | • Collaborated with on-site teams to assess and improve designs based on site-specific conditions, optimizing project outcomes.  |



|           | <ul> <li>Facilitated effective communication with local vendors, contractors, and material suppliers to ensure timely project execution and delivery.</li> <li>Conducted comprehensive rick assessments for projects and implemented/ actions.</li> </ul> |
|-----------|---|
|           | <ul> <li>Conducted comprehensive risk assessments for projects and implemented/ enforced<br/>safety procedures to minimize risks and ensure a safe working environment.</li> </ul>  |
| 06-2020-  | Ministry Of Defence Kohat & FATA  |
| 09-2024   | Program/ General Manager  |
|           | Responsibilities and Achievements:  |
|           | <ul> <li>Oversaw the construction of 2 x schools with a capacity to accommodate 500 students<br/>along with associated facilities, ensuring a conducive learning environment.</li> </ul>  |
|           | <ul> <li>Managed construction of a multi-sports complex, providing state-of-the-art facilities for<br/>various sports.</li> </ul>   |
|           | Oversaw construction of Rehabilitation Projects (including WASH activities) for erstwhile<br>FATA worth over Rs 6 Billion.  |
|           | <ul> <li>Managed construction of more than 50 RCC bunkers/ structures.</li> </ul>   |
|           | <ul> <li>Successfully completed construction of ammunition dumps/ depots, military equipment<br/>storage sheds and multi-storey accommodation.</li> </ul>   |
|           | <ul> <li>Oversaw the fencing of 230 km perimeter to secure Pak-Afghan Border, enhancing<br/>safety and security measures.</li> </ul>  |
|           | • Oversaw all phases of construction, ensuring adherence to safety protocols, quality standards, and project specifications.  |
|           | • Implemented strategies for efficient workflow, productivity, and fostering a positive work environment.   |
|           | <ul> <li>Currently supervising a team of 300 individuals, managing their day-to-day activities,<br/>performance, and ensuring effective teamwork.</li> </ul>  |
| 10 – 2017 | Military Engineering Services, Rawalpindi and Islamabad   |
| 06 – 2020 | Project Manager   |
|           | Military Engineering Services are providing construction services to Pakistan Army, Air force and Navy, dealing public funds of approximately 350 million dollars annually. I have managed two Military Garrisons being Project Manager.                  |
|           | Responsibilities and Achievements:  |
|           | • Successfully completed projects worth over Rs 7 Billion, delivering quality outcomes within specified budgets and timelines.  |
|           | <ul> <li>Supervised the construction of over 150 km of flexible pavement and 15 km of rigid<br/>pavement, ensuring adherence to quality standards.</li> </ul>   |
|           | <ul> <li>Construction and installation of sewerage disposal system for the residents.</li> </ul>  |
|           | Planning, awarding and execution of more than 500 contracts and ensuring  |
|           | <ul> <li>engineering standards and practices to be followed at all stages.</li> <li>Actively involved in design / contracting phase to mitigate the design and contract issues thus evaluate any financial effects and lititation.</li> </ul>             |
|           | <ul> <li>issues thus avoiding any financial effects and litigation.</li> <li>Utilized multi-tasking skills to optimize project completion time and increase efficiency.</li> </ul>  |
|           | <ul> <li>Defining different Standard Operation Procedures for optimum utilization of<br/>resources, mitigating risk and ensuring safety procedures at all levels.</li> </ul>  |
|           | <u>Construction of different colonies (complete community development) with</u>   |
|           | SNES (PL)   |



|           | <ul> <li>more than 72 x Basement + Ground + 9 Floors accommodation flats, more than 60 x Ground + 3 Floors accommodation flats, 8 x bungalows, and maintenance of accommodation facilities.</li> <li>Managed construction of more than 80 multi-storey buildings, ammunition depots, military equipment storage sheds and underground RCC structures.</li> <li>Supervised construction of pre-fabricated steel structures, including warehouses, storage sheds, and industrial buildings.</li> <li>Construction of New Artillery Mess Rawalpindi Cantonment with cost of over \$12 Million and construction of 30 x VIP Guest Rooms/ Hotels (Multi Storey Buildings) and allied facilities.</li> <li>Oversaw construction of simulator buildings for Air Defense Systems.</li> <li>Successfully executed water supply schemes and sewerage infrastructure for different colonies/ projects.</li> <li>Oversaw all phases of construction, ensuring adherence to safety protocols, quality standards, and project specifications.</li> <li>Implemented strategies for efficient workflow, productivity, and fostering a positive work environment.</li> <li>Successful completion of projects overseeing all aspects from excavation to final finishes.</li> <li>Organized and led a staff of 700 employees, managing their day-to-day activities, performance, and ensuring effective teamwork.</li> </ul> |
|-----------|---|
| 10 - 2015 | Frontier Works Organization, Panjgur, Nag & Gidder  |
| 10 – 2017 | Project Manager   |
|           | i Tojoot managor  |
|           | Frontier Works Organization is today's most versatile and vibrant construction firm of Pakistan, was established on 31 October 1966. I was employed as Project Manager on different projects executed by FWO.   |
|           | Responsibilities and Achievements:  |
|           | <ul> <li>Managed construction and maintenance of 154 km stretch of CPEC National highway<br/>N-85 (Panjgur-Nag -Pishuk) overseeing a budgetof Rs 1.5 Billion.</li> </ul>  |
|           | <ul> <li>Construction/ maintenance of 102 x Concrete Culverts and 3 x Concrete Bridges along<br/>the route (Panjgur-Nag-Pishuk), conducting inspections, repairs, and preventive<br/>maintenance to ensure their structural integrity and safety.</li> </ul>  |
|           | <ul> <li>Managed construction and maintenance of 78 km stretch of CPEC National highway N-<br/>85 (Surab-Gidar-Kalgali), overseeing a budgetof Rs 1 Billion.</li> </ul>   |
|           | <ul> <li>Construction/ maintenance of 55 x Concrete Culverts and 1 x Concrete Bridge along<br/>the route (Surab-Gidar-Kalgali), conducting inspections, repairs, and preventive<br/>maintenance to ensure their structural integrity and safety.</li> </ul>   |
|           | • Construction of camps/ infrastructure at Nag, Gidar and Surab ensuring efficient and timely completion of the project.  |
|           | <ul> <li>Oversaw the fencing of 3 km perimeter to secure different camps, enhancing safety and security measures.</li> <li>Installation/ Construction, operation and maintenance of 3 x Crush Plants and 2 x</li> </ul>   |
|           | Asphalt Plants.   |
|           | <ul> <li>Collaborated with a team of engineers and technicians to address any related<br/>issues effectively and ensured adherence to quality standards and timelines,<br/>coordinating with construction teams and suppliers.</li> </ul>   |
|           | <ul> <li>Collaborated with contractors, suppliers, and other stakeholders to meet project</li> </ul>  |
|           |   |



| requirements and specifications.   |
|--|
| <ul> <li>Managed the projects from planning to execution, coordinating with users,</li> </ul>  |
| contractors, suppliers, and local authorities.   |
| <ul> <li>Conducted rates verification and analysis of contracts, ensuring compliance with local</li> </ul>   |
| market standards.  |
| <ul> <li>Conducted constructability analysis of contracts, identifying discrepancies and providing</li> </ul>  |
| actionable recommendations for successful project execution.   |
| <ul> <li>Reviewed designs, bill of quantities, and rate analysis provided by consultants, ensuring</li> </ul>  |
| accuracy and adherence to project requirements.  |
| <ul> <li>Collaborated with on-site teams to assess and improve designs based on site-specific</li> </ul>   |
| conditions, optimizing project outcomes.   |
| · Facilitated effective communication with local vendors, contractors, and material  |
| suppliers to ensure timely project execution and delivery.   |
| <ul> <li>Prepared weekly, monthly, and quarterly reports and returns, providing accurate</li> </ul>  |
| updates on project progress and key performance indicators. Presented findings and   |
| project updates to higher Headquarters.  |
| <ul> <li>Conducted comprehensive risk assessments for projects and implemented/ enforced</li> </ul>  |
| safety procedures to minimize risks and ensure a safe working environment.   |
| <ul> <li>Collaborated with local authorities and community leaders to address the social impact</li> </ul>   |
| of projects, considering the needs and concerns of the local population.   |
| <ul> <li>Maintained approximately 200 km tracks, ensuring smooth operations and safety for</li> </ul>  |
| transportation purposes.   |
| <ul> <li>Actively involved in WASH activities for the camps and developed a sewerage disposal</li> </ul>   |
| scheme for 1800 troops at Nag, Gidar and Surab, promoting proper waste management  |
| and sanitation practices.  |
| <ul> <li>Constructed two helipads for emergency evacuations, ensuring safe and efficient</li> </ul>  |
| landing and takeoff for helicopter operations.   |
| <ul> <li>Organized and led a staff of approx. 900 employees, ensuring efficient workflow,</li> </ul>   |
| productivity and effective project execution.  |
| <ul> <li>Implemented regular inspections and scheduled maintenance activities to address</li> </ul>  |
| any issues promptly.   |
|  |
|  |
| of the projects, considering the needs and concerns of the local population.   |
| <ul> <li>Implemented initiatives to promote community involvement and foster positive<br/>relationships between the granulation and the community</li> </ul> |
| <br>relationships between the organization and the community.  |



| 11 - 2013<br>10 - 2015 | National Logistics Cell, Pearl NLC Qatar  |  |  |
|------------------------|---|--|--|
|                        | Project Manager   |  |  |
|                        | I have served in the Middle East/ Gulf with Qatar Branch of National Logistics Cell<br>(Pearl NLC). The main role for my employment was infrastructure development and<br>maintenance.  |  |  |
|                        | <ul> <li>Responsibilities and Achievements:</li> <li>Construction of Pearl NLC Staff and labor camp/ infrastructure at Ash-Shahaniyah, ensuring efficient and timely completion of the project. Oversaw the erection of prefabricated accommodations, providing comfortable and functional living spaces for personnel.</li> <li>Collaborated with contractors, suppliers, and other stakeholders to meet project requirements and specifications.</li> <li>Successfully completed earthworks and miscellaneous infrastructure of Ras Laffan Hospital.</li> <li>Successfully completed earthworks/ infrastructure development for Al-Matar Metro Station.</li> <li>Successfully completed earthworks/ miscellaneous works of NOH (Orbital Highway) including dumping management and reuse of excavated material economizing cut and fill.</li> <li>Implemented regular inspections and scheduled maintenance activities to address any issues promptly.</li> <li>Collaborated with a team of engineers and technicians to address any related issues effectively.</li> <li>Managed the project from planning to execution, coordinating with users, contractors, suppliers, and local authorities.</li> </ul> |  |  |
|                        | construction teams and suppliers.   |  |  |



| 06 - 2009<br>10 - 2013 | Ministry Of Defence, Sialkot, FATA / NMD, Shinkiari   |  |  |
|------------------------|---|--|--|
|                        | Site Engineer   |  |  |
|                        | <ul> <li>Site Engineer</li> <li>Responsibilities and Achievements:</li> <li>Led the construction of Shopping Complex ex 15 Division, 15 x Posts and Upgradation/<br/>rehabilitation of Army Public School valued at Rs 300 Million.</li> <li>Managed construction of Perimeter Wall and fencing of Sialkot Cantonment to secure<br/>the garrison enhancing safety and security measures.</li> <li>Construction of 17 x Watch Towers/ Posts along perimeter of Sialkot Garrison</li> <li>Construction / Maintenance of 10 Km of track ensuring smooth operations and safety for<br/>security, maintenance and transportation purposes along perimeter of Sialkot Garrison.</li> <li>Constructed two helipads ensuring safe and efficient landing and takeoff for helicopter<br/>operations.</li> <li>Rehabilitation/ upgradation of 70 x soldiers houses in Sialkot Garrison</li> <li>Planning and preparation of Demolition of 3 x Bridges around Sialkot area</li> <li>Organized and led a staff of 350 individuals</li> <li>Managed local contractors and served as the site engineer for the construction of the<br/>college, ensuring adherence to project specifications and timelines.</li> <li>Identified and mitigated risk and safety issues at the construction site, implementing<br/>measures to ensure the well-being of workers and project success.</li> <li>Construction of Improvised Pedestrian Bridge at Jandola to facilitate the locals in their<br/>movement across the river</li> <li>Launching/ construction and maintenance of Compact 200 Bridge to open the traffic for<br/>locals in Sararogha, South Waziristan</li> <li>Construction/ maintenance of 950 Lightening Conductors for Camps/ Posts in South<br/>Waziristan</li> <li>Led emergency response efforts for flood in South Waziristan, utilizing boats and<br/>OBMs to rescue affected individuals.</li> <li>Construction of Basketball Court and Uplift/ Re-Construction of Main Entrance Gate in<br/>Junior Leadership Academy, Shinkiari.</li> </ul> |  |  |
| 04 - 2007<br>06 - 2009 | Frontier Works Organization, Jhal Magsi, Karachi and Coastal Highway  |  |  |
|                        | Site Engineer   |  |  |
|                        | Frontier Works Organization is today's most versatile and vibrant construction firm of Pakistan, was established on 31 October 1966. I was employed as site manager on different projects executed by FWO.  |  |  |
| -<br>-<br>-            | <ul> <li>Responsibilities and Achievements:</li> <li>Managed construction and maintenance of a 64 km stretch of Motorway M-8<br/>(Shahdadkot-Qubo Saeed Khan-Kachi Pull- Barija), overseeing a budget of Rs 900<br/>Million.</li> </ul>   |  |  |
|                        | <ul> <li>Construction/ maintenance of 74 x Concrete Culverts and 1 x Bridge along the route,<br/>conducting inspections, repairs, and preventive maintenance to ensure their structural<br/>integrity and safety.</li> </ul>  |  |  |
|                        | <ul> <li>Managed the project from planning to execution, coordinating with users, contractors,<br/>suppliers, and local authorities.</li> </ul>   |  |  |
|                        | Conducted rates verification and analysis of contracts, ensuring compliance with local  |  |  |



|   | market standards.  |
|---|--|
| • | Conducted constructability analysis of contracts, identifying discrepancies and providing  |
|   | actionable recommendations for successful project execution.   |
| • | Reviewed designs, bill of quantities, and rate analysis provided by consultants, ensuring  |
|   | accuracy and adherence to project requirements.  |
| • | Collaborated with on-site teams to assess and improve designs based on site-specific   |
|   | conditions, optimizing project outcomes.   |
| • | Facilitated effective communication with local vendors, contractors, and material suppliers to ensure timely project execution and delivery.   |
| • | Prepared weekly, monthly, and quarterly reports and returns, providing accurate updates on project progress and key performance indicators. Presented findings and project updates to higher Headquarters. |
| • | Conducted comprehensive risk assessments for projects and implemented/ enforced safety procedures to minimize risks and ensure a safe working environment.   |
| • | Maintained 21 km tracks, ensuring smooth operations and safety for transportation purposes.  |
| • | Oversaw the fencing of 18 km perimeter to secure different camps, enhancing safety and security measures.  |
| • | Organized the emergency evacuation of flood victims from Jhal Magsi, ensuring their safety and well-being.   |
| • | Actively involved in WASH activities by managing construction and provision of 12 x water filtration plants, construction and installation of sewerage disposal plant for the local communities.           |
| • | Established camps for 8000 flood victims, providing basic necessities and support in challenging circumstances.  |
| • | Constructed three helipads for emergency evacuations, ensuring safe and efficient landing and takeoff for helicopter operations.   |
| • | Managed maintenance of a 230 km stretch of Makran Coastal Highway N-10 (Liari-<br>Buzzi Top-Ormara) damaged during floods.   |
| • | Managed demolition of Shershah Bridge Karachi in record 1 Week in coordination with technical teams opening the route for local populace   |
| • | Supervision and management of camp/ offices temporarily established for Shershah   |
|   | Bridge Demolition  |
| • | Developed a sewerage disposal scheme for 1800 troops, promoting proper waste management and sanitation practices.  |
| • | Organized and led a staff of 350 employees, ensuring efficient workflow, productivity, and effective project execution.  |





# Education

12 - 2002**Bachelor of Science: Civil Engineering** 06 - 2006National University of Science and Technology -Islamabad



# Skills

· Constructability analysis

Sustainable construction

Strategic planning and

Multinational and Gulf

execution

Experience

- · Cost estimation
- · Quality control and assurance
- Team leader
- Process improvements
- Financial Management

- Preparation of Bill of Quantities
- · Contract and tender documents · Risk Management
  - Communication with different tiers
  - **Project/** Construction management
  - Negotiation



# Software

Primavera P6, JIRA, ETABS, SAFE, Revit. Microsoft Office

# **Certifications & Licences**

- WES (World Education Services) Verified Civil Engineer
- PMP®, Certified Project Management Professional
- Professional Engineer (P.E)/ Member Pakistan Engineering Council
- Member PMI
- MIE(Pak)
- ISO 45001: Occupational Health & Safety management system (Udemy)
- ISO 31000: Risk Manager Training (Udemy)
- Operational Risk Management Professional Masterclass (Udemy)
- IOSH Managing Safely
- OSHA 30 Hours
- · HABC Fire Safety At Work
- HABC Risk Assessment
- HABC First Aid At Work



#### Languages •

- English (Fluent)
  French (Niveau-B1)
  Urdu (Fluent)

19 N-

# Syed Waqar Ali

# +923024168716 | waqaraliee@gmail.com

## SUMMARY

An Electrical Engineer with almost 8 years of experience in the field of Renewable Energy (Solar PV). Proven success in the aspects of the project performance; including management of the contracts, costing and interfaces with project stakeholders, as well as safety of personnel and equipment. Seeking an opportunity to lead and manage a team of engineers to design and build renewable energy systems that make a positive impact on the environment.

**Specialties:** Utility Projects Construction, Project origination, Project initiation, Project planning, Project execution and control, Construction management, Solar Asset Management, High Voltage, good understanding of Utility interfaces.

# ACADEMIC CREDENTIALS

BSc Electrical Engineering | University of Engineering & Technology, Lahore (UET Lahore) | 2012 - 2016 | CGPA 3.206/4.00

Major Courses: Power System Analysis, High Voltage, Power System Protections, Renewable Energy, Power electronics.

# WORK LXPERIENCE

# Ministry of Defense Production (NRTC Energies (Pvt.) Ltd) | (May-2023 - Present) | Head of Department (Design)

#### Job Summary

Responsible for leading the solar design team & Planning, overseeing the design and engineering of solar energy systems, and ensuring the successful execution of solar projects. This role involves strategic planning, technical expertise, project management, and team leadership.

#### **Key Performance Areas**

- Lead, mentor, and manage a team of solar design engineers.
- Provide technical guidance and support to team members.
- Manage the solar design department's project portfolio.
- Collaborate with project managers to ensure seamless project execution.
- Monitor project timelines, budgets, and quality standards.
- Identify and mitigate design-related risks.
- Oversee the design and engineering of solar PV systems, including rooftop and ground-mounted installations.
- Ensure that designs meet client requirements, industry standards, and regulatory compliance.
- Optimize solar panel layouts for maximum energy generation and efficiency.
- Review and approve design drawings, calculations, and specifications.
- Interface with clients to understand project requirements and expectations.
- Address client inquiries and concerns regarding the design phase.
- Ensure all designs adhere to local, state, and national regulations and building codes.
- Obtain necessary permits and approvals for solar projects.









# Prism Energy (InfraCo Asia - Singapore, PIDG, IAD) | (July-2021 ~ Present) | Manager Projects

### Job Summary

Responsible for overseeing and managing all aspects of solar energy projects from conception to completion. This role involves project planning, execution, team leadership, client interaction, and ensuring projects are delivered on time, within budget, and to the highest quality standards.

### Key Performance Areas

- i. Project Origination
  - Development of Project Proposals
  - Evaluation of Project Proposals
- ii. Project Initiation and Planning
  - Technical Due Diligence
  - IEE/EIA Assessment
  - Risk Assessment

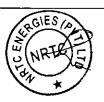
### iii. Project Construction and Control

- Establishment of the project team
- Coordination and management of project team
- Efficient management of resources ensuring deliverables are achieved on time.
- Support negotiations with Suppliers and Contractors
- Ensure successful completion of the execution phase, and delivery to the Operation & Maintenance division.
- Ensure accurate and continuous reporting of project progress to top management, key stakeholders and the SPV.
- Ensure effective contracts management of suppliers and service providers during execution.
- Identify contract breaches and manage project risks.
- iv. Project Closeout
  - Manage administration and close out of contracts.
  - Ensure the Sub-EPC adherence to project processes and procedures.
  - Prepare contract change notices, monitor contract performance, including the reporting and status of the Project.

#### Prism Energy (InfraCo Asia – Singapore, PiDG, IAD) | (July-2020 – June 2021) | Senior Design Engineer

#### Key Performance Areas

- Feasibility studies of projects under development.
- Energy Production Assessment (EPA) of pre-construction projects.
- Solar technology review and assessment of site suitability of solar plant equipment.
- Assessment of Balance of Plant (civil and electrical infrastructure).
- Assessment grid connection and Power Purchase Agreements (PPA).
- Due diligence activity includes data analysis, documentation review and risk analysis.
- Technical analysis of construction and operation contracts.
- Develop proposals for work, including budgets, appropriate contractual terms, and undertaking negotiations on scope and price with customers.
- Construction monitoring to assess construction progress and control the quality of the work.
- Construction contracts, project quality plans.
- Work on multiple projects, managing own time to meet deadlines.



### Four Brothers Energy | (Nov-2019 – July 2021) | Senior Design Engineer

#### **Key Performance Areas**

- Experience of Large-scale systems and plant designs (up to 50 MW) on the basis of Solar PPA, Lease and EPC model.
- Conceptualization of the design and necessary engineering calculations and simulations using computer software i.e., PVsyst.
- Performing site visits and measuring sites with proper layout drawings.
- Provide accurate design, generation, and production of PV projects designs for electrical engineering aspects needed for the project.
- Perform detailed energy production modeling calculations.
- Generation of preliminary layouts on Helioscope, sketch up, Auto Cad.
- Maintain design requirements, knowledge of codes and standards, design procedures, methods, and process, improve the efficiency of project development and project selection process.
- Generation of Project Bill of Quantity for electrical, mechanical, and civil scope of works.
- Prepares product reports by collecting, analyzing, and summarizing information and trends.
- Following up with Utilities formalities and applications required for the project development.
- Tender's documentation preparations and attending meetings with project teams and follow up.

Guangdong Dynavolt Renewable Technology | (Nov-2018 - Nov 2019) | Project Engineer

Guangdong Dynavolt Renewable Technology | (Nov-2016 – Nov-2018) | Design Engineer

### MAJOR PROJECTS UNDERTAKEN

#### A. UTILITY PROJECTS:

- 1. 168 MW Solar Power Project | July 2020 November 2020 | Vietnam.
- 2. 50 MW Solar Power Project | July 2022 March 2023 | Pakistan.
- 3. DABS 20MW On Grid Solar Solution | Dec 2018 Jan 2019 | Afghanistan
- 4. MAHAN 20MW On Grid Solar Solution | June 2015 Sep 2016 | Iran
- B. C & I PROJECTS (Power Purchase Agreements):
  - 5. 1500 kW Solar Power Project | Power Purchase Agreement (PPA) | May 2023 Present | Pakistan
  - 6. 926 kW Solar Power Project | Power Purchase Agreement (PPA) | August 2023 Present | Pakistan
  - 7. 1200 kW Solar Power Project | Power Purchase Agreement (PPA) | May 2022 September 2022 | Pakistan
  - 8. 1850 kW Solar Power Project | Power Purchase Agreement (PPA) | Nov 2021 April 2022 | Pakistan
  - 9. 2000 kW Solar Power Project | Power Purchase Agreement (PPA) | Nov 2021 April 2022 | Pakistan
  - 10. 942 kW Solar Power Project | Power Purchase Agreement (PPA) | Nov 2020 April 2021 | Pakistan
  - 11. UET 1 MW Solar Power Project | Power Purchase Agreement (PPA) | Nov 2020 April 2021 | Pakistan



### C. C& I PROJECTS (EPC):

- 12. 1.5 MW Solar Power Project | EPC | May 2023 September 2023 | Pakistan.
- 13. 1 MW Solar Power Project | EPC | March 2018 September 2018 | Pakistan.
- 14. ADB PMIC Pre-Qualification Document for Solar Home Solutions | May 2019 July 2019 | Pakistan.

#### PROFESSIONAL & ACADEMIC ACHIEVEMENTS

- Got achievement award on management of project construction of more than 10 MW Solar projects during March 2021 April 2022.
- 3rd position in Final year project- "Remote Monitoring of Distribution Transformer with Remote Access".
- Got Merit Scholarships at University and Intermediate levels.

#### TECHNICAL SKILLS

ftware (Simulation/Layout/Generation Studies)

Auto-Cad

PV-syst, SAM (NREL), Helioscope, Sketchup, K2 Base, PVCad

MATLAB, Power World Simulation

**Report writing** Office | Microsoft word, Latex

#### **Trainings & Courses**

Courses | PMP | In Progress

Courses | project Management and Quality Control by IAD Singapore.

Training | HSES - InfraCo Asia Singapore Quality Management Certification

Training | Pakistan Solar Quality Passport – Total Energies

Courses | Online Training Webinars by PV magazine and NABCEP.

# PERSONAL INFORMATION

P-Founder and Vice President of Project "SMILE"

education Ambassador at "The Citizen Foundation"

Book reading on History, PV magazine, Technology advancements globally.

REFERENCES

To be provided on demand



| Sr.<br>No. | Employee<br>ID | Employee<br>Name   | Designation                     | Educational Qualification   |
|------------|----------------|--------------------|---------------------------------|-----------------------------|
| 1          | 100001         | Jawad Anjum        | CEO                             | MBA/ BE(CS Engineer)        |
| 2          | 100016         | Zain ul abideen    | Project Engineer                | BS Electrical Engineering   |
| 3          | 100018         | Ahmed Mujeeb       | A.M Sales                       | BSC(Electrical)             |
| 4          | 100028         | Adnan Raza         | Technician                      | B.A and Electronic Diploma  |
| 5          | 100031         | Syed Waqar Ali     | Senior Manager Design           | B.Sc Electrical Engineering |
| 6          | 100059         | Musa Ali           | Site Engineer                   | BSC (ELECTRICAL)            |
| 7          | 100061         | Fatima Syeda       | Asst. Sales Manager             | BSc(electrical)             |
| 8          | 100067         | Israr Ahmad        | Technician                      | dae- civil                  |
| 9          | 100081         | M. Nasir           | Technician(resi)                | DAE-electrical              |
| 10         | 100091         | Farhan Ahmad       | AM - Ops                        | BS Electrical Technology    |
| 11         | 100094         | Jibrail Khalid     | Senior Sales Manager            | BSC(Electrical)             |
| 12         | 100099         | lmran Khosa        | Manager Operations-C&I          | BSE-EE                      |
| 13         | 100106         | Tanzeel Ur Rehman  | Site Engineer                   | BSC (ELECTRICAL)            |
| 14         | 100108         | Hassan Bhatti      | <b>Business Development Off</b> | BSC(Electrical)             |
| 15         | 100112         | Asmar Iftikhar     | Solution& Proposal Design       | BSC. ENGINEER               |
| 16         | 100117         | Rehan Mahmood Alvi | General Manager                 | PGD(LSCM)                   |
| 17         | 100097         | Maryam Tariq       | Project Coordinator             | MS Environmental Engineer   |
| 18         | 100121         | Muhammad Iqbal     | Civil Supervisor                | DAE                         |
| 19         | 100122         | Muhammad Shakir    | Project Engineer                | BSC Electrical              |
| 20         | 100123         | Ali Rahman         | Site Engineer                   | DAE CIVIL                   |
| 21         | 100124         | Sibtain Naseer     | Senior Manager - Projects       | BE Civil Engineer           |
| 22         | 100126         | Daniyal Khalid     | Assistant Sales Manager         | BS Electrical Engineering   |
| 23         | 100127         | Muhammad Ansar     | Business Development Off        | PHD (Energy )               |
| 24         | 100128         | Muhammad Umar Ro   | Mnager Design                   | MSc (Renewable )            |



# Introduction:

Extensive fossil fuel consumption in almost all human activities has led to some undesirable phenomena such as atmospheric and environmental pollution, which have not been experienced before in known human history. Consequently, global warming, greenhouse effect, climate change, ozone layer depletion, and acid rain terminologies started to appear in the literature frequently. Since 1970, it has been understood scientifically by experiments and researches that these phenomena are closely related to fossil fuel use because they emit greenhouse gases such as carbon dioxide (CO2) and methane (CH4), which hinder the tongwave terrestrial radiation escape into space, and, consequently, the earth troposphere becomes warmer. In order to avoid further impacts of these phenomena, the two concentrative alternatives are either to improve the fossil fuel quality with reductions in their harmful emissions into the atmosphere or, more significantly, to replace fossil fuel usage as much as possible with environmentally friendly, clean, and renewable energy sources. Among these sources, solar energy comes at the top of the list due to its abundance and more even distribution in nature than any other renewable energy type, such as wind, geothermal, hydro, wave, and tidal energies. Solar energy technologies are essential components of a sustainable energy future. Energy from fossil fuels may be inexpensive and assurances may have been given of the plentiful supplies of petroleum and other fossil fuels, but these fuels are finite in nature and a major source of greenhouse gas emissions.

### **Objective:**

Pakistan is located in the Sunny Belt and can take advantage of its ideal situation for utilization of solar energy. The country's potential for solar generation is beyond doubt as it has high solar irradiation and enough space for installation of generation system those are ideal for PV and other solar energy applications. Villages and other areas which are away from grid or distribution system of utilities can also benefit from solar power generation which will also save the extra cost of laying the system and the losses. Every day, for example, the country receives an average of about 19 Mega Joules per square meter of solar energy Pakistan being in the Sun Belt is ideally located to take advantage of solarenergy technologies. This energy source is widely distributed and abundantly available in the country. The mean global irradiation falling on horizontal surface is about 200-250 watt per sq.m in a day, This amounts to about 2500- 3000 sun shine hours and 1.9-2.3 MWh per sq. meter in a year. It has an average daily global isolation of 19 to 20 Mi/sq. meter per day with annual mean sunshine durations 8 to 8.5 hours (6-7hrs in cold and 10-12 hrs. in hot season) and these values are among the highest in the world.

For daily global radiation up to 23MJ/m2, 24(80%) consecutive days are available in this area for solar energy. Such conditions are ideal for solar thermal applications. Pakistan receives about 15.5x1014 kwh of solar irradiance each year with most regions receiving approximately 8 to 10 sunlight hours per day. The installed capacity of solar photovoltaic power is estimated to be 1600 GW per year, providing approximately 3.5 PWh of electricity (a figure approximately 41 times that of current power generation in the country). To summarize, the sun shines for 250-300 days per years in Pakistan with average sunshine hours of 8- 10 per day. This gives huge amount of energy to be used for electricity generation by solar photovoltaic and solar thermal power plants.

## **Environment Assessment:**

The Lahore and Okara project will be executed on within the premises of Purchaser, and the Applicant has carried out a detailed environment assessment of the site in preparation of the Solar PV Plant. The assessment of the Project has been considered for both positive and negative effects. The proposed photovoltaic Power Project has been located as per international guidelines. Adoption of green power generation with no emission and effluent discharge with have least impact on the ambient environment and on the host community.

The importance of the sustainable development concept has increased in the whole world. As a result, some new regulations enforce that all development projects should be compatible with the environmental criterions. An environmental impact assessment should be carried out to make sure that projects are compatible with the environmental criterions. Environmental Impact Assessment (EIA) can be defined as a process of environmental management, planning, and decision-making with a purpose of keeping and improving the quality of the environment. The main goal is to develop environmentally friendly industrialization. With this kind of environmentally friendly industrialization, "sustainable development" can be a possibility in the future by keeping the usage/protection balance between economic development and the environmental protection.

Every energy generation and transmission method affect the environment. Conventional signature generating options can damage air, climate, water, land & wildlife, landscape as well as raiser to be the levels of harmful radiation. PV technology is substantially safer offering a solution to heavy

environmental and social problems associated with fossil and nuclear fuels. Solar PV energy technology provides obvious environmental advantages in comparison to the conventional energy sources thus contributing to the sustainable development of human activities. Not counting the depletion of the exhausted natural resources, their main advantage is related to the reduced CO2 emissions and normally absence of any air emissions or waste products during their operations.

The use of solar power has additional positive implications such as:

- Reduction of the emissions of the greenhouse gases (mainly CO2, NOx) and prevention of toxic gas emissions (502, particulates)
- Reduction of the required transmission lines of the electricity grids.

# **Project Environmental Impacts & Mitigation Measure:**

This Section discusses the potential environmental impacts, assesses the significance, recommends mitigation measure to minimize the adverse effect and identifies the residual impacts associated with the proposed activities of the project during the construction and operation phase of the proposed project at the proposed site and of secondary actions like potable, raw water and waste water lines. Solar energy is a lot cleaner when compared with conventional energy sources. Solar energy systems have many significant advantages, like being cheaper and not producing any pollutants during operation, and being almost an infinite energy source when compared with fossil fuels. Nevertheless, solar energy systems have some certain negative impacts on the environment just like any other energy system. Some of these impacts will be summarized in this section.

# **Identification of Potential Impacts:**

- a) Discharge of Pollutants
- b) Visual Impacts
- c) Impact on Natural Resources
- d) Air Pollution
- e) Noise Intrusion
- f) Impact on Air
- g) Impact on Ground Water! Surface Water
- h) Impact on Solid Waste



i) Impact on Soil

j) Impact on Natural Resources

#### **Discharge of Pollutants:**

Solar cells do not emit any pollutants during their operations. But solar cell modules contain some toxic substances, and there is a potential risk of releasing these chemicals to the environment during a fire. Necessary precautions will be taken for emergency situations like fire.

#### **Visual Impacts:**

There will be some visual impacts depending on the type of the scheme and the surroundings of the solar cells. Especially for applications on the buildings, solar cells can be used as a cladding material that could be integrated into the building during the construction phase. Solar cell applications after the construction phase of the buildings might cause negative visual impacts. However, through proper planning the Applicant will minimize this impact.

#### **Impacts on Natural Resources:**

Despite being a benign energy system during operation, solar cells have some negative impacts on the environment during their production phase like many other systems. The energy needed for the production of solar energy systems is still produced in conventional methods today. Some toxic chemical substances used during the production phase are produced as a byproduct. However, the solar panels to be

utilized for this project have been manufactured in China therefore, there is no direct impact on the designated vicinity.

#### **Air Pollution:**

Solar cells do not emit any substances to the air during operation. But there could be some emissions during manufacturing and transport. The emissions associated with the transport of the modules are insignificant when compared with the emissions associated with the manufacture, Transport emissions are 0.1-1% of the manufacturing emissions.



#### **Noise Intrusion:**

Solar cells do not make a noise during operation. But during the construction phase, there will be a little noise as usual in other construction activities. However, since the solar panels to be utilized for this project have been manufactured in China, this is not a risk for the designated vicinity.

#### Impact on Air:

There would be no hazardous emissions at site as well as during construction phase except Motor Vehicle and Crane. Moreover, there are no objectionable odors as well as alternation of air temperature.

#### Impact on Ground Water/ Surface Water:

There would be no use of water during design phase except curing of civil pads during construction, which have no negative impact on environment.

#### Impact on Solid Waste:

It may only Create litter and trash waste which is recyclable and may be cleared from site after construction. Impact on Soil: No impacts as all installed systems are roof top.

#### **Impact on Natural Resources:**

There won't be any increase in the rate of usage of any natural resource like any minerals, additional fuel other than vehicles. But there would be increase in the amount of usage of Paper for mapping, enlisting items etc. However, paper may be recycled by throwing it in ordinary dustbin, further maximum usage of electronic system e.g., emails will be done.

#### **Environment Assessment:**

a) Almost all conventional methods of energy generation have varying degrees of adverse environmental impact. These methods have far reached detrimental effects on the climate, air, water, land and wildlife of the adjacent vicinities. However, Solar PV energy technology provides significant environmental advantages in comparison



to the conventional energy sources while contributing to the sustainable development of human activities. Besides slowing down the depletion of natural resources, the main environmental advantage is zero air emissions, waste production and eventual reduction in emissions of greenhouse gases (COx, NOx) and toxic gases (SOx).

b) Solar power plants have zero fuel requirement and hence limit the depletion of natural resources, fossil fuels. Unlike conventional thermal power plants, no water consumption is required for cooling purposes. A very optimized quantity of water is occasionally used for plant maintenance / cleaning. As stated earlier, the proposed system of 507p DC will offset approximately 607 tons of carbon dioxide annually.

| Environment | Level of | Reasons               | Mitigation           |
|-------------|----------|-----------------------|----------------------|
| Parameters  | Impact   |                       | Measures             |
| Air Impact  | Low      | Solar Energy          | No Emissions,        |
|             |          | Carbon Free           | however, during      |
|             |          |                       | construction         |
|             |          |                       | adequate measures    |
|             |          |                       | to limit dust        |
|             |          |                       | pollution will be    |
|             |          |                       | taken.               |
| Water       | Low      | Plant will require a  | Specialized          |
|             |          | very low quantity of  | equipment that       |
|             |          | water for cleaning    | conserves water will |
|             |          | purpose only          | be used to cleaning  |
|             |          |                       | the PV modules.      |
| Land        | Low      | No Impact on          | The land being       |
|             |          | Land                  | allocated for this   |
|             |          |                       | facility is baren.   |
| Ecosystem   | Low      | No                    | There is no          |
|             |          | ecologically          | significant          |
|             |          | sensitive area        | vegetation cover     |
|             |          | lies with in premises | within the selected  |
|             |          |                       | area, land is barren |

The Applicant has carried out environment assessment of the Site for installation of solar:

| Socio EcoSystem | Low 🔬 | Total area identified | Not Applicable |
|-----------------|-------|-----------------------|----------------|
|                 |       | for said project is   |                |
|                 |       | adjacent to the plant |                |
|                 | ~     | premises and no       |                |
|                 |       | acquisitions needed.  |                |
|                 |       | No displacement       |                |
|                 |       | will occur.           |                |



# **PVsyst - Simulation report**

Grid-Connected System

Project: Lahore Mes (CMH)

Variant: New simulation variant No 3D scene defined, no shadings System power: 1001 kWp Lahore MES (CMH) - Pakistan





## Project: Lahore Mes (CMH)

#### Variant: New simulation variant

**PVsyst V7.3.1** VC0, Simulation date: 08/01/24 10:37 with v7.3.1

|  |                      | Project s  | ummary ———                               |  |  |
|--|----------------------|--|--|--|--|
| Geographical Site<br>Lahore MES (CMH)<br>Pakistan      |                      | <b>Situation</b><br>Latitude<br>Longitude<br>Altitude<br>Time zone | 31.54 °N<br>74.37 °E<br>210 m<br>UTC+5   | <b>Project settings</b><br>Albedo            | 0.20                                   |
| Meteo data<br>Lahore MES (CMH)<br>Meteonorm 8.1 (1996- | 2015), Sat=100% - Sy | nthetic  |  |  |  |
|  |                      | System s   | ummary —                                 |  |  |
| Grid-Connected Sy<br>Simulation for year no            |                      | No 3D scene defin  | ed, no shadings                          |  |  |
| PV Field Orientatio<br>Fixed plane<br>Tilt/Azimuth     | n<br>26 / 0 °        | Near Shadings<br>No Shadings                                       |  | <b>User's needs</b><br>Unlimited load (grid) |  |
| System information                                     | n                    |  | Inverters                                |  |  |
| Nb. of modules<br>Pnom total                           |                      | 1726 units<br>1001 kWp   | Nb. of units<br>Pnom total<br>Pnom ratio |  | 3 units<br>900 kWac<br>1.112           |
|  |                      | Results s  | ummary — —                               |  |  |
| Produced Energy  | 1201970 kWh/year     | Specific production  | 1201 kWh/kWp/year                        | Perf. Ratio PR                               | 73.94 %                                |
|  |                      | Table of c   | contents                                 |  | ······································ |
| Project and results sur                                |                      | s, System losses   |  |  |  |
| Main results   |                      | -  |  |  |  |
|  |                      | · · · · · · · · · · · · · · · · · · ·                              |  |  |  |
|  |                      |  |  |  |  |
|  |                      |  |  |  |  |





#### **PVsyst V7.3.1** VC0, Simulation date: 08/01/24 10:37 with v7.3.1

**Grid-Connected System** 

26/0\*

**PV Field Orientation** 

## Project: Lahore Mes (CMH)

#### Variant: New simulation variant

#### General parameters

No 3D scene defined, no shadings

Sheds configuration No 3D scene defined

Horizon Free Horizon

Orientation

Fixed plane

Tilt/Azimuth

Near Shadings No Shadings Models usedTranspositionPerezDiffusePerez, MeteonormCircumsolarseparate

User's needs Unlimited load (grid)

|                            | PV Array C                | Characteristics          | · · · · ·               |
|----------------------------|---------------------------|--------------------------|-------------------------|
| PV module                  |                           | Inverter                 |                         |
| Manufacturer               | CSI Solar                 | Manufacturer             | Huawei Technologies     |
| Model                      | CS7L-580MB-AG 1500V       | Model                    | SUN2000-330KTL-H2       |
| (Original PVsyst database) |                           | (Custom parameters de    | efinition)              |
| Unit Nom. Power            | 580 Wp                    | Unit Nom. Power          | 300 kWac                |
| Number of PV modules       | 1726 units                | Number of inverters      | 3 units                 |
| Nominal (STC)              | 1001 kWp                  | Total power              | 900 kWac                |
| Array #1 - PV Array        |                           |                          |                         |
| Number of PV modules       | 868 units                 | Number of inverters      | 8 * MPPT 17% 1.3 unit   |
| Nominal (STC)              | 503 kWp                   | Total power              | 400 kWac                |
| Modules                    | 31 Strings x 28 In series |                          |                         |
| At operating cond. (50°C)  |                           | Operating voltage        | 500-1500 V              |
| Pmpp                       | 463 kWp                   | Max. power (=>30°C)      | 330 kWac                |
| U mpp                      | 854 V                     | Pnom ratio (DC:AC)       | 1.26                    |
| t mpp                      | 542 A                     | No Power sharing between | MPPTs                   |
| Array #2 - Sub-array #2    |                           |                          |                         |
| Number of PV modules       | 858 units                 | Number of inverters      | 10 * MPPT 17% 1.7 units |
| Nominal (STC)              | 498 kWp                   | Total power              | 500 kWac                |
| Modules                    | 33 Strings x 26 In series |                          |                         |
| At operating cond. (50°C)  |                           | Operating voltage        | <b>500-</b> 1500 V      |
| Pmpp                       | 457 kWp                   | Max. power (=>30°C)      | 330 kWac                |
| b mpp                      | 793 V                     | Pnom ratio (DC:AC)       | 1.00                    |
| Impp                       | 577 A                     | No Power sharing between | MPPTs                   |
| Total PV power             |                           | Total inverter power     |                         |
| Nominal (STC)              | 1001 kWp                  | Total power              | 900 kWac                |
| Total                      | 1726 modules              | Number of inverters      | 3 units                 |
| Module area                | 4885 m²                   | Pnom ratio               | 1.11                    |
|                            |                           | No Power sharing         |                         |

#### Array losses

| Array Soiling Los: | 5 <b>8</b> 5  | Thermal Loss factor     |                     | Serie Diode Loss   |              |
|--------------------|---------------|-------------------------|---------------------|--------------------|--------------|
| Loss Fraction      | 4.0 %         | Module temperature acco | rding to irradiance | Voltage drop       | 0.7 V        |
|                    |               | Uc (const)              | 29.0 W/m²K          | Loss Fraction      | 0.1 % at STC |
|                    |               | Uv (wind)               | 0.0 W/m²K/m/s       |                    |              |
| LID - Light induce | d Degradation | Module Quality Loss     |                     | Module mismatch    | losses       |
| Loss Fraction      | 2.0 %         | Loss Fraction           | -0.4 %              | Loss Fraction GIES | 2.0 % at MPP |
|                    |               |                         |                     |                    | -121         |



## Project: Lahore Mes (CMH)

#### Variant: New simulation variant

**PVsyst V7.3.1** VC0, Simulation date: 08/01/24 10:37 with v7.3.1

| Strings Mismatch los   | s                  | Module ave  | rage degrad    | ation                                   |           |                           |          |
|--|--------------------|---|----------------|---|-----------|---------------------------|----------|
| Loss Fraction  | 0.1 %              | Year no   | nage degrad    | 10                                      |           |                           |          |
|  |                    | Loss factor   |                | 0.4 %/year                              |           |                           |          |
|  |                    |   | e to degradati | •                                       |           |                           |          |
|  |                    | Imp RMS disp  | -              | 0.4 %/year                              |           |                           |          |
|  |                    | Vmp RMS dis   |                | 0.4 %/year                              |           |                           |          |
|  |                    |   | poraion        | 0.4 <i>16</i> /year                     |           |                           |          |
| IAM loss factor<br>Incidence effect (IAM): Us  | er defined profile |   |                |   |           |                           |          |
| 10° 20°  | 30°                | 40°   | 50°            | 60°                                     | 70°       | 80°                       | 90°      |
| 0.998 0.998  | 0.995              | 0.992   | 0.986          | 0.970                                   | 0.917     | 0.763                     | 0.000    |
|  |                    |   |                |   |           |                           |          |
|  |                    | DC  |                |   |           |                           |          |
|  |                    | DC  | wiring loss    | ies —                                   |           |                           | ·        |
| Global wiring resistance   | 10 mΩ              |   |                |   |           |                           |          |
| Loss Fraction  | 1.5 % at STC       |   |                |   |           |                           |          |
| Array #1 - PV Array  |                    |   | An             | ay #2 - Sub-ar                          | rav #2    |                           |          |
| Global array res.  |                    | 26 mΩ   |                | bal array res.                          |           | 23 r                      | nΩ       |
| Loss Fraction  |                    | 1.5 % at STC  |                | s Fraction                              |           | 1.5 %                     | % at STC |
|  | ·                  |   |                |   |           |                           |          |
|  |                    | S <sub>}</sub>                                      | ystem losse    |   | ······    |                           |          |
| Unavailability of the s  | ystem              | Auxiliaries I                                       | 055            |   |           |                           |          |
| ime fraction   | 3.4 %              | Proportionnal                                       | to Power       | 5.0 W/kW                                |           |                           |          |
|  | 12.4 days,         | 0.0 kW from P                                       |                |   |           |                           |          |
|  | 3 periods          | Night aux. con                                      | IS.            | 500 W                                   |           |                           |          |
|  |                    | AC  | wiring loss    | ies                                     | · · · -   |                           |          |
| i <b>nv. output line up to</b> l<br>nverter voltage  | WV transto         | 800 Vac tri   |                |   |           |                           |          |
| Loss Fraction  |                    | 0.08 % at STC                                       |                |   |           |                           |          |
| nverter: SUN2000-330K  | ri "H2             | 0.00 /0 8010  | Inv            | erter: SUN2000-:                        | 20KTI -42 |                           |          |
| Vire section (1 Inv.)  |                    | 3 x 240 mm²   |                |   |           | Alu 2 x 3 x 150 n         | 2        |
| Vires length   |                    | 20 m  |                | e section (2 Inv.)<br>rage wires length |           | Alu 2 X 3 X 150 II<br>0 r |          |
| -  |                    | 20 111  | Ave            | rage miles leligti                      | •         | Ur                        | 11       |
| MV line up to injection  | า                  |   |                |   |           |                           |          |
| VV Voltage   |                    | 11 kV   |                |   |           |                           |          |
| Nires  | Alu 3              | 3 x 120 mm²   |                |   |           |                           |          |
| _ength   |                    | 100 m   |                |   |           |                           |          |
| loss Fraction  |                    | 0.02 % at STC                                       |                |   |           |                           |          |
|  |                    | - AC loss   | es in transf   | ormers                                  |           |                           |          |
|  |                    |   |                |   |           |                           |          |
| WV transfo   |                    |   |                |   |           |                           |          |
| <b>MV transfo</b><br>Medium voltage  |                    | 11 kV   |                |   |           |                           |          |
| <b>VV transfo</b><br>Medium voltage<br>Fransformer from Datasi   | neets              | 11 kV   |                |   |           |                           |          |
| Medium voltage<br>Fransformer from Datas   | neets              |   |                |   |           |                           |          |
| Medium voltage<br>Fransformer from Datas<br>Nominal power  |                    | 1250 kVA  |                |   |           |                           |          |
| Medium voltage<br>Fransformer from Datas<br>Nominal power<br>ron Loss (24/24 Connexi                                     |                    | 1250 kVA<br>1.00 kVA                                |                |   |           |                           |          |
| Medium voltage<br>Fransformer from Datas<br>Nominal power<br>ron Loss (24/24 Connexi<br>ron loss fraction                |                    | 1250 kVA<br>1.00 kVA<br>0.08 % of PNom              |                |   |           | ES                        |          |
| Medium voltage<br>Fransformer from Datas<br>Nominal power<br>ron Loss (24/24 Connexi<br>ron loss fraction<br>Copper loss |                    | 1250 kVA<br>1.00 kVA<br>0.08 % of PNom<br>20.00 kVA |                |   | 44        | ESIP                      |          |
| Medium voltage<br>Fransformer from Datas<br>Nominal power<br>ron Loss (24/24 Connexi<br>ron loss fraction                | on)                | 1250 kVA<br>1.00 kVA<br>0.08 % of PNom              |                |   | ENED      | ES (Q)                    |          |



PVsyst V7.3.1 VC0, Simulation date: 08/01/24 10:37 with v7.3.1

## Project: Lahore Mes (CMH)

Variant: New simulation variant

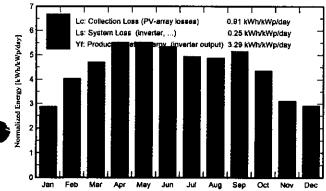
#### Main results

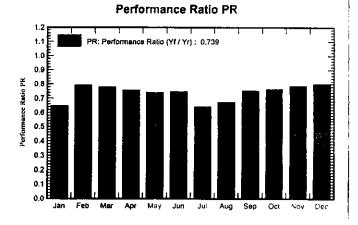
#### System Production

Produced Energy (P50) 1201970 kWh/year Produced Energy (P90) 1103932 kWh/year Produced Energy (P99) 1024030 kWh/year Specific production (P50) Produced Energy (P90) Produced Energy (P99)

1201 kWh/kWp/year Performance Ratio PR 73.94 % 1103 kWh/kWp/year 1023 kWh/kWp/year







|           | GlobHor | DiffHor | T_Amb | Globinc | GlobEff | EArray        | PR    |
|-----------|---------|---------|-------|---------|---------|---------------|-------|
|           | kWh/m²  | kWh/m²  | °C    | kWh/m²  | kWh/m²  | kWh           | ratio |
| January   | 69.8    | 43.8    | 11.97 | 89.2    | 84.1    | 75051         | 0.648 |
| February  | 91.5    | 47.0    | 16.08 | 112.8   | 106.6   | 93022         | 0.793 |
| March     | 130.8   | 77.5    | 22.10 | 145.7   | 137.2   | 117704        | 0.779 |
| Aprii     | 160.2   | 87.6    | 27.05 | 165.9   | 156.2   | 130724        | 0 760 |
| Мау       | 176.0   | 99.4    | 33.10 | 171.5   | 161.5   | 132088        | 0.742 |
| June      | 169.5   | 102.6   | 33.05 | 160.2   | 150.7   | 124093        | 0.747 |
| July      | 160.6   | 102.3   | 31.57 | 153.2   | 144.1   | 119855        | 0.641 |
| August    | 151.4   | 95.3    | 30.79 | 151.6   | 142.7   | 118810        | 0.675 |
| September | 141.5   | 71.5    | 29.07 | 154.5   | 145.6   | 121017        | 0.755 |
| October   | 115.7   | 69.5    | 26.00 | 135.2   | 127.6   | 107744        | 0.768 |
| tovember  | 76.5    | 52.0    | 19.07 | 93.4    | 88.0    | 76644         | 0.788 |
| December  | 68.5    | 41.9    | 13.92 | 90.7    | 85.5    | <b>75</b> 726 | 0.801 |
| Year      | 1511.9  | 890.5   | 24.52 | 1623.8  | 1529.9  | 1292479       | 0.739 |

## **Balances and main results**

## Clabilla

| reguinas |  |
|----------|--|
| GlobHor  | Global horizontal irradiation                |
| DiffHor  | Horizontal diffuse irradiation               |
| T_Amb    | Ambient Temperature                          |
| GlobInc  | Global incident in coll. plane               |
| GlobEff  | Effective Global, corr. for IAM and shadings |
|          |  |

EArray PR

Effective energy at the output of the array Performance Ratio







PVsyst V7.3.1 VC0, Simulation date: 08/01/24 10:37 with v7.3.1

## Project: Lahore Mes (CMH)

#### Variant: New simulation variant

|                       | Loss dia        | A.e.u.   |
|-----------------------|-----------------|--|
| 1512 kWh/m²           |                 | Global horizontal irradiation  |
|                       | +7.4%           | Global incident in coll. plane   |
|                       | -1.86%          | IAM factor on global   |
|                       | -4.00%          | Soiling loss factor  |
| 1530 kWh/m² * 4885    | m² coll.        | Effective irradiation on collectors  |
| efficiency at STC = 2 | 20.58%          | PV conversion  |
| 1538279 kWł           | 1               | Array nominal energy (at STC effic.)   |
|                       | -3.80%          | Module Degradation Loss ( for year #10)  |
|                       | 9 -0.27%        | PV loss due to irradiance level  |
|                       | -6.53%          | PV loss due to temperature   |
|                       | <b>(+0.43%</b>  | Module quality loss  |
|                       | -2.00%          | LID - Light induced degradation  |
|                       | 9-3.91%         | Mismatch loss, modules and strings<br>(including 1.8% for degradation dispersior |
|                       | -0.93%          | Ohmic wiring loss  |
| 1292479 kWh           |                 | Array virtual energy at MPP  |
|                       | -1.66%          | Inverter Loss during operation (efficiency)                                      |
|                       | 9 0.00%         | Inverter Loss over nominal Inv. power  |
|                       | 0.00%           | Inverter Loss due to max. input current  |
|                       | 9 0.00%         | Inverter Loss over nominal inv. voltage  |
|                       | <b>→</b> -0.01% | Inverter Loss due to power threshold   |
|                       | 9 0.00%         | Inverter Loss due to voltage threshold   |
|                       | ) -0.01%        | Night consumption  |
| 1270870 kWh           |                 | Available Energy at Inverter Output  |
|                       | <b>-</b> 0.66%  | Auxiliaries (fans, other)  |
|                       | 9 -0.03%        | AC ohmic loss  |
|                       | 4 -1.24%        | Medium voltage transfo loss  |
|                       | 9 -0.01%        | MV line ohmic loss   |
|                       | -3.55%          | System unavailability  |
| 1201970 kWh           |                 | Energy injected into grid  |



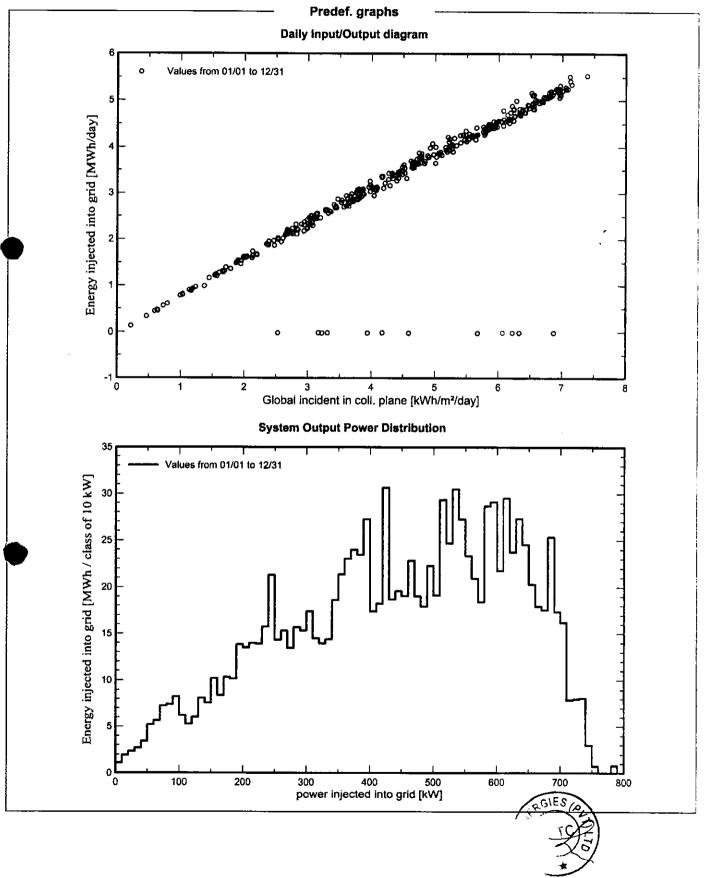
...



Project: Lahore Mes (CMH)

Variant: New simulation variant

**PVsyst V7.3.1** VC0, Simulation date: 08/01/24 10:37 with v7.3.1





## Project: Lahore Mes (CMH)

#### Variant: New simulation variant

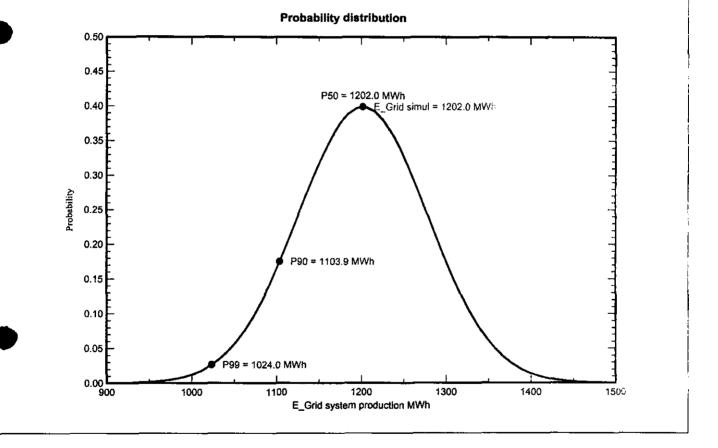
**PVsyst V7.3.1** VC0, Simulation date: 08/01/24 10:37 with v7.3.1

|             |                           |                 | F 30 |
|-------------|---------------------------|-----------------|------|
| Meteo d     | ata                       |                 |      |
| Source      | Meteonorm 8.1 (1996-20    | 015), Sat=100%  |      |
| Kind        | Mc                        | onthly averages |      |
| Synthetic   | - Multi-year average      |                 |      |
| Year-to-y   | ear variability(Variance) | 6.1 %           |      |
| Specified   | 1 Deviation               |                 |      |
| Climate o   | hange                     | 0.0 %           |      |
| Global      | /ariability (meteo + sys  | stem)           |      |
| Variability | (Quadratic sum)           | 6.4 %           |      |
|             |                           |                 |      |

#### P50 - P90 evaluation

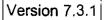
| Simulation and parameters uncerta  | ainties    |
|------------------------------------|------------|
| PV module modelling/parameters     | 1.0 %      |
| inverter efficiency uncertainty    | 0.5 %      |
| Soiling and mismatch uncertainties | 1.0 %      |
| Degradation uncertainty            | 1.0 %      |
| Annual production probability      |            |
| Variability                        | 76.5 MWh   |
| P50                                | 1202.0 MWh |
| P90                                | 1103.9 MWh |

1024.0 MWh



P99







# **PVsyst - Simulation report**

Grid-Connected System

Project: MES Lahore (MM Line)

Variant: New simulation variant No 3D scene defined, no shadings System power: 501 kWp Lahore MES (MM Line) - Pakistan



Author



.

## Project: MES Lahore (MM Line)

#### Variant: New simulation variant

**PVsyst V7.3.1** VC0, Simulation date: 08/01/24 10:48 with v7.3.1

|  |                            | —— Project s   | ummary                                   |   |                              |
|--|----------------------------|--|--|---|------------------------------|
| Geographical Site<br>Lahore MES (MM Lin<br>Pakistan              | e)                         | <b>Situation</b><br>Latitude<br>Longitude<br>Attitude<br>Time zone | 31.51 °N<br>74.36 °E<br>207 m<br>UTC+5   | Project settings<br>Albedo                  | 0.20                         |
| <b>Meteo data</b><br>Lahore MES (MM Line<br>Meteonorm 8.1 (1996- | )<br>2015), Sat=100% - Syr | nthetic  |  |   |                              |
|  |                            | System s   | summary                                  | ····  |                              |
| Grid-Connected Sy<br>Simulation for year no                      |                            | No 3D scene defin  | ed, no shadings                          |   |                              |
| <b>PV Field Orientatio</b><br>Fixed plane<br>Tilt/Azimuth        | n<br>26 / 0 °              | <b>Near Shadings</b><br>No Shadings                                |  | <b>User's needs</b><br>Unlimited load (grid | )                            |
| System information<br>PV Array                                   | n                          |  | Inverters                                |   |                              |
| Nb. of modules<br>Pnom total                                     |                            | 864 units<br>501 kWp   | Nb. of units<br>Pnom total<br>Pnom ratio |   | 2 units<br>600 kWac<br>0.835 |
|  |                            |  | umma <del>r</del> y                      |   |                              |
| Produced Energy  | 593959 kWh/year            | Specific production  | 1185 kWh/kWp/year                        | Perf. Ratio PR                              | 72.74 %                      |
| ·····  |                            | Table of d   | contents                                 |   |                              |
| •  | V Array Characteristics    | s, System losses   |  |   |                              |
| Loss diagram   |                            |  |  |   |                              |
|  |                            |  |  |   |                              |





**PVsyst V7.3.1** VC0, Simulation date: 08/01/24 10:48 with v7.3.1

## Project: MES Lahore (MM Line)

#### Variant: New simulation variant

|  |                     | Ger              | eral param      | eters —            | · · · ·          | -             |              |  |
|--|---------------------|------------------|-----------------|--------------------|------------------|---------------|--------------|--|
| Grid-Connected Sys                     | tem                 | No 3D scei       | ne defined, n   | o shadings         |                  |               |              |  |
| <b>PV Field Orientation</b>            |                     |                  |                 |                    |                  |               |              |  |
| Orientation                            |                     | Sheds confi      | guration        |                    | Models us        | sed           |              |  |
| Fixed plane                            |                     | No 3D scene      | defined         |                    | Transposit       | tion          | Perez        |  |
| Tilt/Azlmuth                           | 26/0°               |                  |                 |                    | Diffuse          | Perez, Met    | eonorm       |  |
|  |                     |                  |                 |                    | Circumsol        | ar s          | eparate      |  |
| Horizon                                |                     | Near Shad        | inas            |                    | User's n         | ande          |              |  |
| Free Horizon                           |                     | No Shadings      | -               |                    | Unlimited I      |               |              |  |
| ······································ | ·                   | – PV Arı         | ray Charact     | eristics -         | ·                |               |              |  |
| PV module                              |                     |                  | Inv             | verter             |                  |               |              |  |
| Manufacturer                           |                     | CSI Solar        | Ma              | nufacturer         |                  | Huawei 1      | Technologies |  |
| Model                                  | CS7L-5              | 580MB-AG 1500V   | Mo              | del                |                  | SUN2000       | -330KTL-H2   |  |
| (Original PVsyst data                  | abase)              |                  |                 | (Custom paramet    | ters definition) |               |              |  |
| Unit Nom. Power                        |                     | 580 Wp           | Un              | t Nom. Power       |                  | 300           | 0 kWac       |  |
| Number of PV modules                   |                     | 864 units        | Nu              | mber of inverters  |                  | 2             | 2 units      |  |
| Nominal (STC)                          |                     | 501 kWp          | Tot             | al power           |                  | 600           | 0 kWac       |  |
| Modules                                | 32 String           | s x 27 in series | Ор              | erating voltage    |                  | 500-1500      | υv           |  |
| At operating cond. (50°                | C)                  |                  |                 | x. power (=>30°C)  | )                | 330           | 0 kWac       |  |
| Ртрр                                   |                     | 460 kWp          | Pn              | om ratio (DC:AC)   |                  | 0.84          | 4            |  |
| U mpp                                  |                     | 823 V            | Po              | ver sharing within | this inverter    |               |              |  |
| l mpp                                  |                     | 559 A            |                 |                    |                  |               |              |  |
| Total PV power                         |                     |                  | То              | tal inverter pow   | /er              |               |              |  |
| Nominal (STC)                          |                     | 501 kWp          |                 | al power           |                  | 600           | ) kWac       |  |
| Total                                  |                     | 864 modules      |                 | nber of inverters  | 2 units          |               | 2 units      |  |
| Module area                            |                     | 2445 m²          | Pn              | om ratio           |                  | 0.84          | 0.84         |  |
|  |                     |                  | Array losse     | s ——               |                  |               |              |  |
| Array Soiling Losses                   | •                   | Thermal Lo       | ss factor       |                    | DC wirin         | g losses      |              |  |
| Loss Fraction                          | 4.0 %               | Module temp      | erature accordi | ng to irradiance   | Global arra      | ay res.       | 24 mΩ        |  |
|  |                     | Uc (const)       |                 | 29.0 W/m²K         | Loss Fract       | ion           | 1.5 % at ST  |  |
| •                                      |                     | Uv (wind)        |                 | 0.0 W/m²K/m/s      |                  |               |              |  |
| Serie Diode Loss                       |                     | LID - Light      | Induced Deg     | radation           | Module C         | Quality Loss  |              |  |
| Voltage drop                           | 0.7 V               | Loss Fraction    | -               | 2.0 %              | Loss Fract       | -             | -0.4 %       |  |
| Loss Fraction                          | 0.1 % at STC        |                  |                 |                    |                  |               |              |  |
| Module mismatch lo                     | 65 <b>8</b> 5       | Strings Mis      | match loss      |                    | Module a         | verage degra  | adation      |  |
| Loss Fraction                          | 2.0 % at MPP        | Loss Fraction    |                 | 0.1 %              | Year no          |               | 10           |  |
|  |                     |                  |                 |                    | Loss factor      | r             | 0.4 %/year   |  |
|  |                     |                  |                 |                    | Mismatch         | due to degrad |              |  |
|  |                     |                  |                 |                    | Imp RMS o        | dispersion    | 0.4 %/year   |  |
|  |                     |                  |                 |                    | Vmp RMS          | dispersion    | 0 4 %/year   |  |
| AM loss factor                         |                     |                  |                 |                    |                  |               |              |  |
| incidence effect (IAM): U              | ser defined profile |                  |                 |                    |                  |               |              |  |
| 10° 20'                                | 30°                 | 40°              | 50°             | 60°                | 70°              | 80°           | 90*          |  |
| 10 20                                  |                     |                  |                 |                    |                  |               | 50           |  |

0.986

0.970

0.000

Page 3/8

0.917

0.998

0.998

0.995

0.992



#### Variant: New simulation variant

**PVsyst V7.3.1** VC0, Simulation date: 08/01/24 10:48 with v7.3.1

|                             |                                       | System los               | ses                  |        |
|-----------------------------|---------------------------------------|--------------------------|----------------------|--------|
| Unavailability of the       | system                                | Auxiliaries loss         |                      |        |
| Time fraction               | 3.4 %                                 | Proportionnal to Power   | 5.0 W/kW             |        |
|                             | 12.4 days,                            | 0.0 kW from Power threst | i.                   |        |
|                             | 3 periods                             | Night aux. cons.         | 500 W                |        |
|                             | · · · · · · · · · · · · · · · · · · · | AC wiring lo             | \$\$ <del>6</del> \$ |        |
| inv. output line up to      | MV transfo                            |                          |                      |        |
| Inverter voltage            |                                       | 800 Vac tri              |                      |        |
| Loss Fraction               |                                       | 0.10 % at STC            |                      |        |
| Inverter: SUN2000-330H      | (TL-H2                                |                          |                      |        |
| Wire section (2 Inv.)       | Alu 2 x 3                             | x 240 mm²                |                      |        |
| Average wires length        |                                       | 20 m                     |                      |        |
| MV line up to Injectio      | n                                     |                          |                      |        |
| MV Voltage                  |                                       | 11 kV                    |                      |        |
| Wires                       | Alu 3 x 95 mm²                        |                          |                      |        |
| Length                      | 100 m                                 |                          |                      |        |
| Loss Fraction               |                                       | 0.01 % at STC            |                      |        |
|                             |                                       | - AC losses in trar      | sformers             | ······ |
| MV transfo                  |                                       |                          |                      |        |
| Medium voltage              |                                       | 11 kV                    |                      |        |
| Transformer from Datas      | sheets                                |                          |                      |        |
| Nominal power               |                                       | 630 kVA                  |                      |        |
| Iron Loss (24/24 Connex     | ion)                                  | on) 1.00 kVA             |                      |        |
| Iron loss fraction          |                                       | 0.16 % of PNom           |                      |        |
| Copper loss                 |                                       | 20.00 kVA                |                      |        |
| Copper loss fraction        |                                       | 3.17 % at PNom           |                      |        |
| Coils equivalent resistance | xe 3 x                                | 32.25 mΩ                 |                      |        |





#### PVsyst V7.3.1 VC0, Simulation date: 08/01/24 10:48 with v7.3.1

## Project: MES Lahore (MM Line)

#### Variant: New simulation variant

#### Main results

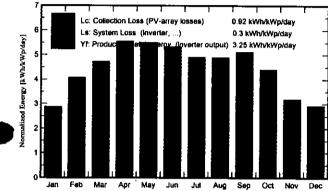
#### **System Production**

Produced Energy (P50) 593959 kWh/year Produced Energy (P90) 556330 kWh/year Produced Energy (P99) 525662 kWh/year

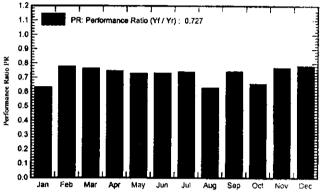
Wh/year Speci Wh/year Produ Wh/year Produ

Specific production (P50) Produced Energy (P90) Produced Energy (P99) 1185 kWh/kWp/yearPerformance Ratio PR72.74 %1110 kWh/kWp/year1049 kWh/kWp/year

## Normalized productions (per installed kWp)



Performance Ratio PR



#### GlobHor DiffHor T\_Amb GlobInc GlobEff EArray E\_Grid PR kWh/m² kWh/m² °C kWh/m<sup>2</sup> kWh/m<sup>2</sup> kWh kWh ratio 69.8 43.7 January 11.88 89.2 84.1 37531 28331 0.634 February 92.3 46.7 16.09 114.0 107.7 46962 44484 0.779 March 131.6 77.3 22.10 146.8 138.3 59265 56348 0.766 161.0 April 87.3 27.05 166.8 157.0 65711 62574 0.749 Мау 176.7 96.9 170.8 32.91 160.7 65704 62568 0.731 June 169.5 100.5 32.80 160.2 150.8 61926 58956 0.735 160.5 102.3 July 31.45 152.3 143.1 595**9**4 **567**15 0.743 August 151.5 96.0 30.72 151.7 142.8 59496 48077 0.633 September 141.8 76.6 29.06 154.1 145.1 60591 57635 0.746 October 116.4 68.0 25.94 136.8 129.1 54502 45298 0.661 November 77.4 49.9 19.09 96.0 90.5 39361 37144 0.772 December 68.6 41.9 13.95 90.9 85.7 38037 35830 0.786 1517.1 887.0 Year 24.46 1629.4 1535.0 648681 593959 0.727

## Balances and main results

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





#### Variant: New simulation variant

**PVsyst V7.3.1** VC0, Simulation date: 08/01/24 10:48 with v7.3.1

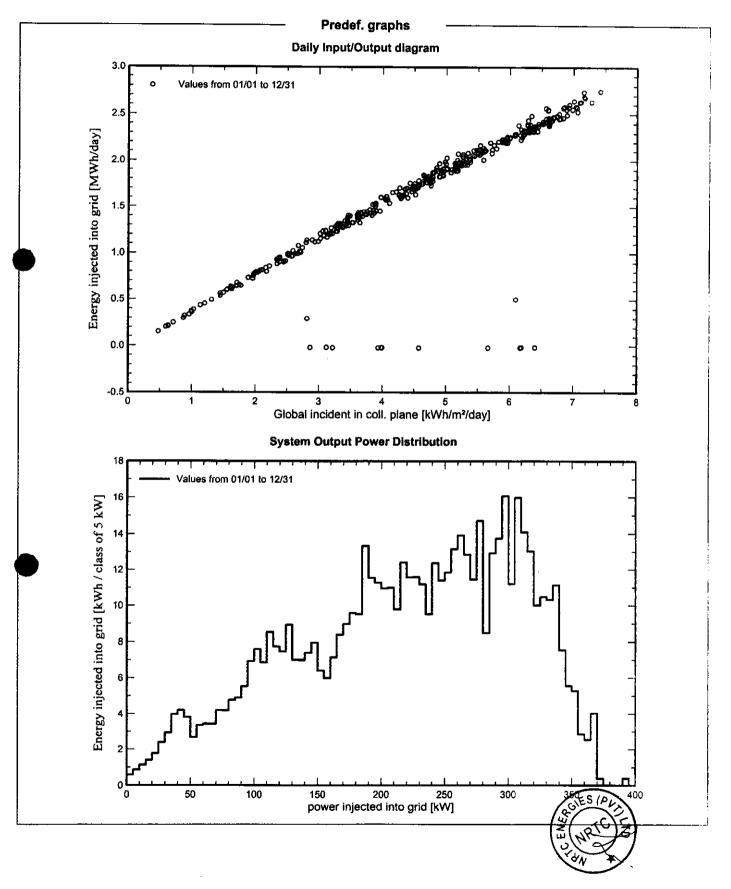
|   |                          | Loss dia        | gram   |   |
|---|--------------------------|-----------------|--|---|
|   | 1517 kWh/m²              |                 | Global horizontal irradiation  |   |
|   |                          | +7.4%           | Global incident in coll. plane   |   |
|   |                          | -1.87%          | IAM factor on global   |   |
|   |                          | -4.00%          | Soiling loss factor  |   |
|   | 1535 kWh/m² * 2445 m²    | coll.           | Effective irradiation on collectors  |   |
|   | efficiency at STC = 20.5 | 8%              | PV conversion  |   |
|   | 772638 kWh               |                 | Array nominal energy (at STC effic.)   |   |
| ] |                          | 3.80%           | Module Degradation Loss ( for year #10)  |   |
|   |                          | +-0.27%         | PV loss due to irradiance level  |   |
|   |                          | -6.47%          | PV loss due to temperature   |   |
| { |                          | <b>(+0.43%</b>  | Module quality loss  | i |
|   |                          | -2.00%          | LID - Light induced degradation  |   |
|   |                          | 4.00%           | Mismatch loss, modules and strings<br>(including 1.9% for degradation dispersion |   |
|   |                          | -0.98%          | Ohmic wiring loss  |   |
|   | 648681 kWh               |                 | Array virtual energy at MPP  |   |
|   |                          | 9-1.69%         | Inverter Loss during operation (efficiency)                                      | ļ |
|   |                          | 9 0.00%         | Inverter Loss over nominal inv. power  |   |
| 1 |                          | > 0.00%         | Inverter Loss due to max. input current  | ĺ |
|   |                          | ₩ 0.00%         | Inverter Loss over nominal inv. voltage  |   |
|   |                          | 9 0.00%         | Inverter Loss due to power threshold   |   |
|   |                          | <b>∀ 0.00%</b>  | Inverter Loss due to voltage threshold   |   |
|   |                          | <b>→</b> -0.01% | Night consumption  |   |
|   | 637660 kWh               |                 | Available Energy at Inverter Output  |   |
|   |                          | -0.84%          | Auxiliaries (fans, other)  |   |
|   |                          | 9-0.04%         | AC ohmic loss  | ļ |
| 8 |                          | -2.46%          | Medium voltage transfo loss  |   |
|   |                          | 9 -0.01%        | MV line ohmic loss   |   |
|   |                          | 9-3.64%         | System unavailability  |   |
|   | 593959 kWh               |                 | Energy injected into grid  |   |
|   |                          | )               |  | ļ |





Variant: New simulation variant

**PVsyst V7.3.1** VC0, Simulation date: 08/01/24 10:48 with v7.3.1





#### Variant: New simulation variant

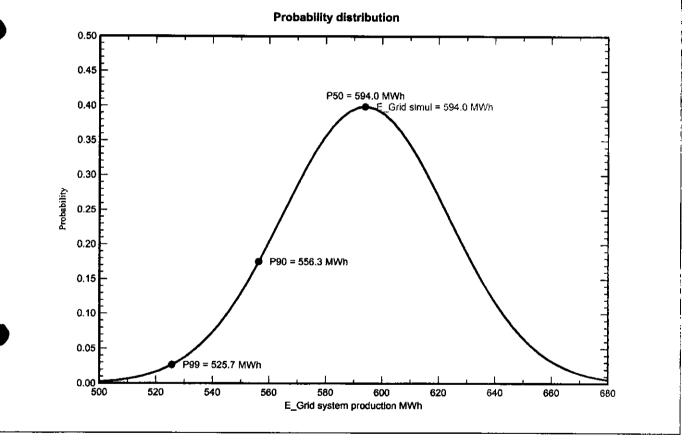
PVsyst V7.3.1 VC0, Simulation date: 08/01/24 10:48 with v7.3.1

|             |                             | 1.0        |
|-------------|-----------------------------|------------|
| Meteo d     | lata                        |            |
| Source      | Meteonorm 8.1 (1996-2015),  | Sat=100%   |
| Kind        | Monthi                      | y averages |
| Synthetic   | - Multi-year average        |            |
| Year-to-y   | ear variability(Variance)   | 4.6 %      |
| Specified   | d Deviation                 |            |
| Climate o   | hange                       | 0.0 %      |
| Global v    | variability (meteo + system | 1)         |
| Variability | (Quadratic sum)             | 4.9 %      |
|             |                             |            |

#### P50 - P90 evaluation

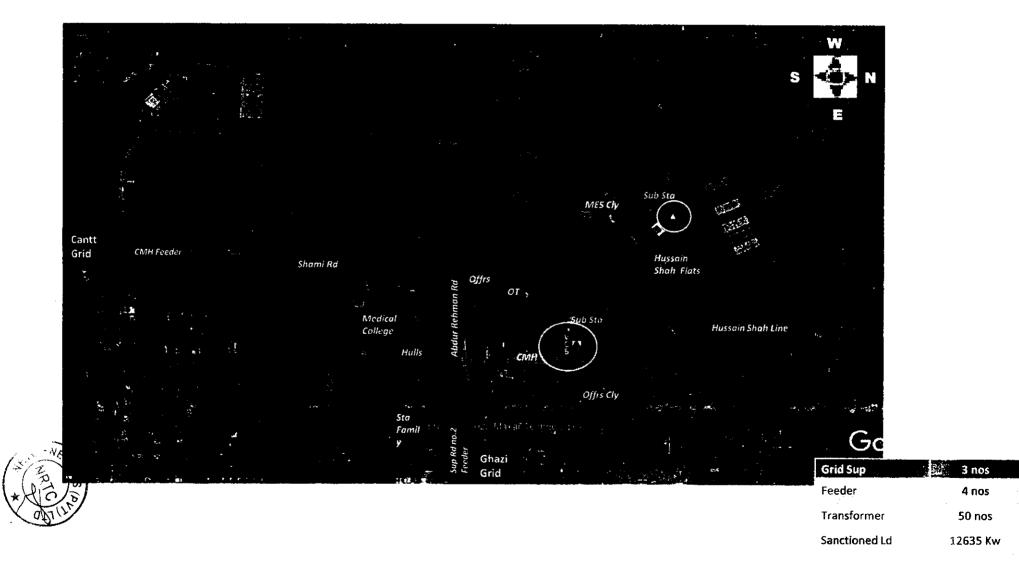
| PV module modelling/parameters     | 1.0 %                  |
|------------------------------------|------------------------|
| Inverter efficiency uncertainty    | 0.5 %                  |
| Soiling and mismatch uncertainties | 1.0 %                  |
| Degradation uncertainty            | 1.0 %                  |
| Annual production probability      |                        |
| Variability                        | 29.3 MWh               |
| <b>BFA</b>                         |                        |
| P50                                | 594.0 MWh              |
| P50<br>P90                         | 594.0 MWh<br>556.3 MWh |

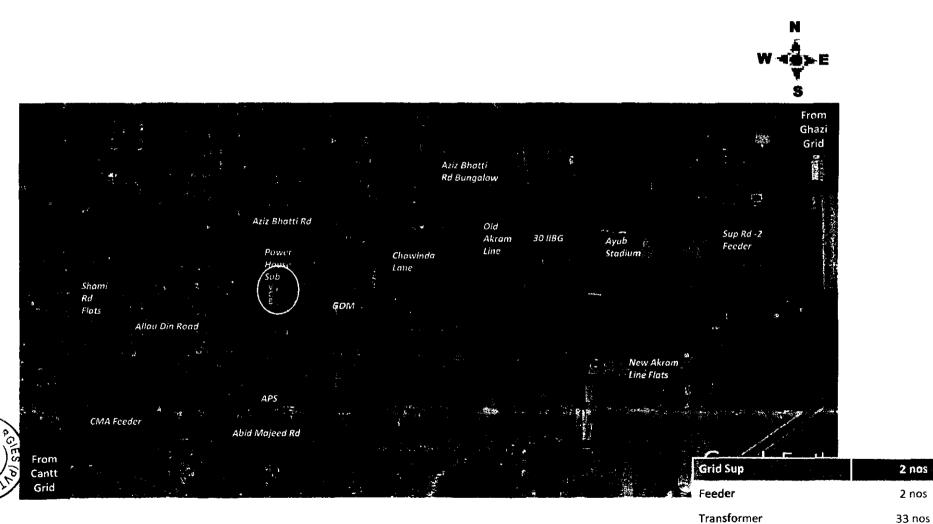
Simulation and parameters uncertainties



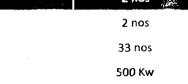


## Proposed Solar 1 MW – CMH Feeder from Cantt Grid



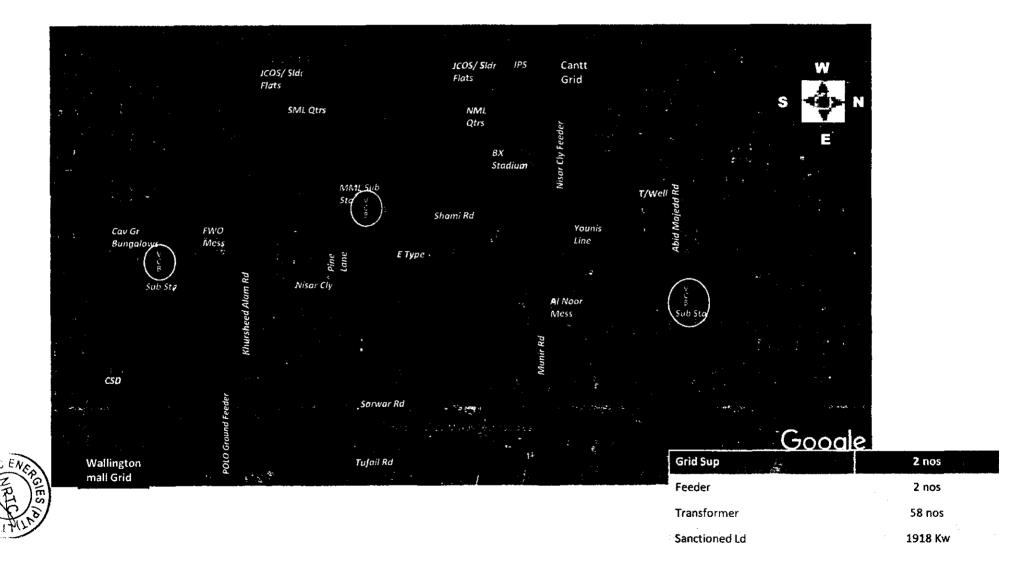


## Proposed Solar 0.5 MW - Akram Line - CMA Feeder from Cantt Grid

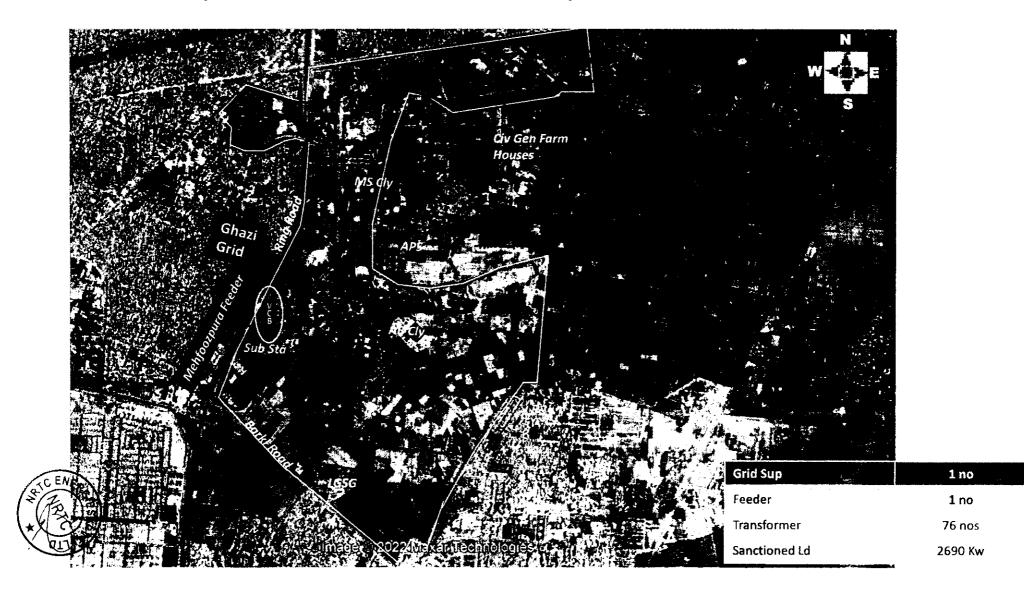


Sanctioned Ld

## Proposed Solar 0.5 MW – MM Line – Nisar Cly Feeder from Cantt Grid

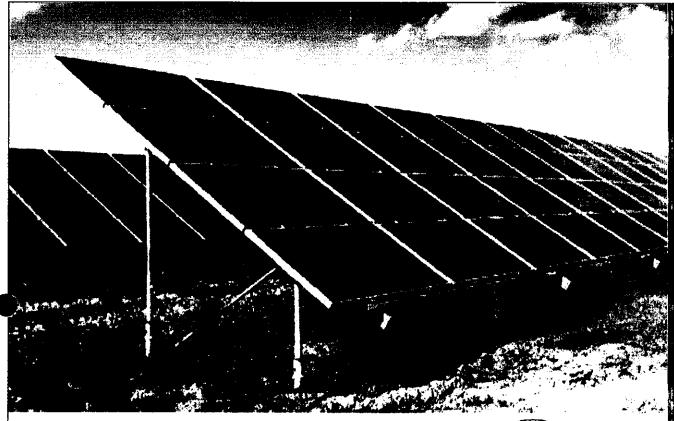


## Proposed Solar 0.5 MW – MSG – Mehfoozpura Feeder from Ghazi Grid



|  | Capacity and Degradation Factor (3.5MW)  |             |             |             |             |           |  |
|--|--|-------------|-------------|-------------|-------------|-----------|--|
|  | Description  | CMH Lahore  | Okara       | MM Lines    | Akram Lines | MSG       |  |
| Sr. No.  | Description  | 1MW         | 1MW         | 500kW       | 500kW       | 500kW     |  |
| 1  | Total Installed Capacity of the<br>Generation Facility/Solar Power<br>Plant! Ground Mount Solar  | 1,000       | 1,000       | 500         | 500         | 500       |  |
| Average Sun Hour Availability/<br>2 Day (Irradiation on Inclined<br>Surface) |  | 5 - 5.5 Hrs | - 5.5 Hrs |  |
| 3  | No. of days per year   | 365         | 365         | 365         | 365         | 365       |  |
| 4  | Annual generating capacity of<br>Generation Facility/Solar Power<br>Plantl Ground Mount Solar (As<br>Per Simulation) (MW)  | 1,391.4     | 1,391.4     | 695.7       | 695.7       | 695.7     |  |
| 5  | Total expected generation of the<br>Generation Facility/Solar Power<br>Plant! Ground Mount Solar during<br>the twenty-five (25) years term of<br>this license (MW) with Degradation Factor | 28,524      | 28,629      | 14,088      | 14,175      | 14,227    |  |
| 7  | Net Capacity Factor of<br>Generation Facility/Solar Power<br>Plant! Ground Mount Solar   | 15.86       | 15.90       | 15.76       | 15.80       | 15.82     |  |
| 8  | Degradation Factor after 25 years  | 18.00       | 17.70       | 19.00       | 18.50       | 18.20     |  |









# SYSTEM STUDY ANALYSIS OF COMBINED MILITARY HOSPITAL (CMH) 999kW SOLAR PV SYSTEM

Report

ARCO Energy **PAKISTAN** 

Tel: +92-300-8827101





٠

## CONTENTS

| EXECUTIVE SUMMARY  |
|--|
| 1 INTRODUCTION   |
| 1.1 Project Description  |
| 1.2 Interconnection Arrangement  |
| 1.3 Objective of System Study Analysis   |
| 1.4 Study Components   |
| 2 STUDY METHODOLOGY  |
| 2.1 Study Criteria   |
| 2.2 Steady State Analysis  |
| 2.2.1 System Intact Analysis   |
| 2.2.2 Transmission Line Loading Analysis                                       |
| 2.2.3 Voltage Analysis   |
| 3 STEADY STATE ANALYSIS  |
| 3.1 Model Development  |
| 3.2 Power Flow Assessment Without CMH PP and with Sanctioned Load In Service 8 |
| 3.2.1 Base Year 2025: Peak Loading Summer with Sanctioned Load in Service      |
| 3.3 Power Flow Assessment with CMH PP  |
| 3.3.1 Base Year 2025: Peak Loading Summer with Sanctioned Load In Service      |
| 3.4 Conclusion   |
| 4 CONCLUSION   |
| 4.1 Steady State Assessment  |
| LIST OF ANNEXURES  |







## **EXECUTIVE SUMMARY**

This report provides the documentation of an assessment that has been performed for the interconnection of a 999kW Solar PV Power Generation project at Combined Military Hospital (CMH) distribution system at 11kV project of "Military Engineering Services" (MES). The project will be a Grid tied 999kW Solar PV based system connected with the power network of CMH. The '999kW CMH solar PV Power Generation project' is located at CMH, Cantt, Lahore, Punjab, Pakistan.

The integration of solar power generation at the CMH premises necessitates a comprehensive system study analysis to ensure optimal operation of the electrical network. CMH currently receives a single point supply from LESCO with a sanctioned load of 4.6MW. The introduction of solar power generation will influence the flow of electricity within the premises, impacting both consumption and injection dynamics.

The existing setup includes transformers, switchgear, and distribution panels to distribute electricity throughout the premises. The sanctioned load of 4.6MW is the maximum load that can be drawn from LESCO's grid.

The entire solar generation within the CMH premises will be consumed internally without exporting any power to the grid. To ensure the safe and efficient integration of solar power, a load flow study is required to analyze the impact of this interconnection on the existing electrical network. This study will assist in obtaining solar generation concurrence and ensuring compliance with relevant technical and regulatory requirements.

The analyses have been carried out in following scenarios;

- Without 999kW CMH solar PV system with sanctioned load in service.
- With 999kW CMH solar PV system with sanctioned load in service.

Steady state power flow assessment has been performed using the network data of CMH. Power flow study was conducted without Solar Project with sanctioned load in service to analyze the magnitude and phase angles of bus voltages, line loadings and power flows under steady-state conditions. Power flow analysis was also conducted with sanctioned load in service after the interconnection of the Solar project with the CMH distribution system. The power flow results for the system intact shows that the power flows on all the CMH transmission and distribution line branches are within their normal







line loading limit. There is no capacity constraint in terms of power flow or voltage ratings within the study area.

This systems study is a critical step in obtaining solar generation concurrence for CMH. By ensuring the stability and reliability of the electrical system, the study facilitates seamless solar power integration while maintaining compliance with CMH and regulatory requirements.

Based on the study results, it is concluded that proposed generation interconnection assessment for 999kW CMH solar PV Power Generation project meets the NEPRA grid code planning criteria.







## **1** INTRODUCTION

### 1.1 **Project Description**

This report provides the documentation of an assessment that has been performed by ARCO Energy in response to a request made by Combined Military Hospital (CMH) ("Project Owner" or "PO") for the interconnection of a 999kWp Solar PV Power Generation project ("Project") to the CMH power System at 11kV.

The '999kW CMH solar PV Power Generation project' is located at CMH, Cantt, Lahore, Punjab, Pakistan. Figure 1.1 shows Google site map of the project.

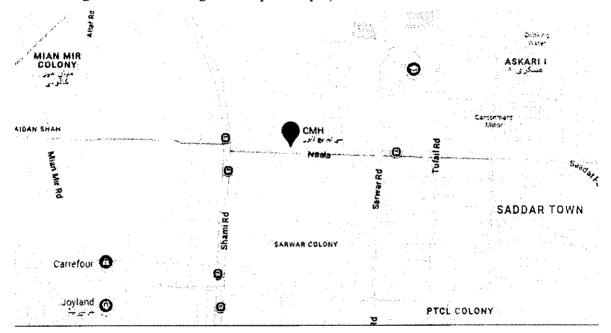


Figure 1.1: Google Site Map of the Solar PV Power Generation Project.







### 1.2 Interconnection Arrangement

CMH aims to integrate solar power generation into its existing electrical infrastructure. CMH currently receives a single-point power supply from LESCO with a sanctioned load of 4.6MW. The entire solar generation within the CMH premises will be consumed internally without exporting any power to the grid. The objective of the analyses is to evaluate the impact of the solar power plant on the CMH transmission and distribution system.

## 1.3 Objective of System Study Analysis

The primary objectives of the load flow study are:

- To evaluate the impact of solar power injection on the voltage levels and power distribution within CMH premises.
- To determine the changes in power flow patterns resulting from the integration of solar generation.
- To ensure that the existing electrical infrastructure can support the additional solar power without causing instability or operational issues.
- To verify compliance with regulatory requirements for solar power interconnection and obtain concurrence for solar generation.

## 1.4 Study Components

999kW solar PV system is modelled into the CMH distribution system by ARCO Energy. Technical analysis includes:

- i) Data gathering and modelling
- ii) Steady state analysis
- iii) Conclusion

The above scope of work involved in the technical analysis has been carried to demonstrate that connection assessment of this PV system meets the National Electric Power Regulatory Authority (NEPRA) distribution code.

The analyses have been carried out in following scenarios;

- Without 999kW CMH solar PV system with sanctioned load in service.
- With 999kW CMH solar PV system with sanctioned load in service.







This report documents the results of the steady state analyses. The principal objective of these analyses is to evaluate the impact of 999kW solar PV system to the distribution system of CMH and vice versa.







## 2 STUDY METHODOLOGY

## 2.1 Study Criteria

The study has been carried out based on the National Electric Power Regulatory Authority (NEPRA) Grid Code planning criteria. Key parameters and their corresponding limits have been summarized in table below.

| Para           | ameter           | Range  |  |  |
|----------------|------------------|--|--|--|
| Voltage Level  | Normal Condition | ±5 % p.u at 132kV and below<br>+8%,-5% p.u at 220kVand above |  |  |
|                | Contingency      | ±10 % p.u  |  |  |
| T/Line Loading | Normal Condition | 100%   |  |  |
| Capacity       | Contingency      | 100%   |  |  |
|                | Nominal          | 50 Hz  |  |  |
| Frequency      | Normal Variation | 49.8 Hz - 50.2 Hz  |  |  |
|                | Contingency Band | 49.4 Hz - 50.5 Hz  |  |  |
| Power Factor   | Lagging          | 0.95   |  |  |
| rower ractor   | Leading          | 0.95   |  |  |

### 2.2 Steady State Analysis

The purpose of steady-state analysis is to analyse the impact of the proposed solar power plant on distribution system facilities under steady-state conditions. It involves two distinct analyses: line loading analysis and voltage analysis. Power flow solutions using the PSS/E® program (Version 33.4) has been performed.

A "study area" was defined to represent the areas of interest within CMH.

#### 2.2.1 System Intact Analysis

The incremental impact of the project on substations and transmission line loading under normal conditions was evaluated by comparing transmission and distribution system power flows through different scenarios for the project.

#### 2.2.2 Transmission Line Loading Analysis

11kV and 0.4kV rated transmission and distribution facilities in the study area have been monitored for line loadings.







## 2.2.3 Voltage Analysis

Voltages at buses inside the study area have been monitored for possible for voltage violations in accordance with NEPRA Grid Code guidelines.

7







## **3 STEADY STATE ANALYSIS**

## 3.1 Model Development

Project specific data was provided by the plant owner and it has been compiled and presented in **Annexure-A**. The steady state model of the power plant is presented in table below:

| , <u>, , , , , , , , , , , , , , , , , , </u> | Generator                      |
|---|--------------------------------|
| No. of Collector Units                        | 1                              |
| Generation size of each<br>collector (kVA)    | 841                            |
| Active Power of each<br>collector Pgen. (kW)  | 799                            |
| Power Factor                                  | 0.95 lagging, 0.95 leading     |
| Qmin, Qmax (kVAR)                             | - 0.2626, 0.2626               |
| Rated Frequency                               | 50 Hz                          |
| Generation Voltage                            | 440V                           |
| Xsource                                       | ∞                              |
| ·····   | Generation Step Up Transformer |
| No of Transformer                             | 1                              |
| kVA Capacity of each<br>GSU                   | 1250                           |
| % Reactance (X)                               | 5 %                            |
|   | СМН                            |
| Sanctioned Load (LESCO)                       | 4600 kW                        |

Steady state power flow assessment has been performed using the network data of CMH.

## 3.2 Power Flow Assessment Without CMH PP and with Sanctioned Load In Service

Power flow study without CMH solar and with sanctioned load in service, was conducted to analyze the magnitude and phase angles of bus voltages, line loadings and power flows under steady-state conditions.

The result of this power flow analysis is in Annexure-B.







#### 3.2.1 Base Year 2025: Peak Loading Summer with Sanctioned Load in Service

Power flow analysis has been performed on the peak loading summer (June) 2025 case of CMH network. This base case included a detailed representation of the CMH transmission and distribution system in the study area.

The steady state results, depicts that the power flows on all the CMH distribution line branches are within their normal loading limits. There is no capacity constraint in terms of load flow or voltage ratings around the study area. Result of the power flow analysis is attached in Figure B-1.

### 3.3 Power Flow Assessment with CMH PP

Power flow study of CMH solar project was conducted with sanctioned load (in service and out or service) to determine the reliability impact of the 999kW CMH solar project on the CMH distribution system. This includes the performance of load flow analysis to identify any facility overload or voltage condition that violates the NEPRA planning criteria. Any such violation that is either directly attributable to this project or for which it will have a shared responsibility is included in this report.

The results of the project power flow analysis are plotted in Annexure-B.

#### 3.3.1 Base Year 2025: Peak Loading Summer with Sanctioned Load In Service

A base case has been developed with sanctioned load in service at CMH solar for peak loading summer (June) 2025 that allow us to judge the impact of CMH solar project on the CMH network. Project power flow analysis has been performed after the connection of the project with the CMH distribution system. This includes the detailed representation of the power plant.

The steady state result, with sanctioned load in service at CMH solar depicts that the power flows on all the transmission line branches are within their normal loading limits. There is no capacity constraint in terms of load flow or voltage ratings around the study area. Result of the power flow analysis is attached in **Figure B-2**.

The results of the project bus voltages analysis are attached in Annexure-C.

## 3.4 Conclusion

Steady state power flow assessment has been performed. Power flow study was conducted without solar Project with sanctioned load in service to analyze the magnitude and phase angles of bus voltages, line loadings and power flows under steady-state conditions. Power flow analysis was also conducted







with sanctioned load in service after the interconnection of the Solar project with the CMH distribution system. The power flow results for the system intact shows that the power flows on all the CMH distribution line branches are within their normal line loading limit. There is no capacity constraint in terms of power flow or voltage ratings within the study area.







### **4** CONCLUSION

#### 4.1 Steady State Assessment

Steady state power flow assessment has been performed. Power flow study was conducted without CMH solar with sanctioned load in service, to analyze the magnitude and phase angles of bus voltages, line loadings, and power flows under steady-state conditions. Power flow analysis was also conducted with CMH solar and with sanctioned load in service with CMH distribution system. Power flow results showed that the power flows on all the CMH distribution branches are within their normal loading limit. There is no capacity constraint in terms of power flow or voltage ratings within the study area.

The steady state results found no capacity constraint in terms of power flow and voltage ranges.

Hence, it is concluded that based on the study results the Interconnection Assessment for 999kW CMH solar PV system with CMH Transmission and Distribution Network, meets the NEPRA grid code planning criteria.







### LIST OF ANNEXURES

Annex A: Project Specific Data.

Annex A-1: Project Site Map.

Annex A-2: Power Plant Data.

Annex B: Power Flow Steady State Analysis Result

Figure B-1: Base Year 2025 - Peak loading summer without CMH solar and Sanctioned load in service.

Figure B-2: Base Year 2025 - Peak loading summer with CMH solar and Sanctioned load in service.

Annex C: Assessment of Bus Voltages.

Annex C-1: Without CMH solar and with Sanctioned Load In Service.

Annex C-2: With CMH solar and with Sanctioned Load In Service.



## Annexure-A

Project Specific Data



# Annexure-A-1

Project Site Map



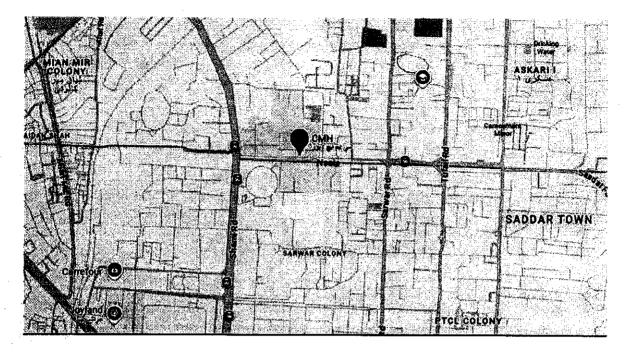


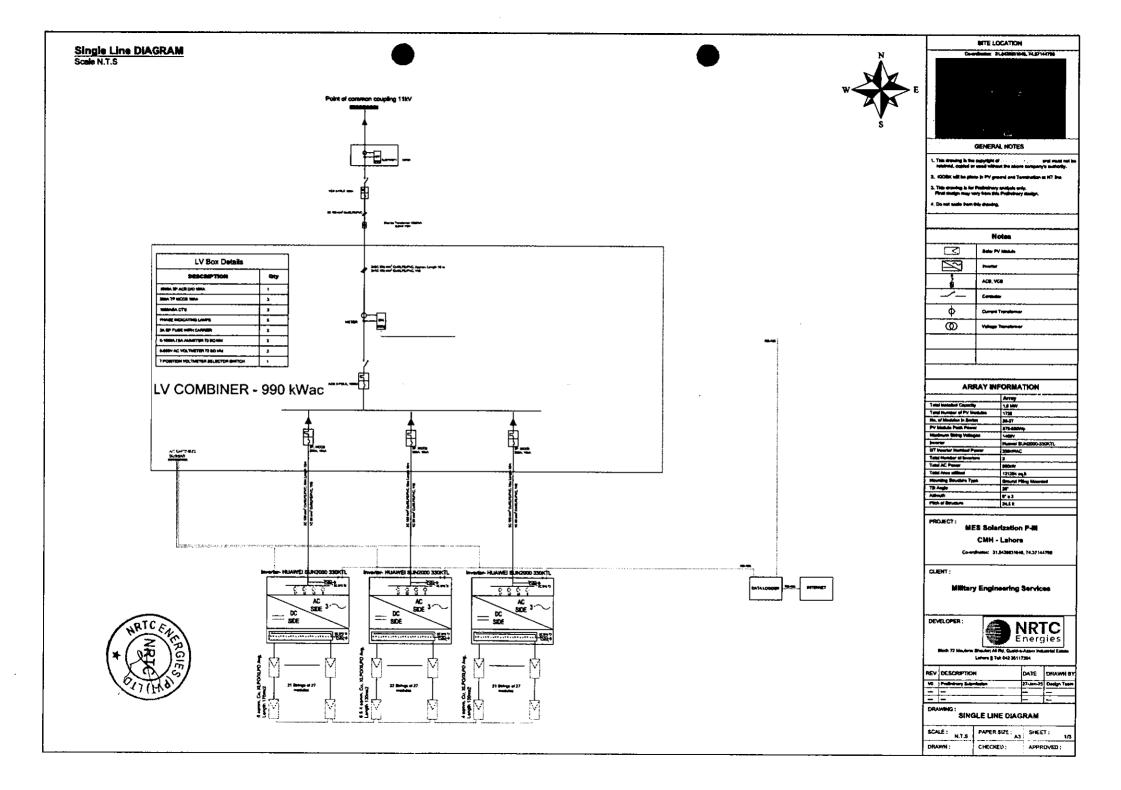
Figure 1.1: Google Site Map of the Solar PV Power Generation Project.

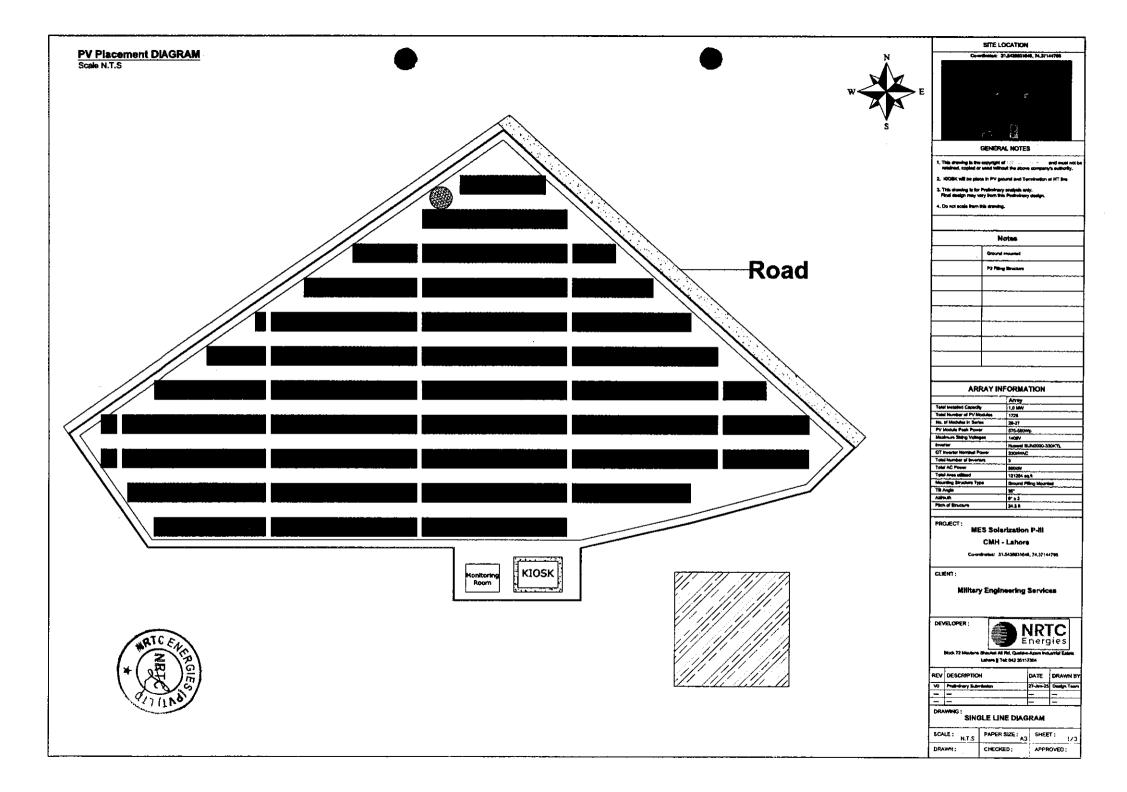
# Annexure-A-2

7

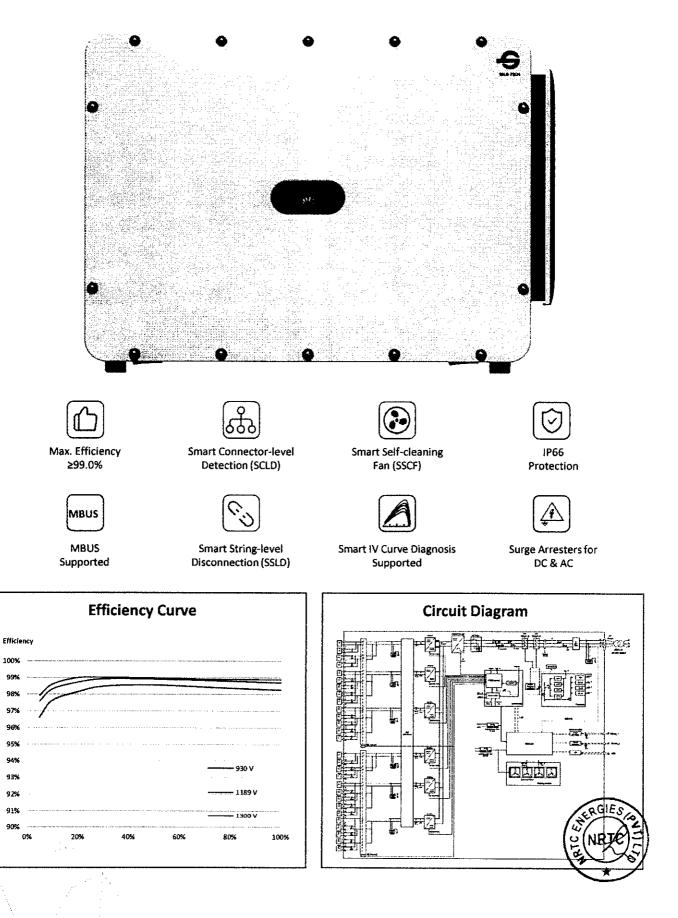
Power Plant Data







## SUN2000-330KTL-H1 Smart String Inverter



SOLAR.HUAWEI.COM

## sun2000-330kTL-H1 Technical Specifications

| Protection Degree                                       | IP 66                                 |
|---|---------------------------------------|
| AC Cannector  | Waterproof Connector + OT/DT Terminal |
| Relative Humidity                                       | 0~100%                                |
| Max. Operating Altitude without Derating                | 4,000 m (13,123 ft.)                  |
| Cooling Method  | Smart Air Cooling                     |
| Operating Temperature Range                             | -25 ℃ ~ 60 ℃                          |
| Weight (with mounting plate)                            | ≤112 kg                               |
| Dimensions (W x H x D)                                  | 1,048 x 732 x 395 mm                  |
|   | General                               |
| R5485   | Yes                                   |
| MBUS  | Yes                                   |
| USB   | Yes                                   |
| Display   | LED Indicators, WLAN + APP            |
| nesidai con ciri MURILURING UNL                         | Yes Communication                     |
| Residual Current Monitoring Unit                        | Yes                                   |
| AC Grounding Fault Protection                           | Yes                                   |
| AC Surge Arrester<br>DC Insulation Resistance Detection | Type II<br>Vec                        |
| DC Surge Arrester                                       | Type II                               |
| PV-array String Fault Monitoring                        | Yes                                   |
| DC Reverse-polarity Protection                          | Yes                                   |
| AC Overcurrent Protection                               | Yes                                   |
| Anti-islanding Protection                               | Yes                                   |
| Smart String-Level Disconnector(SSLD)                   | Yes                                   |
|   | Protection                            |
| Total Harmonic Distortion                               | <1%                                   |
| Adjustable Power Factor Range                           | 0.8 LG 0.8 LD                         |
| Max. Output Current                                     | 238.2 A                               |
| Nominal Output Current                                  | 216.6 A                               |
| Rated AC Grid Frequency                                 | 50 Hz / 60 Hz                         |
| Nominal Output Voltage                                  | 800 V, 3W + PE                        |
| Max. AC Active Power (cosφ=1)                           | 330,000 W                             |
| Max. AC Apparent Power                                  | 330,000 VA                            |
| Nominal AC Active Power                                 | 300,000 W                             |
|   | Output                                |
| Nominal Input Voltage                                   | 1,080 V                               |
| MPPT Operating Voltage Range                            | 500 V ~ 1,500 V                       |
| Start Voltage   | 550 V                                 |
| Max. PV Inputs per MPPT                                 | 4/5/5/4/5/5                           |
| Max. Short Circuit Current per MPPT                     | 115 A                                 |
| Max. Current per MPPT                                   |                                       |
| Number of MPP Trackers                                  | 6                                     |
| Max. Input Voltage                                      | 1,500 V                               |
|   | Input                                 |
| European Efficiency                                     | ≥98.8%                                |



# LR5-72HTH 560~575M

- Suitable for distributed projects
- Excellent outdoor power generation performance
- High module quality ensures long-term reliability



15-year Warranty for Materials and Processing



25-year Warranty for Extra Linear Power Output

#### Complete System and Product Certifications

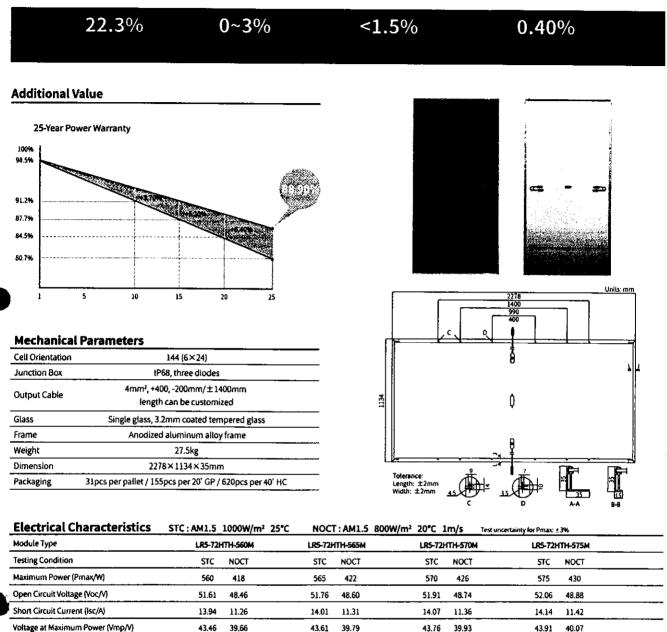
IEC 61215, IEC 61730, UL 61730 ISO9001:2015: ISO Quality Management System ISO14001: 2015: ISO Environment Management System ISO45001: 2018: Occupational Health and Safety IEC62941: Guideline for module design qualification and type approval





# Hi-MO 🗗

## LR5-72HTH 560~575M



#### **Operating Parameters**

Current at Maximum Power (Imp/A)

Module Efficiency(%)

| Operational Temperature            | -40°C ~ +85°C    |  |
|------------------------------------|------------------|--|
| Power Output Tolerance             | 0 ~ 3%           |  |
| Voc and Isc Tolerance              | ±3%              |  |
| Maximum System Voltage             | DC1500V (IEC/UL) |  |
| Maximum Series Fuse Rating         | 25A              |  |
| Nominal Operating Cell Temperature | 45±2°C           |  |
| Protection Class                   | Class II         |  |
| Size Patien                        | UL type 1 or 2   |  |
| Fire Rating                        | IEC Class C      |  |

12.89

10.55

21.7

#### Mechanical Loading

| Front Side Maximum Static Loading | 5400Pa                               |
|-----------------------------------|--------------------------------------|
| Rear Side Maximum Static Loading  | 2400Pa                               |
| Hailstone Test                    | 25mm Hailstone at the speed of 23m/s |

13.10

10.72

22,3

#### **Temperature Ratings (STC)**

13.03

10.67

22.1

| Temperature Coefficient of Isc  | +0.050%/°C |  |
|---------------------------------|------------|--|
| Temperature Coefficient of Voc  | -0.230%/*C |  |
| Temperature Coefficient of Pmax | -0.290%/"C |  |



No.8369 Shangyuan Road, Xi'an Economic And Technological Development Zone, Xi'an, Shaanxi, China. Web: www.longi.com

12.96

10.61

21.9

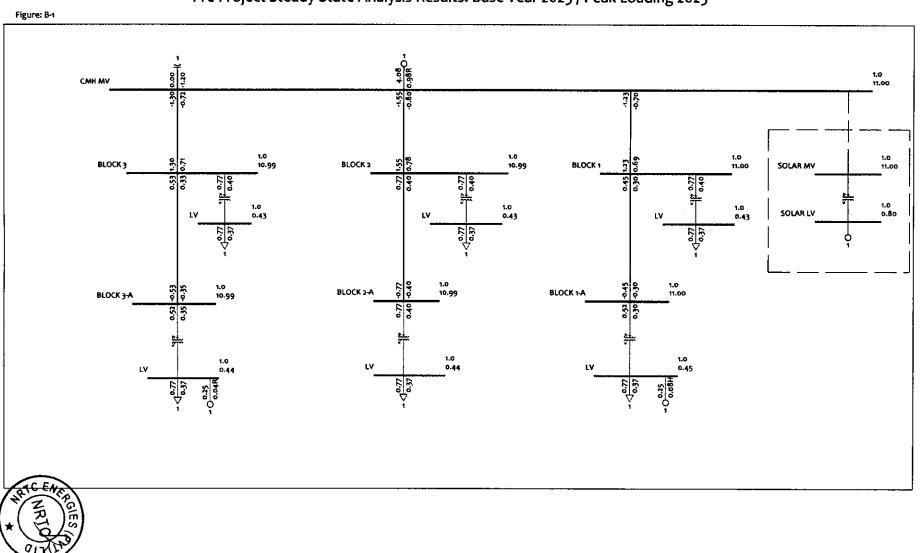
Specifications included in the parameter are subject to change without holice. LONGI reserves the rightop holic.

## Annexure-B

Steady State Analysis Results

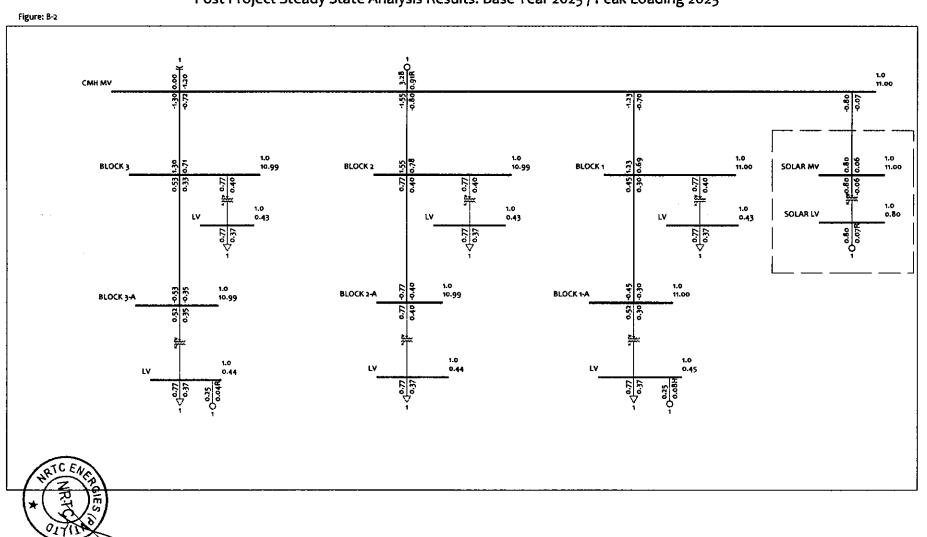


## Load Flow Analysis of 999kW Solar PV System at Combined Military Hospital (CMH)



Pre Project Steady State Analysis Results: Base Year 2025 / Peak Loading 2025

## Load Flow Analysis of 990kW Solar PV System at Combined Military Hospital (CMH)



Post Project Steady State Analysis Results: Base Year 2025 / Peak Loading 2025

## Annexure-C

# Assessment of bus voltages



## Annexure-C-1

Without CMH PP and With Sanctioned Load

5

In Service



| PTI INTERACTIVE POWER SYSTEM SIMULATORPSS(R)E | SAT, FEB 15 2025 17:10       |
|---|------------------------------|
| CMH SOLAR PV SYSTEM                           | <b>%MVA FOR TRANSFORMERS</b> |

% I FOR NON-TRANSFORMER BRANCHES

| X FROM B               |                | AREA | VOLT   |       | GEN     | LOAD    | SHUNT   | Х ТО ВО         | is      | x        |      |      |
|------------------------|----------------|------|--------|-------|---------|---------|---------|-----------------|---------|----------|------|------|
|                        |                | ZONE | PU/KV  | ANGLE | MW/MVAR | MW/MVAR | MW/MVAR | BUS# X NAME -   | X BASKV | AREA CKT | MW   | MVAR |
|                        | 11.000         | 4    | 1.0000 | 0.0   | 4.1     | 0.0     | 0.0     |                 |         |          |      |      |
| 14 10                  |                | 1    | 11.000 |       | 1.0R    | 0.0     | -1.2    | 41001 BLOCK 1   | 11.000  | 41       | 1.2  | 0.7  |
|                        |                |      |        |       |         |         |         | 41005 BLOCK 2   | 11.000  | 4 1      | 1.5  | 0.8  |
| 17 10                  |                |      |        |       |         |         |         | 41009 BLOCK 3   | 11.000  | 41       | 1.3  | 0.7  |
| 15 10<br>41001 BLOCK 1 |                | 4    | 0.9997 | -0.0  | 0.0     | 0.0     | 0.0     |                 |         |          |      |      |
|                        |                | 1    | 10.997 |       | 0.0     | 0.0     | 0.0     | 4100 CMH MV     | 11.000  | 4 1      | -1.2 | -0.7 |
| .4 10                  |                |      |        |       |         |         |         | 41002 LV        | 0.4400  | 4 1      | 0.8  | 0.4  |
| .000LK                 | 54 2           |      |        |       |         |         |         | 41003 BLOCK 1-A | 11.000  | 4 1      | 0.5  | 0.3  |
| 5 10<br>41002 LV       |                | 4    | 0.9875 | -1.4  | 0.0     | 0.8     | 0.0     |                 |         |          |      |      |
| . 000un                |                | 1    | 0.4345 |       | 0.0     | 0.4     | 0.0     | 41001 BLOCK 1   | 11.000  | 4 1      | -0.8 | -0.4 |
| 41003 BLOCK 1-1        |                | 4    | 0.9996 | -0.0  | 0.0     | 0.0     | 0.0     |                 |         |          |      |      |
|                        |                | 1    | 10.995 |       | 0.0     | 0.0     | 0.0     | 41001 BLOCK 1   | 11.000  | 4 1      | -0.5 | -0.3 |
| 10                     |                |      |        |       |         |         |         | 41004 LV        | 0.4400  | 4 1      | 0.5  | 0.3  |
| 41004 LV               | 38 2<br>0.4400 | 4    | 1.0160 | -0.9  | 0.2     | 0.8     | 0.0     |                 |         |          |      |      |
| .000UN                 |                | 1    | 0.4470 |       | 0.1H    | 0.4     | 0.0     | 41003 BLOCK 1-A | 11.000  | 4 1      | ÷0.5 | -0.3 |
| 41005 BLOCK 2          |                | 4    | 0.9993 | -0.0  | 0.0     | 0.0     | 0.0     |                 |         |          |      |      |
|                        |                | 1    | 10.992 |       | 0.0     | 0.0     | 0.0     | 4100 CMH MV     | 11.000  | 4 1      | -1.5 | -0.8 |
| 17 10                  | <b>F</b> A 0   |      |        |       |         |         |         | 41006 LV        | 0.4400  | 4 1      | 0.8  | 0.4  |
| .000LK                 | 54 2           |      |        |       |         |         |         |                 |         |          |      |      |



| 9 10             |        |          |      |      |     |       | 41007 BLOCK 2-A                         | 11.000 | 4 | 1 | 0.8  | 0.4  |
|------------------|--------|----------|------|------|-----|-------|---|--------|---|---|------|------|
| 41006 LV         |        | 4 0.9870 | -1.4 | 0.0  | 0.8 | 0.0   |   |        |   |   |      |      |
| 1.000UN          |        | 1 0.4343 |      | 0.0  | 0.4 | 0.0   | 41005 BLOCK 2                           | 11.000 | 4 | 1 | -0.8 | -0.4 |
| 41007 BLOCK 2-2  |        | 4 0.9993 | -0.0 | 0.0  | 0.0 | 0.0   |   |        |   |   |      |      |
| 9 1.0            |        | 1 10.992 |      | 0.0  | 0.0 | 0.0   | 41005 BLOCK 2                           | 11.000 | 4 | 1 | -0.8 | -0.4 |
| 0.988LK          | 54 2   |          |      |      |     |       | 41008 LV                                | 0.4400 | 4 | 1 | 0.8  | 0.4  |
| 41008 LV         | 0.4400 | 4 0.9999 | -1.4 | 0.0  | 0.8 | 0.0   |   |        |   |   |      |      |
| 1.000UN          | 54 2   | 1 0.4399 |      | 0.0  | 0.4 | 0.0   | 41007 BLOCK 2-A                         | 11.000 | 4 | 1 | -0.8 | -0.4 |
| 41009 BLOCK 3    |        | 4 0.9991 | -0.0 | 0.0  | 0.0 | 0.0   | * |        |   |   |      |      |
| 15 10            |        | 1 10.990 |      | 0.0  | 0.0 | 0.0   | 4100 CMH MV                             | 11.000 | 4 | 1 | -1.3 | -0.7 |
| .000LK           | 54 2   |          |      |      |     |       | 410010 LV                               | 0.4400 | 4 | 1 | 0.8  | 0.4  |
| 6 10             |        |          |      |      |     |       | 410011 BLOCK 3-A                        | 11.000 | 4 | 1 | 0.5  | 0.3  |
| 410010 LV        | 0.4400 | 4 0.9868 | -1.5 | 0.0  | 0.8 | 0.0   |   |        |   |   |      |      |
| 1.000UN          |        | 1 0.4342 |      | 0.0  | 0.4 | 0.0   | 41009 BLOCK 3                           | 11.000 | 4 | 1 | -0.8 | -0.4 |
| 410011 BLOCK 3-2 |        | 4 0.9987 | -0.1 | 0.0  | 0.0 | 0.0 - |   |        |   |   |      |      |
| <br>6 10         |        | 1 10.985 |      | 0.0  | 0.0 | 0.0   | 41009 BLOCK 3                           | 11.000 | 4 | 1 | -0.5 | -0.3 |
|                  | 21 3   |          |      |      |     | 4     | 410012 LV                               | 0.4400 | 4 | 1 | 0.5  | 0.3  |
| 410012 LV        | 0.4400 | 4 1.0045 | -0.6 | 0.2  | 0.8 | 0.0 - |   |        |   |   |      |      |
| 1.000UN          |        | 1 0.4420 |      | 0.0R | 0.4 | 0.0 4 | 410011 BLOCK 3-A                        | 11.000 | 4 | 1 | -0.5 | -0.3 |



## Annexure-C-2

筆 海绵子

# With CMH PP and With Sanctioned Load

In Service



|                      | CI       | MH SO | PTI<br>LAR PV S |       | CTIVE PO | WER SYSTI | em simulj | ATORPSS(R)E     | %MVA F  | 15 2025 1<br>OR TRANSFOR<br>OR NON-TRAN | MERS | BRANCHES |
|----------------------|----------|-------|-----------------|-------|----------|-----------|-----------|-----------------|---------|---|------|----------|
| X FROM BUS           | SX       | AREA  | VOLT            |       | GEN      | LOAD      | SHUNT     | Х ТО В          | US      | x                                       |      |          |
|                      | -X BASKV | ZONE  | PU/KV           | ANGLE | MW/MVAR  | MW/MVAR   | MW/MVAR   | BUS# X NAME     | X BASKV | AREA CKT                                | MW   | MVAR     |
| 4100 CMH MV          | 11.000   | 4     | 1.0000          | 0.0   | 3.3      | 0.0       | 0.0       | ~~~~~~~~~       |         | ·                                       |      |          |
| 4 10                 |          | 1     | 11.000          |       | 0.9R     | 0.0       | ~1.2      | 41001 BLOCK 1   | 11.000  | 4 1                                     | 1.2  | 0.7      |
|                      |          |       |                 |       |          |           |           | 41005 BLOCK 2   | 11.000  | 4 1                                     | 1.5  | 0.8      |
| 7 10                 |          |       |                 |       |          |           |           | 41009 BLOCK 3   | 11.000  | 4 1                                     | 1.3  | 0.7      |
| 5 10                 |          |       |                 |       |          |           |           | 410013 SOLAR MV | 11.000  | 4 1                                     | -0.8 | -0.1     |
| 10<br>41001 BLOCK 1  | 11.000   | 4     | 0.9997          | -0.0  | 0.0      | 0.0       | 0.0       |                 |         |   |      |          |
|                      |          | 1     | 10.997          |       | 0.0      | 0.0       | 0.0       | 4100 CMH MV     | 11.000  | 4 1                                     | -1.2 | -0.7     |
| 1 10                 |          |       | · · · ·         |       |          |           |           | 41002 LV        | 0.4400  | 4 1                                     | 0.8  | 0.4      |
| .000LK 5             | 4 2      |       |                 |       |          |           |           | 41003 BLOCK 1-A | 11.000  | 4 1                                     | 0.5  | 0.3      |
|                      | 0.4400   | 4     | 0.9875          | -1.4  | 0.0      | 0.8       | 0.0       |                 |         |   |      |          |
| 5                    |          | 1     | 0.4345          |       | 0.0      | 0.4       | 0.0       | 41001 BLOCK 1   | 11.000  | 4 1                                     | -0.8 | -0.4     |
| 41003 BLOCK 1-A      |          | 4     | 0.9996          | -0.0  | 0.0      | 0.0       | 0.0       |                 |         |   |      |          |
|                      |          | 1     | 10.995          |       | 0.0      | 0.0       | 0.0       | 41001 BLOCK 1   | 11.000  | 4 1                                     | ~0.5 | -0.3     |
| 10                   |          |       |                 |       |          |           |           | 41004 LV        | 0.4400  | 4 1                                     | 0.5  | 0.3      |
| .975LK 3<br>41004 LV | 0.4400   | 4     | 1.0160          | -0.9  | 0.2      | 0.8       | 0.0       |                 |         |   |      |          |
| .000UN 3             |          | 1     | 0.4470          |       | 0.1H     | 0.4       | 0.0       | 41003 BLOCK 1-A | 11.000  | 4 1                                     | -0.5 | -0.3     |
| 41005 BLOCK 2        | 11.000   | 4     | 0.9993          | -0.0  | 0.0      | 0.0       | 0.0       | *****           |         |   |      |          |

1 10.992 0.0 0.0 0.0 4100 CMH MV 11.000 4 1 -1.5 -0.8

17 10

| 1.000LK 54               | 2      |          |      |      |     |     | 41006 LV                  | 0.4400 | 4 | 1      | 0.8      | 0.4  |
|--------------------------|--------|----------|------|------|-----|-----|---------------------------|--------|---|--------|----------|------|
| 9 10                     | 2      |          |      |      |     |     | 41007 BLOCK 2-A           | 11.000 | 4 | 1      | 0.8      | 0.4  |
| 41006 LV (               |        | 4 0.9870 | -1.4 | 0.0  | 0.8 | 0.0 |                           |        |   |        |          |      |
| 1.000UN 54               |        | 1 0.4343 |      | 0.0  | 0.4 | 0.0 | 41005 BLOCK 2             | 11.000 | 4 | 1      | -0.8     | -0.4 |
| 41007 BLOCK 2-A          | L1.000 | 4 0.9993 | -0.0 | 0.0  | 0.0 | 0.0 |                           |        |   |        |          |      |
| 9 10                     | -      | 1 10.992 |      | 0.0  | 0.0 | 0.0 | 41005 BLOCK 2<br>41008 LV |        |   | 1<br>1 |          |      |
| 0.988LK 54<br>41008 LV 0 | .4400  | 4 0.9999 | -1.4 | 0.0  | 0.8 | 0.0 |                           |        |   |        |          | -    |
| 1.000UN 54               |        | 1 0.4399 |      | 0.0  | 0.4 | 0.0 | 41007 BLOCK 2-A           | 11.000 | 4 | 1      | -0.8     | -0.4 |
| 41009 BLOCK 3 1          |        | 4 0.9991 | -0.0 | 0.0  | 0.0 | 0.0 |                           |        |   |        | <u>-</u> |      |
| 15 10                    | -      | 1 10.990 |      | 0.0  | 0.0 | 0.0 | 4100 CMH MV               | 11.000 | 4 | 1      | -1.3     | -0.7 |
| 1.000LK 54               | 2      |          |      |      |     |     | 410010 LV                 | 0.4400 | 4 | 1      | 0.8      | 0.4  |
| 6 10                     | 2      |          |      |      |     |     | 410011 BLOCK 3-A          | 11.000 | 4 | 1      | 0.5      | 0.3  |
| 410010 LV (              |        | 4 0.9868 | -1.5 | 0.0  | 0.8 | 0.0 |                           |        |   |        |          |      |
| 1.000UN 54               |        | 1 0.4342 |      | 0.0  | 0.4 | 0.0 | 41009 BLOCK 3             | 11.000 | 4 | 1      | -0.8     | -0.4 |
| 410011 BLOCK 3-A         |        | 4 0.9987 | -0.1 | 0.0  | 0.0 | 0.0 |                           |        |   |        |          |      |
| 6 10                     | _      | 1 10.985 |      | 0.0  | 0.0 | 0.0 | 41009 BLOCK 3             | 11.000 | 4 | 1      | -0.5     | -0.3 |
| 0.988LK 21               | 2      |          |      |      |     |     | 410012 LV                 | 0.4400 | 4 | 1      | 0.5      | 0.3  |
| 410012 LV (              | .4400  | 4 1.0045 | -0.6 | 0.2  | 0.8 | 0.0 |                           |        |   |        |          |      |
| 1.000UN 21               |        | 1 0.4420 |      | 0.0R | 0.4 | 0.0 | 410011 BLOCK 3-A          | 11.000 | 4 | 1      | -0.5     | -0.3 |
| 410013 SOLAR MV 1        | 1.000  | 4 1.0002 | 0.0  | 0.0  | 0.0 | 0.0 |                           |        |   |        |          |      |
| 6 10                     | •      | 1 11.002 |      | 0.0  | 0.0 | 0.0 | 4100 CMH MV               | 11.000 | 4 | 1      | 0.8      | 0.1  |

TC NRM C G ×



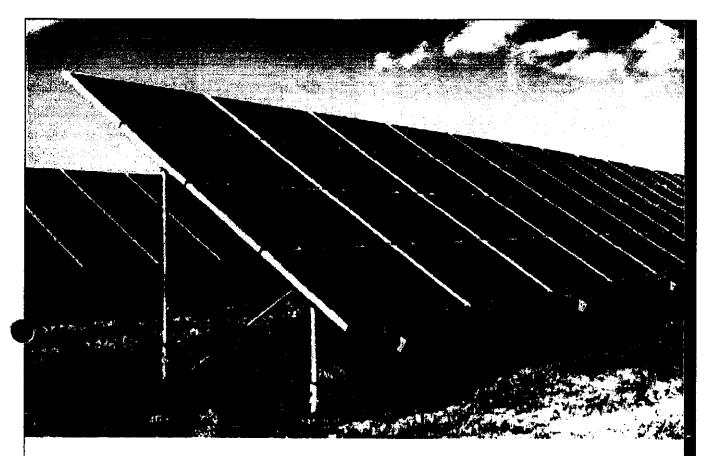
1.000UN

-0.1

0.1

1.000LK 64 1 410014 SOLAR LV 0.8000 4 1.0015 0.8 0.9 0.0 0.0 ----and the second 1 0.8012 0.1R 0.0 410013 SOLAR MV 11.000 4 1 0.8 0.0 64 1

410014 SOLAR LV 0.8000 4 1 -0.8





# SYSTEM STUDY ANALYSIS OF NEW AKRAM LINE (NAL) 500kW SOLAR PV SYSTEM

Report

ARCO Energy

PAKISTAN Tel: +92-300-8827101



## CONTENTS

| EXECUTIVE SUMMARY  |     |
|--|-----|
| 1 INTRODUCTION   |     |
| 1.1 Project Description  |     |
| 1.2 Interconnection Arrangement  | 4   |
| 1.3 Objective of System Study Analysis                                       | 4   |
| 1.4 Study Components   | 4   |
| 2 STUDY METHODOLOGY  | 6   |
| 2.1 Study Criteria   | 6   |
| 2.2 Steady State Analysis  | 6   |
| 2.2.1 System Intact Analysis   | 6   |
| 2.2.2 Transmission Line Loading Analysis                                     | 6   |
| 2.2.3 Voltage Analysis   | 7   |
| 3 STEADY STATE ANALYSIS  |     |
| 3.1 Model Development  | 8   |
| 3.2 Power Flow Assessment Without NAL PP and with Sanctioned Load In Service | e 8 |
| 3.2.1 Base Year 2025: Peak Loading Summer with Sanctioned Load in Service    | 9   |
| 3.3 Power Flow Assessment with NAL PP  | 9   |
| 3.3.1 Base Year 2025: Peak Loading Summer with Sanctioned Load In Service    | 9   |
| 3.4 Conclusion   | 9   |
| 4 CONCLUSION   | 11  |
| 4.1 Steady State Assessment  | 11  |
| LIST OF ANNEXURES  |     |





### **EXECUTIVE SUMMARY**

This report provides the documentation of an assessment that has been performed for the interconnection of a 500kW Solar PV Power Generation project at New Akram Line (NAL) distribution system at 11kV project of "Military Engineering Services" (MES). The project will be a Grid tied 500kW Solar PV based system connected with the power network of NAL. The '500kW NAL solar PV Power Generation project' is located at G9FV+RF5, Abid Majeed Rd, Cantt, Lahore, Punjab, Pakistan.

The integration of solar power generation at the NAL premises necessitates a comprehensive system study analysis to ensure optimal operation of the electrical network. NAL currently receives a single point supply from LESCO with a sanctioned load of 0.5MW. The introduction of solar power generation will influence the flow of electricity within the premises, impacting both consumption and injection dynamics.

The existing setup includes transformers, switchgear, and distribution panels to distribute electricity throughout the premises. The sanctioned load of 0.5MW is the maximum load that can be drawn from LESCO's grid.

The entire solar generation within the NAL premises will be consumed internally without exporting any power to the grid. To ensure the safe and efficient integration of solar power, a load flow study is required to analyze the impact of this interconnection on the existing electrical network. This study will assist in obtaining solar generation concurrence and ensuring compliance with relevant technical and regulatory requirements.

The analyses have been carried out in following scenarios;

- Without 500kW NAL solar PV with sanctioned load in service.
- With 500kW NAL solar PV with sanctioned load in service.

Steady state power flow assessment has been performed using the network data of NAL. Power flow study was conducted without Solar Project with sanctioned load in service to analyze the magnitude and phase angles of bus voltages, line loadings and power flows under steady-state conditions. Power flow analysis was also conducted with sanctioned load in service after the interconnection of the Solar project with the NAL distribution system. The power flow results for the system intact shows that the





power flows on all the NAL transmission and distribution line branches are within their normal line loading limit. There is no capacity constraint in terms of power flow or voltage ratings within the study area.

This systems study is a critical step in obtaining solar generation concurrence for NAL. By ensuring the stability and reliability of the electrical system, the study facilitates seamless solar power integration while maintaining compliance with NAL and regulatory requirements.

Based on the study results, it is concluded that proposed generation interconnection assessment for 500kW NAL solar PV Power Generation project meets the NEPRA grid code planning criteria.





### **1 INTRODUCTION**

### 1.1 Project Description

This report provides the documentation of an assessment that has been performed by ARCO Energy in response to a request made by New Akram Line (NAL) ("Project Owner" or "PO") for the interconnection of a 500kWp Solar PV Power Generation project ("Project") to the NAL power System at 11kV.

The '500kW NAL solar PV Power Generation project' is located at G9FV+RF5, Abid Majeed Rd, Cantt, Lahore, Punjab, Pakistan. Figure 1.1 shows Google site map of the project.

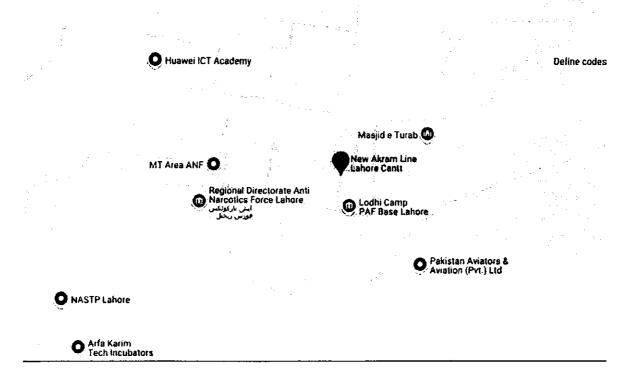


Figure 1.1: Google Site Map of the Solar PV Power Generation Project.





### 1.2 Interconnection Arrangement

NAL aims to integrate solar power generation into its existing electrical infrastructure. NAL currently receives a single-point power supply from LESCO with a sanctioned load of 0.5MW. The entire solar generation within the NAL premises will be consumed internally without exporting any power to the grid. The objective of the analyses is to evaluate the impact of the solar power plant on the NAL transmission and distribution system.

### 1.3 Objective of System Study Analysis

The primary objectives of the load flow study are:

- To evaluate the impact of solar power injection on the voltage levels and power distribution within NAL premises.
- To determine the changes in power flow patterns resulting from the integration of solar generation.
- To ensure that the existing electrical infrastructure can support the additional solar power without causing instability or operational issues.
- To verify compliance with regulatory requirements for solar power interconnection and obtain concurrence for solar generation.

### 1.4 Study Components

500kW solar PV system is modelled into the NAL distribution system by ARCO Energy. Technical analysis includes:

- i) Data gathering and modelling
- ii) Steady state analysis
- iii) Conclusion

The above scope of work involved in the technical analysis has been carried to demonstrate that connection assessment of this PV system meets the National Electric Power Regulatory Authority (NEPRA) distribution code.

The analyses have been carried out in following scenarios;

- Without 500kW NAL solar PV with sanctioned load in service.
- With 500kW NAL solar PV with sanctioned load in service.





This report documents the results of the steady state analyses. The principal objective of these analyses is to evaluate the impact of 500kW solar PV system to the distribution system of NAL and vice versa.





### 2 STUDY METHODOLOGY

### 2.1 Study Criteria

The study has been carried out based on the National Electric Power Regulatory Authority (NEPRA) Grid Code planning criteria. Key parameters and their corresponding limits have been summarized in table below.

| Para           | ameter           | Range  |
|----------------|------------------|--|
| Voltage Level  | Normal Condition | ±5 % p.u at 132kV and below<br>+8%,-5% p.u at 220kVand above |
|                | Contingency      | ±10 % p.u  |
| T/Line Loading | Normal Condition | 100%   |
| Capacity       | Contingency      | 100%   |
|                | Nominal          | 50 Hz  |
| Frequency      | Normal Variation | 49.8 Hz - 50.2 Hz  |
|                | Contingency Band | 49.4 Hz - 50.5 Hz  |
| Power Factor   | Lagging          | 0.95   |
| I OWEL PACION  | Leading          | 0.95   |

#### 2.2 Steady State Analysis

The purpose of steady-state analysis is to analyse the impact of the proposed solar power plant on distribution system facilities under steady-state conditions. It involves two distinct analyses: line loading analysis and voltage analysis. Power flow solutions using the PSS/E® program (Version 33.4) has been performed.

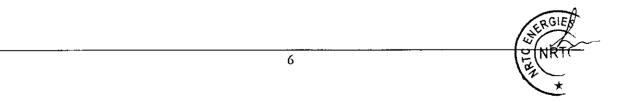
A "study area" was defined to represent the areas of interest within NAL.

#### 2.2.1 System Intact Analysis

The incremental impact of the project on substations and transmission line loading under normal conditions was evaluated by comparing transmission and distribution system power flows through different scenarios for the project.

#### 2.2.2 Transmission Line Loading Analysis

11kV and 0.4kV rated transmission and distribution facilities in the study area have been monitored for line loadings.





### 2.2.3 Voltage Analysis

Voltages at buses inside the study area have been monitored for possible for voltage violations in accordance with NEPRA Grid Code guidelines.





### **3 STEADY STATE ANALYSIS**

### 3.1 Model Development

Project specific data was provided by the plant owner and it has been compiled and presented in **Annexure-A**. The steady state model of the power plant is presented in table below:

|                         | Generator                      |
|-------------------------|--------------------------------|
| No. of Collector Units  | 1                              |
| Generation size of each | 421                            |
| collector (kVA)         | 421                            |
| Active Power of each    | 400                            |
| collector Pgen. (kW)    | 400                            |
| Power Factor            | 0.95 lagging, 0.95 leading     |
| Qmin, Qmax (kVAR)       | - 0.1315, 0.1315               |
| Rated Frequency         | 50 Hz                          |
| Generation Voltage      | 0.8V                           |
| Xsource                 | ∞                              |
|                         | Generation Step Up Transformer |
| No of Transformer       | 1                              |
| kVA Capacity of each    | 630                            |
| GSU                     |                                |
| % Reactance (X)         | 5 %                            |
|                         | New Akram Line                 |
| Sanctioned Load (LESCO) | 500 kW                         |

Steady state power flow assessment has been performed using the network data of NAL.

## 3.2 Power Flow Assessment Without NAL PP and with Sanctioned Load In Service

Power flow study without NAL solar and with sanctioned load in service, was conducted to analyze the magnitude and phase angles of bus voltages, line loadings and power flows under steady-state conditions.

The result of this power flow analysis is in Annexure-B.





#### 3.2.1 Base Year 2025: Peak Loading Summer with Sanctioned Load in Service

Power flow analysis has been performed on the peak loading summer (June) 2025 case of NAL network. This base case included a detailed representation of the NAL transmission and distribution system in the study area.

The steady state results, depicts that the power flows on all the NAL distribution line branches are within their normal loading limits. There is no capacity constraint in terms of load flow or voltage ratings around the study area. Result of the power flow analysis is attached in **Figure B-1**.

#### 3.3 Power Flow Assessment with NAL PP

Power flow study of NAL solar project was conducted with sanctioned load (in service and out of service) to determine the reliability impact of the 500kW NAL solar project on the NAL distribution system. This includes the performance of load flow analysis to identify any facility overload or voltage condition that violates the NEPRA planning criteria. Any such violation that is either directly attributable to this project or for which it will have a shared responsibility is included in this report.

The results of the project power flow analysis are plotted in Annexure-B.

#### 3.3.1 Base Year 2025: Peak Loading Summer with Sanctioned Load In Service

A base case has been developed with sanctioned load in service at NAL solar for peak loading summer (June) 2025 that allow us to judge the impact of NAL solar project on the NAL network. Project power flow analysis has been performed after the connection of the project with the NAL distribution system. This includes the detailed representation of the power plant.

The steady state result, with sanctioned load in service at NAL solar depicts that the power flows on all the transmission line branches are within their normal loading limits. There is no capacity constraint in terms of load flow or voltage ratings around the study area.

Result of the power flow analysis is attached in Figure B-2.

The results of the project bus voltages analysis are attached in Annexure-C.

#### 3.4 Conclusion

Steady state power flow assessment has been performed. Power flow study was conducted without solar Project with sanctioned load in service to analyze the magnitude and phase angles of bus voltages, line loadings and power flows under steady-state conditions. Power flow analysis was also conducted





with sanctioned load in service after the interconnection of the Solar project with the NAL distribution system. The power flow results for the system intact shows that the power flows on all the NAL distribution line branches are within their normal line loading limit. There is no capacity constraint in terms of power flow or voltage ratings within the study area.





## **Akram Line**

### 4 CONCLUSION

#### 4.1 Steady State Assessment

Steady state power flow assessment has been performed. Power flow study was conducted without NAL solar with sanctioned load in service, to analyze the magnitude and phase angles of bus voltages, line loadings, and power flows under steady-state conditions. Power flow analysis was also conducted with NAL solar and with sanctioned load in service with NAL distribution system. Power flow results showed that the power flows on all the NAL distribution branches are within their normal loading limit. There is no capacity constraint in terms of power flow or voltage ratings within the study area.

The steady state results found no capacity constraint in terms of power flow and voltage ranges.

Hence, it is concluded that based on the study results the Interconnection Assessment for 500kW New Akram Line solar PV system with NAL Transmission and Distribution Network, meets the NEPRA grid code planning criteria.





## **Akram Line**

### LIST OF ANNEXURES

Annex A: Project Specific Data.

Annex A-1: Project Site Map.

Annex A-2: Power Plant Data.

Annex B: Power Flow Steady State Analysis Result

Figure B-1: Base Year 2025 - Peak loading summer without NAL solar and Sanctioned load in service.

Figure B-2: Base Year 2025 - Peak loading summer with NAL solar and Sanctioned load in service.

Annex C: Assessment of Bus Voltages.

Annex C-1: Without NAL solar and with Sanctioned Load In Service.

Annex C-2: With NAL solar and with Sanctioned Load In Service.



### Annexure-A

き 神道である

. . .

4

Project Specific Data



## Annexure-A-1

34.1.3

تيدن الروا

anto distant

Project Site Map



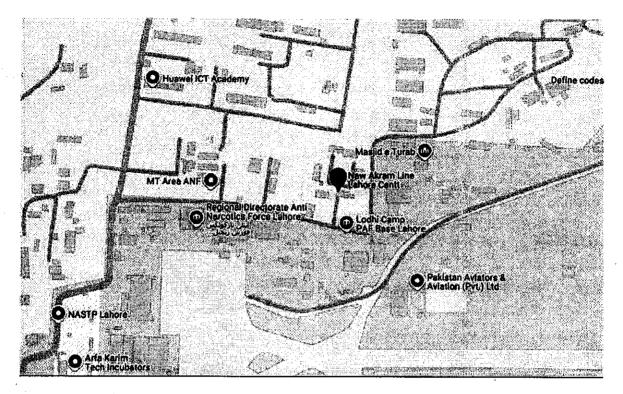


Figure 1.1: Google Site Map of the Solar PV Power Generation Project.

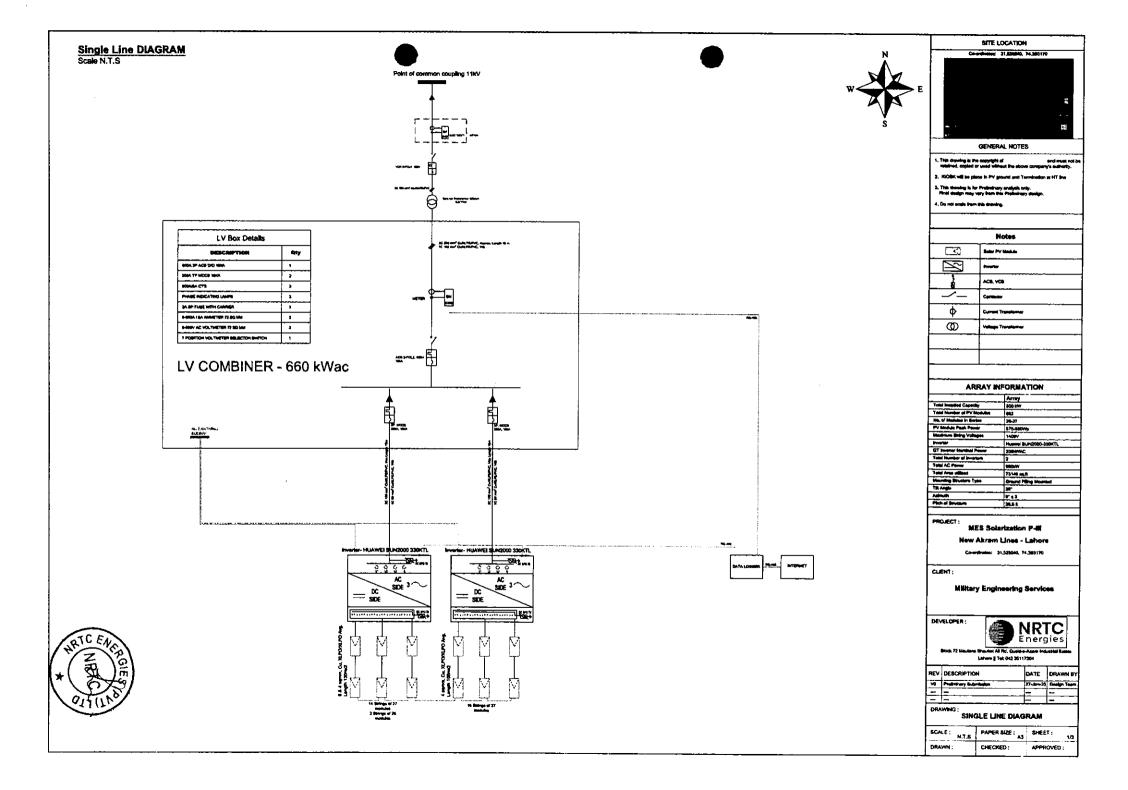


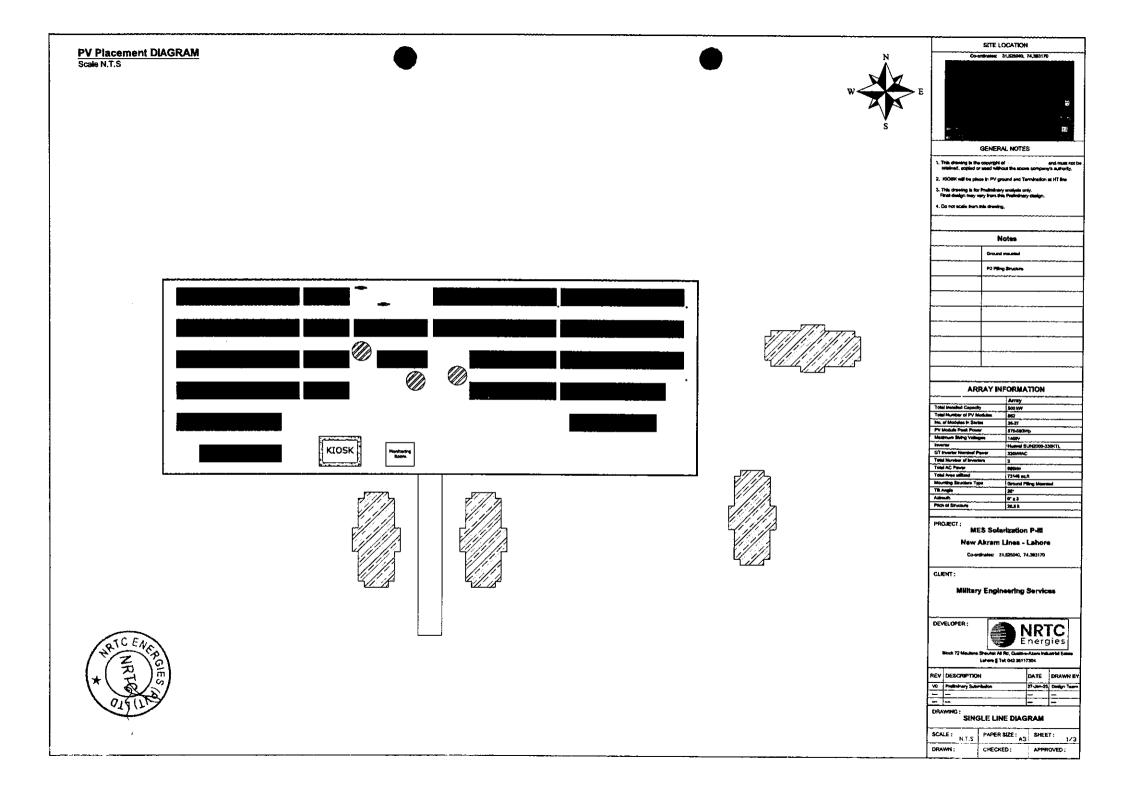
### Annexure-A-2

×.

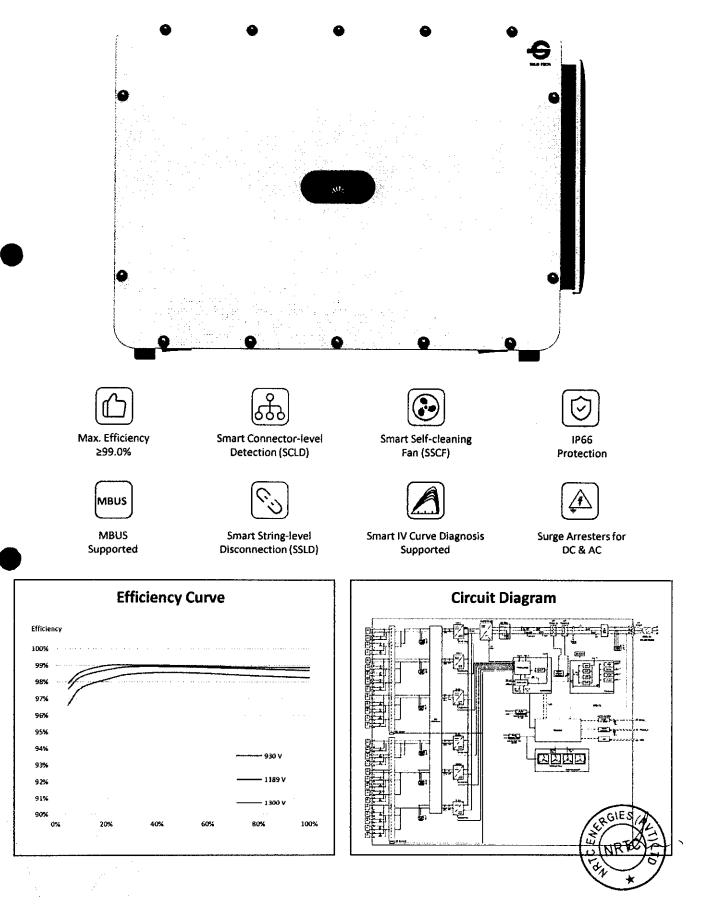
Power Plant Data







### SUN2000-330KTL-H1 Smart String Inverter



#### SOLAR.HUAWEI.COM

### sun2000-330кт1-н1 Technical Specifications

| Max. Efficiency  | ≥99.0%   |
|--|--|
| European Efficiency  | ≥98.8%   |
|  | Input  |
| Max. Input Voltage   | •<br>1,500 V                                   |
| Number of MPP Trackers   | 6  |
| Max. Current per MPPT  | . 65 A   |
| Max. Short Circult Current per MPPT  | 115 A  |
| Max. PV Inputs per MPPT  | 4/5/5/4/5/5                                    |
| Start Voltage  | 550 V  |
| MPPT Operating Voltage Range   | 500 V ~ 1,500 V                                |
| Nominal Input Voltage  | 1,080 V  |
|  | Output   |
| Nominal AC Active Power  | 300,000 W                                      |
| Max. AC Apparent Power   | 330,000 VA                                     |
| Max. AC Active Power (coso=1)  |  |
| Nominal Output Voltage   | 330,000 W                                      |
| Rated AC Grid Frequency  | 800 V, 3W + PE                                 |
| Nominal Output Current   | 50 Hz / 60 Hz<br>216.6 A                       |
| азманнын шталын илтала кенактала экс на на алаалаа алаала шалаунаа цистран на на <sub>с</sub> акаланаа алаала. |  |
| Max. Output Current  | 238.2 A  |
| Adjustable Power Factor Range  | 0.8 LG 0.8 LD                                  |
| Total Harmonic Distortion  | <1%  |
|  | Protection                                     |
| Smart String-Level Disconnector(SSLD)  | Yes  |
| Anti-Islanding Protection  | Yes  |
| AC Overcurrent Protection  | Yes  |
| DC Reverse-polarity Protection   | Yes  |
| PV-array String Fault Monitoring   | Yes  |
| DC Surge Arrester  | Туре ІІ  |
| AC Surge Arrester  | Type II  |
| DC Insulation Resistance Detection   | Yes  |
| AC Grounding Fault Protection  | Yes  |
| Residual Current Monitoring Unit   | Yes  |
|  | Communication                                  |
| Display  | LED Indicators, WLAN + APP                     |
| JSB  | Yes  |
| MBUS   | Yes  |
| R5485  | Yes  |
|  | General  |
| Dimensions (W x H x D)   | 1,048 x 732 x 395 mm                           |
| Weight (with mounting plate)   | ≤112 kg  |
|  | -25 °C ~ 60 °C                                 |
| Operating Temperature Range  |  |
| Cooling Method   | Smart Air Cooling                              |
| Max. Operating Altitude without Derating   | 4,000 m (13,123 ft.)                           |
|  | 0~100%   |
| Relative Humidity  |  |
| Relative Humidity<br>AC Connector<br>Protection Degree   | Waterproof Connector + OT/DT Terminal<br>IP 66 |





## LR5-72HTH 560~575M

- Suitable for distributed projects
- Excellent outdoor power generation performance
- High module quality ensures long-term reliability



15-year Warranty for Materials and Processing



25-year Warranty for Extra Linear Power Output

#### Complete System and Product Certifications

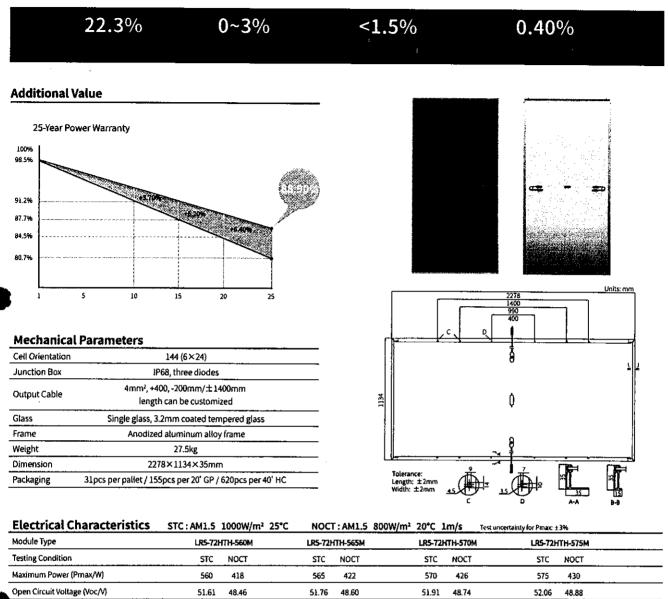
IEC 61215, IEC 61730, UL 61730 ISO9001:2015: ISO Quality Management System ISO14001: 2015: ISO Environment Management System ISO45001: 2018: Occupational Health and Safety IEC62941: Guideline for module design qualification and type approval





## Hi-MO

### LR5-72HTH 560~575M



| Voltage at Maximum Power (Vmp/V) | 43.46 | 39.66 | 43.61 | 39.79 | 43.76 | 39.93 |
|----------------------------------|-------|-------|-------|-------|-------|-------|
| Current at Maximum Power (Imp/A) | 12.89 | 10.55 | 12.96 | 10.61 | 13.03 | 10.67 |
| Module Efficiency(%)             | 2     | 1.7   | 2     | 1.9   | 2     | 2.1   |

14.01

11.31

11.26

13.94

#### **Operating Parameters**

Short Circuit Current (Isc/A)

| Operational Temperature            | -40°C ~ +85°C    |  |
|------------------------------------|------------------|--|
| Power Output Tolerance             | 0~3%             |  |
| Voc and Isc Tolerance              | ±3%              |  |
| Maximum System Voltage             | DC1500V (IEC/UL) |  |
| Maximum Series Fuse Rating         | 25A              |  |
| Nominal Operating Cell Temperature | 45±2°C           |  |
| Protection Class                   | Class II         |  |
| Fire Detine                        | UL type 1 or 2   |  |
| Fire Rating                        | IEC Class C      |  |

#### Mechanical Loading

| 5400Pa                               |
|--------------------------------------|
| 2400Pa                               |
| 25mm Hailstone at the speed of 23m/s |
|                                      |

14.14

43.91

13.10

11.42

40.07

10,72

22,3

11.36

14.07

#### Temperature Ratings (STC)

| Temperature Coefficient of Isc   | +0.050%/°C |
|----------------------------------|------------|
| Temperature Coefficient of Voc   | -0.230%/°C |
| Temperature Coefficient of Prnax | -0.290%/°C |



No.8369 Shangyuan Road, Xi'an Economic And Technological Development Zone, Xi'an, Shaanxi, China. Web: www.longi.com

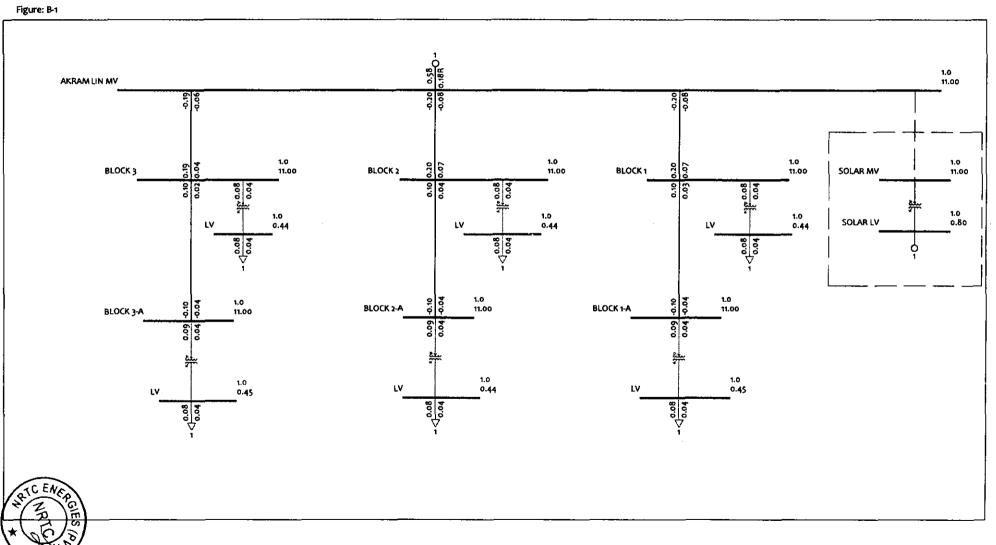
Specifications include are subject to change LONGi reserves the rig interpretation. (2022)

### Annexure-B

Steady State Analysis Results



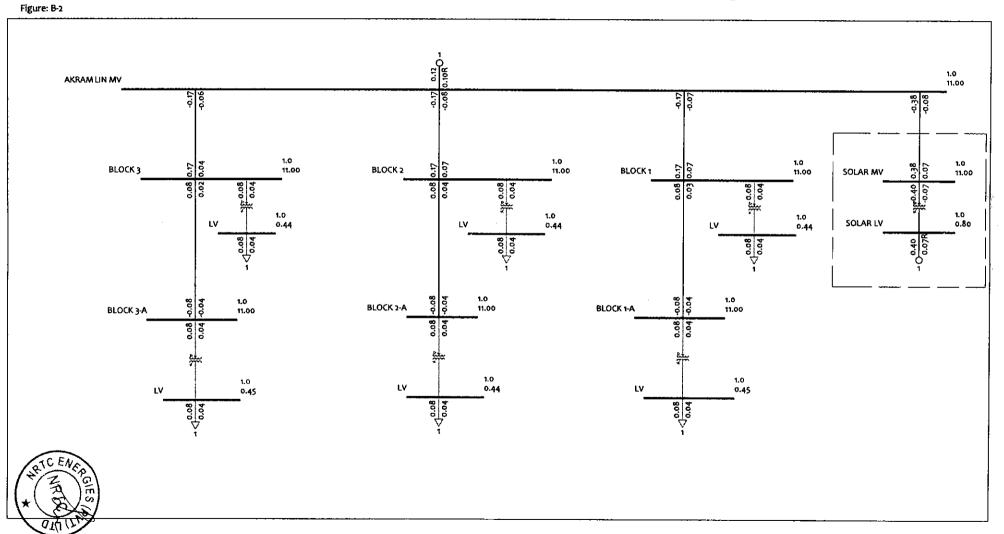
### Load Flow Analysis of 500kWp Solar PV System at New Akram Line (NAL)



Pre Project Steady State Analysis Results: Base Year 2025 / Peak Loading 2025

1

### Load Flow Analysis of 500kWp Solar PV System at New Akram Line (NAL)



Post Project Steady State Analysis Results: Base Year 2025 / Peak Loading 2025

1

### Annexure-C

Assessment of bus voltages



### Annexure-C-1

### Without NAL PP and With Sanctioned Load

In Service



#### PTI INTERACTIVE POWER SYSTEM SIMULATOR--PSS(R)E SAT, FEB 15 2025 17:14 AKRAM LINE SOLAR PV SYSTEM %MVA FOR TRANSFORMERS

% I FOR NON-TRANSFORMER BRANCHES

| X FROM BUS -<br>TRANSFORMER RATI |        | AREA | VOLT   |       | GEN     | LOAD    | SHUNT   | XX                                    |
|----------------------------------|--------|------|--------|-------|---------|---------|---------|---------------------------------------|
|                                  | BASKV  | ZONE | PU/KV  | ANGLE | MW/MVAR | MW/MVAR | MW/MVAR | BUS# X NAME X BASKV AREA CKT MW MVAR  |
| 4100 AKRAM LIN MV                |        | 4    | 1.0000 | 0.0   | 0.6     | 0.0     | 0.0     |                                       |
| 2 10                             | -      | 1    | 11.000 |       | 0.2R    | 0.0     | 0.0     | 41001 BLOCK 1 11.000 4 1 0.2 0.1      |
| 2 10                             |        |      |        |       |         |         |         | 41005 BLOCK 2 11.000 4 1 0.2 0.1      |
| 2 10                             |        |      |        |       |         |         |         | 41009 BLOCK 3 11.000 4 1 0.2 0.0      |
| 41001 BLOCK 1                    |        | 4    | 1.0000 | -0.0  | 0.0     | 0.0     | 0.0     |                                       |
| 2 10                             |        | 1    | 11.000 |       | 0.0     | 0.0     | 0.0     | 4100 AKRAM LIN MV11.000 4 1 -0.2 -0.1 |
| 1.000LK 6                        | 2      |      |        |       |         |         |         | 41002 LV 0.4400 4 1 0.1 0.0           |
| 1 10                             | -      |      |        |       |         |         |         | 41003 BLOCK 1-A 11.000 4 1 0.1 0.0    |
| 41002 LV                         |        | 4    | 0.9987 | -0.2  | 0.0     | 0.1     | 0.0     |                                       |
| 1.000UN 6                        | 2      | 1    | 0.4394 |       | 0.0     | 0.0     | 0.0     | 41001 BLOCK 1 11.000 4 1 -0.1 -0.0    |
| 41003 BLOCK 1-A                  |        | 4    | 0.9999 | -0.0  | 0.0     | 0.0     | 0.0     |                                       |
| 1 10                             |        | 1    | 10.999 |       | 0.0     | 0.0     | 0.0     | 41001 BLOCK 1 11.000 4 1 -0.1 -0.0    |
| 0.975LK 6<br>41004 LV            |        | ,    | 1.0243 | -0.2  | 0.0     | 0.1     | 0.0     | 41004 LV 0.4400 4 1 0.1 0.0           |
| 1.000UN 6                        |        |      | 0.4507 | -0.2  | 0.0     | 0.0     |         | 41003 BLOCK 1-A 11.000 4 1 -0.1 -0.0  |
| 41005 BLOCK 2                    | 11.000 | 4    | 0.9999 | -0.0  | 0.0     | 0.0     | 0.0     |                                       |
|                                  | -      | 1    | 10.999 |       | 0.0     | 0.0     | 0.0     | 4100 AKRAM LIN MV11.000 4 1 -0.2 -0.1 |
| 2 10<br>1.000LK 6                | 2      |      |        |       |         |         |         | 41006 LV 0.4400 4 1 0.1 0.0           |

HRTC LARRENES

| 1 10             |                  |          |      |     |     | 41007 BLOCK 2-A 11.000 4 1 0.1 0.0        |
|------------------|------------------|----------|------|-----|-----|---|
| 41006 LV         |                  | 4 0.9986 | -0.2 | 0.0 | 0.1 | 0.0                                       |
| 1.0000 אוו       |                  | 1 0.4394 |      | 0.0 | 0.0 | 0.0 41005 BLOCK 2 11.000 4 1 -0.1 -0.0    |
| 41007 BLOCK 2-A  |                  | 4 0.9999 | -0.0 | 0.0 | 0.0 | 0.0                                       |
| 1 10             | ier fait den see | 1 10.999 |      | 0.0 | 0.0 | 0.0 41005 BLOCK 2 11.000 4 1 -0.1 -0.0    |
| 0.988LK          | 6 2              |          |      |     |     | 41008 LV 0.4400 4 1 0.1 0.0               |
| 41008 LV         | 0.4400           | 4 1.0113 | -0.2 | 0.0 | 0.1 | 0.0                                       |
| 1.000UN          |                  | 1 0.4450 |      | 0.0 | 0.0 | 0.0 41007 BLOCK 2-A 11.000 4 1 -0.1 -0.0  |
| 41009 BLOCK 3    |                  | 4 0.9999 | -0.0 | 0.0 | 0.0 | 0.0                                       |
| 2 10             |                  | 1 10.999 |      | 0.0 | 0.0 | 0.0 4100 AKRAM LIN MV11.000 4 1 -0.2 -0.1 |
|                  | 6 2              |          |      |     |     | 410010 LV 0.4400 4 1 0.1 0.0              |
|                  | 0 2              |          |      |     |     | 410011 BLOCK 3-A 11.000 4 1 0.1 0.0       |
|                  | 0.4400           | 4 0.9986 | -0.2 | 0.0 | 0.1 | 0.0                                       |
| 1.000UN          |                  | 1 0.4394 |      | 0.0 | 0.0 | 0.0 41009 BLOCK 3 11.000 4 1 -0.1 -0.0    |
| 410011 BLOCK 3-A | 11.000           | 4 0.9999 | -0.0 | 0.0 | 0.0 | 0.0                                       |
| 1 10             |                  | 1 10.998 |      | 0.0 | 0.0 | 0.0 41009 BLOCK 3 11.000 4 1 -0.1 -0.0    |
|                  | <b>.</b>         |          |      |     |     | 410012 LV 0.4400 4 1 0.1 0.0              |
| 410012 LV        | 0.4400           | 4 1.0117 | -0.1 | 0.0 | 0.1 | 0.0                                       |
| 1.000UN          | 3 3              | 1 0.4451 |      | 0.0 | 0.0 | 0.0 410011 BLOCK 3-A 11.000 4 1 -0.1 -0.0 |



### Annexure-C-2

### With NAL PP and With Sanctioned Load

In Service



PTI INTERACTIVE POWER SYSTEM SIMULATOR--PSS(R)E SAT, FEB 15 2025 17:15 AKRAM LINE SOLAR PV SYSTEM **MVA FOR TRANSFORMERS** % I FOR NON-TRANSFORMER BRANCHES X----- FROM BUS ----- X AREA VOLT GEN LOAD SHUNT X----- TO BUS -----X TRANSFORMER RATING BUS# X-- NAME -- X BASKV ZONE PU/KV ANGLE MW/MVAR MW/MVAR MW/MVAR BUS# X-- NAME -- X BASKV AREA CKT MW MVAR RATIO ANGLE % SET A 4100 AKRAM LIN MV11.000 4 1.0000 0.0 0.1 0.0 0.0 ------0.1R 1 11.000 0.0 0.0 41001 BLOCK 1 11.000 4 1 0.2 0.1 2 10 41005 BLOCK 2 11.000 4 1 0.2 0.1 2 10 41009 BLOCK 3 11.000 4 1 0.2 0.0 2 10 410013 SOLAR MV 11,000 4 1 -0.4 -0.1 4 10 41001 BLOCK 1 11.000 4 1.0000 -0.0 0.0 0.0 ------1 11.000 0.0 0.0 0.0 4100 AKRAM LIN MV11.000 4 1 -0.2 -0.1 2 10 41002 LV 0.4400 4 1 0.1 0.0 6 2 1.000LK 41003 BLOCK 1-A 11.000 4 1 0.1 0.0 1 10 0.4400 4 0.9987 -0.2 41002 LV 0.0 0.1 0.0 -----1 0.4394 0.0 0.0 41001 BLOCK 1 11.000 4 1 -0.1 -0.0 0.0 1.000UN 62 41003 BLOCK 1-A 11.000 4 0.9999 -0.0 0.0 0.0 ----1 10.999 0.0 0.0 0.0 41001 BLOCK 1 11.000 4 1 -0.1 -0.0 1 10 41004 LV 0.4400 4 1 0.1 0.0 0.975LK 2 41004 LV 0.4400 4 1.0243 -0.1 0.0 0.1 0.0 -----1 0.4507 0.0 0.0 0.0 41003 BLOCK 1-A 11.000 4 1 -0.1 -0.0 62 1.000UN 41005 BLOCK 2 11.000 4 0.9999 -0.0 0.0 0.0 

0.0

0.0 4100 AKRAM LIN MV11.000 4 1 -0.2 -0.1

2 LUNERGIERO

1 10.999

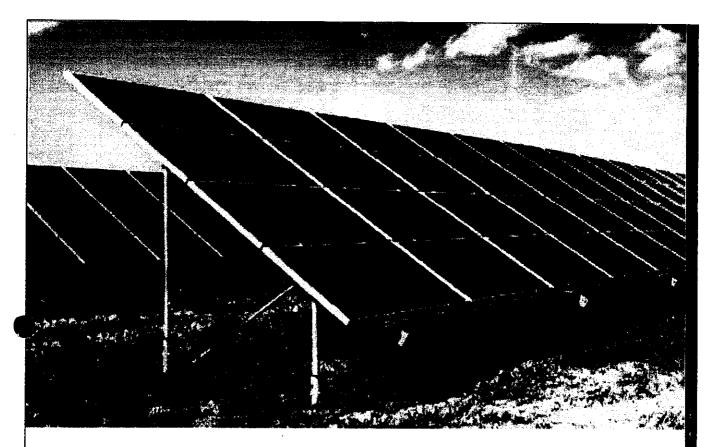
0.0

|                   |        | -        |      |     |     |        |                  |         |   |   |      |      |
|-------------------|--------|----------|------|-----|-----|--------|------------------|---------|---|---|------|------|
| 1.000LK           | 62     |          |      |     |     | 4      | 41006 LV         | 0.4400  | 4 | 1 | 0.1  | 0.0  |
| 1 10              |        |          |      |     |     | 4      | 41007 BLOCK 2-A  | 11.000  | 4 | 1 | 0.1  | 0.0  |
| 41006 LV          | 0.4400 | 4 0.9987 | -0.2 | 0.0 | 0.1 | 0.0    |                  |         |   |   |      |      |
| 1.000UN           | 62     | 1 0.4394 |      | 0.0 | 0.0 | 0.0 4  | 41005 BLOCK 2    | 11.000  | 4 | 1 | -0.1 | -0.0 |
| 41007 BLOCK 2-    |        | 4 0.9999 | -0.0 | 0.0 | 0.0 | 0.0    |                  |         |   |   |      |      |
| 1 10              |        | 1 10.999 |      | 0.0 | 0.0 |        | 41005 BLOCK 2    | 11.000  | 4 | 1 | -0.1 | -0.0 |
|                   | 62     |          |      |     |     | 4      | 41008 LV         | 0.4400  | 4 | 1 | 0.1  | 0.0  |
| 41008 LV          | 0.4400 | 4 1.0113 | -0.2 | 0.0 | 0.1 | 0.0    |                  |         |   |   |      |      |
| 1.000UN           | 62     | 1 0.4450 |      | 0.0 | 0.0 | 0.0 4  | 41007 BLOCK 2-A  | 11.000  | 4 | 1 | -0.1 | -0.0 |
| 41009 BLOCK 3     |        | 4 0.9999 | -0.0 | 0.0 | 0.0 | 0.0    |                  |         |   |   |      |      |
| 2 10              |        | 1 10.999 |      | 0.0 | 0.0 |        | 4100 AKRAM LIN M |         | - | 1 |      | -0.1 |
| 1.000LK           | 62     |          |      |     |     | 41     | 10010 LV         | 0.4400  | 4 | 1 | 0.1  | 0.0  |
| 1 10<br>410010 LV | 0.4400 | 4 0.9986 | -0.2 | 0.0 | 0.1 |        | 10011 BLOCK 3-A  |         |   | 1 | • •  |      |
| 1.000UN           |        | 1 0.4394 |      | 0.0 | 0.0 | 0.0 4  | 11009 BLOCK 3    | 11.000  | 4 | 1 | -0.1 | -0.0 |
| 410011 BLOCK 3-   |        | 4 0.9999 | -0.0 | 0.0 | 0.0 | 0.0    |                  |         |   |   |      |      |
| 1 10              |        | 1 10.998 |      | 0.0 | 0.0 | 0.0 4  | 1009 BLOCK 3     | 11.000  | 4 | 1 | -0.1 | -0.0 |
| 0.988LK           | 3 3    |          |      |     |     | 41     | 10012 LV         | 0.4400  | 4 | 1 | 0.1  | 0.0  |
|                   | 0.4400 | 4 1.0117 | -0.1 | 0.0 | 0.1 | 0.0    |                  |         |   |   |      |      |
| 1.000UN           |        | 1 0.4452 |      | 0.0 | 0.0 | 0.0 41 | 10011 BLOCK 3-A  | 11.000  | 4 | 1 | -0.1 | -0.0 |
| 410013 SOLAR MV   |        | 4 1.0001 | 0.0  | 0.0 | 0.0 | 0.0    |                  |         |   |   |      |      |
| C LIFER 10        |        | 1 11.001 |      | 0.0 | 0.0 | 0.0    | 4100 AKRAM LIN M | W11.000 | 4 | 1 | 0.4  | 0.1  |

.

| 1.000LK 64 1<br>410014 SOLAR LV 0.8000 | 4 1.0015 0.5 | 0.4  | 0.0 | 410014 SOLAR LV | 0.8000 | 4 1 | -0.4 | -0.1 <b>.</b> . |
|--|--------------|------|-----|-----------------|--------|-----|------|-----------------|
| <br>1.000UN 64 1                       | 1 0.8012     | 0.1R | 0.0 |                 |        | 4 1 | 0.4  | 0.1             |

THE NRIGHTS





### SYSTEM STUDY ANALYSIS OF MIAN MIR LINE (MML) 500kW SOLAR PV SYSTEM

Report

ARCO Energy

**PAKISTAN** Tel: +92-300-8827101



### CONTENTS

| EXECUTIVE SUMMARY  |
|--|
| 1 INTRODUCTION   |
| 1.1 Project Description  |
| 1.2 Interconnection Arrangement  |
| 1.3 Objective of System Study Analysis   |
| 1.4 Study Components   |
| 2 STUDY METHODOLOGY  |
| 2.1 Study Criteria   |
| 2.2 Steady State Analysis  |
| 2.2.1 System Intact Analysis   |
| 2.2.2 Transmission Line Loading Analysis                                       |
| 2.2.3 Voltage Analysis   |
| 3 STEADY STATE ANALYSIS  |
| 3.1 Model Development  |
| 3.2 Power Flow Assessment Without MML PP and with Sanctioned Load In Service 8 |
| 3.2.1 Base Year 2025: Peak Loading Summer with Sanctioned Load in Service      |
| 3.3 Power Flow Assessment with MML PP  |
| 3.3.1 Base Year 2025: Peak Loading Summer with Sanctioned Load In Service      |
| 3.4 Conclusion   |
| 4 CONCLUSION   |
| 4.1 Steady State Assessment  |
| LIST OF ANNEXURES  |





### **EXECUTIVE SUMMARY**

This report provides the documentation of an assessment that has been performed for the interconnection of a 500kW Solar PV Power Generation project at Mian Mir Line (MML) distribution system at 11kV project of "Military Engineering Services" (MES). The project will be a Grid tied 500kW Solar PV based system connected with the power network of MML. The '500kW MML solar PV Power Generation project' is located at Ground of 17 NLI / HQ 106 Bde North Mian Mir Line, Shami Rd, Cantt, Lahore, Pakistan.

The integration of solar power generation at the MML premises necessitates a comprehensive system study analysis to ensure optimal operation of the electrical network. MML currently receives a single point supply from LESCO with a sanctioned load of 1.918MW. The introduction of solar power generation will influence the flow of electricity within the premises, impacting both consumption and injection dynamics.

The existing setup includes transformers, switchgear, and distribution panels to distribute electricity throughout the premises. The sanctioned load of 1.918MW is the maximum load that can be drawn from LESCO's grid.

The entire solar generation within the MML premises will be consumed internally without exporting any power to the grid. To ensure the safe and efficient integration of solar power, a load flow study is required to analyze the impact of this interconnection on the existing electrical network. This study will assist in obtaining solar generation concurrence and ensuring compliance with relevant technical and regulatory requirements.

The analyses have been carried out in following scenarios;

- Without 500kW MML solar PV with sanctioned load in service.
- With 500kW MML solar PV with sanctioned load in service.

Steady state power flow assessment has been performed using the network data of MML. Power flow study was conducted without Solar Project with sanctioned load in service to analyze the magnitude and phase angles of bus voltages, line loadings and power flows under steady-state conditions. Power flow analysis was also conducted with sanctioned load in service after the interconnection of the Solar project with the MML distribution system. The power flow results for the system intact shows that





the power flows on all the MML transmission and distribution line branches are within their normal line loading limit. There is no capacity constraint in terms of power flow or voltage ratings within the study area.

This systems study is a critical step in obtaining solar generation concurrence for MML. By ensuring the stability and reliability of the electrical system, the study facilitates seamless solar power integration while maintaining compliance with MML and regulatory requirements.

Based on the study results, it is concluded that proposed generation interconnection assessment for 500kW MML solar PV Power Generation project meets the NEPRA grid code planning criteria.





### **1 INTRODUCTION**

### 1.1 Project Description

This report provides the documentation of an assessment that has been performed by ARCO Energy in response to a request made by Mian Mir Line (MML) ("Project Owner" or "PO") for the interconnection of a 500kWp Solar PV Power Generation project ("Project") to the MML power System at 11kV.

The '500kW MML solar PV Power Generation project' is located at Ground of 17 NLI / HQ 106 Bde North Mian Mir Line, Shami Rd, Cantt, Lahore, Pakistan. Figure 1.1 shows Google site map of the project.

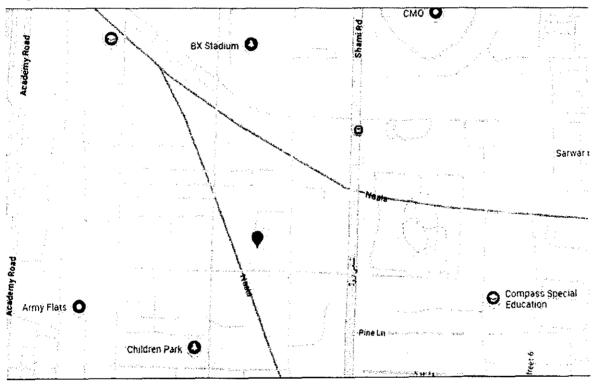


Figure 1.1: Google Site Map of the Solar PV Power Generation Project.





### 1.2 Interconnection Arrangement

MML aims to integrate solar power generation into its existing electrical infrastructure. MML currently receives a single-point power supply from LESCO with a sanctioned load of 1.918MW. The entire solar generation within the MML premises will be consumed internally without exporting any power to the grid. The objective of the analyses is to evaluate the impact of the solar power plant on the MML transmission and distribution system.

### 1.3 Objective of System Study Analysis

The primary objectives of the load flow study are:

- To evaluate the impact of solar power injection on the voltage levels and power distribution within MML premises.
- To determine the changes in power flow patterns resulting from the integration of solar generation.
- To ensure that the existing electrical infrastructure can support the additional solar power without causing instability or operational issues.
- To verify compliance with regulatory requirements for solar power interconnection and obtain concurrence for solar generation.

### 1.4 Study Components

500kW solar PV system is modelled into the MML distribution system by ARCO Energy. Technical analysis includes:

- i) Data gathering and modelling
- ii) Steady state analysis
- iii) Conclusion

The above scope of work involved in the technical analysis has been carried to demonstrate that connection assessment of this PV system meets the National Electric Power Regulatory Authority (NEPRA) distribution code.

The analyses have been carried out in following scenarios;

- Without 500kW MML solar PV with sanctioned load in service.
- With 500kW MML solar PV with sanctioned load in service.





This report documents the results of the steady state analyses. The principal objective of these analyses is to evaluate the impact of 500kW solar PV system to the distribution system of MML and vice versa.





### 2 STUDY METHODOLOGY

### 2.1 Study Criteria

The study has been carried out based on the National Electric Power Regulatory Authority (NEPRA) Grid Code planning criteria. Key parameters and their corresponding limits have been summarized in table below.

| Para           | ameter           | Range  |  |  |  |
|----------------|------------------|--|--|--|--|
| Voltage Level  | Normal Condition | ±5 % p.u at 132kV and below<br>+8%,-5% p.u at 220kVand above |  |  |  |
| ĺ              | Contingency      | ±10 % p.u  |  |  |  |
| T/Line Loading | Normal Condition | 100%   |  |  |  |
| Capacity       | Contingency      | 100%   |  |  |  |
|                | Nominal          | 50 Hz  |  |  |  |
| Frequency      | Normal Variation | 49.8 Hz - 50.2 Hz  |  |  |  |
|                | Contingency Band | 49.4 Hz - 50.5 Hz  |  |  |  |
| Power Factor   | Lagging          | 0.95   |  |  |  |
| rower ractor   | Leading          | 0.95   |  |  |  |

### 2.2 Steady State Analysis

The purpose of steady-state analysis is to analyse the impact of the proposed solar power plant on distribution system facilities under steady-state conditions. It involves two distinct analyses: line loading analysis and voltage analysis. Power flow solutions using the PSS/E® program (Version 33.4) has been performed.

A "study area" was defined to represent the areas of interest within MML.

#### 2.2.1 System Intact Analysis

The incremental impact of the project on substations and transmission line loading under normal conditions was evaluated by comparing transmission and distribution system power flows through different scenarios for the project.

#### 2.2.2 Transmission Line Loading Analysis

11kV and 0.4kV rated transmission and distribution facilities in the study area have been monitored for line loadings.





#### 2.2.3 Voltage Analysis

Voltages at buses inside the study area have been monitored for possible for voltage violations in accordance with NEPRA Grid Code guidelines.





### **3 STEADY STATE ANALYSIS**

### 3.1 Model Development

Project specific data was provided by the plant owner and it has been compiled and presented in **Annexure-A**. The steady state model of the power plant is presented in table below:

|  | Generator                      |
|--|--------------------------------|
| No. of Collector Units                       | 1                              |
| Generation size of each<br>collector (kVA)   | 421                            |
| Active Power of each<br>collector Pgen. (kW) | 400                            |
| Power Factor                                 | 0.95 lagging, 0.95 leading     |
| Qmin, Qmax (kVAR)                            | - 0.1315, 0.1315               |
| Rated Frequency                              | 50 Hz                          |
| Generation Voltage                           | 0.8V                           |
| Xsource                                      | 00                             |
|  | Generation Step Up Transformer |
| No of Transformer                            | 1                              |
| kVA Capacity of each<br>GSU                  | 630                            |
| % Reactance (X)                              | 5 %                            |
|  | Mian Mir Line                  |
| Sanctioned Load (LESCO)                      | 1918 kW                        |

Steady state power flow assessment has been performed using the network data of MML.

### 3.2 Power Flow Assessment Without MML PP and with Sanctioned Load In Service

Power flow study without MML solar and with sanctioned load in service, was conducted to analyze the magnitude and phase angles of bus voltages, line loadings and power flows under steady-state conditions.

The result of this power flow analysis is in Annexure-B.





#### 3.2.1 Base Year 2025: Peak Loading Summer with Sanctioned Load in Service

Power flow analysis has been performed on the peak loading summer (June) 2025 case of MML network. This base case included a detailed representation of the MML transmission and distribution system in the study area.

The steady state results, depicts that the power flows on all the MML distribution line branches are within their normal loading limits. There is no capacity constraint in terms of load flow or voltage ratings around the study area. Result of the power flow analysis is attached in **Figure B-1**.

#### 3.3 Power Flow Assessment with MML PP

Power flow study of MML solar project was conducted with sanctioned load (in service and out of service) to determine the reliability impact of the 500kW MML solar project on the MML distribution system. This includes the performance of load flow analysis to identify any facility overload or voltage condition that violates the NEPRA planning criteria. Any such violation that is either directly attributable to this project or for which it will have a shared responsibility is included in this report.

The results of the project power flow analysis are plotted in Annexure-B.

#### 3.3.1 Base Year 2025: Peak Loading Summer with Sanctioned Load In Service

A base case has been developed with sanctioned load in service at MML solar for peak loading summer (June) 2025 that allow us to judge the impact of MML solar project on the MML network. Project power flow analysis has been performed after the connection of the project with the MML distribution system. This includes the detailed representation of the power plant.

The steady state result, with sanctioned load in service at MML solar depicts that the power flows on all the transmission line branches are within their normal loading limits. There is no capacity constraint in terms of load flow or voltage ratings around the study area. Result of the power flow analysis is attached in **Figure B-2**.

The results of the project bus voltages analysis are attached in Annexure-C.

### 3.4 Conclusion

Steady state power flow assessment has been performed. Power flow study was conducted without solar Project with sanctioned load in service to analyze the magnitude and phase angles of bus voltages, line loadings and power flows under steady-state conditions. Power flow analysis was also conducted





with sanctioned load in service after the interconnection of the Solar project with the MML distribution system. The power flow results for the system intact shows that the power flows on all the MML distribution line branches are within their normal line loading limit. There is no capacity constraint in terms of power flow or voltage ratings within the study area.





### 4 CONCLUSION

#### 4.1 Steady State Assessment

Steady state power flow assessment has been performed. Power flow study was conducted without MML solar with sanctioned load in service, to analyze the magnitude and phase angles of bus voltages, line loadings, and power flows under steady-state conditions. Power flow analysis was also conducted with MML solar and with sanctioned load in service with MML distribution system. Power flow results showed that the power flows on all the MML distribution branches are within their normal loading limit. There is no capacity constraint in terms of power flow or voltage ratings within the study area.

The steady state results found no capacity constraint in terms of power flow and voltage ranges.

Hence, it is concluded that based on the study results the Interconnection Assessment for 500kW Mian Mir Line solar PV system with MML Transmission and Distribution Network, meets the NEPRA grid code planning criteria.





# MIAN MIR LINE

### LIST OF ANNEXURES

Annex A: Project Specific Data.

Annex A-1: Project Site Map.

Annex A-2: Power Plant Data.

Annex B: Power Flow Steady State Analysis Result

Figure B-1: Base Year 2025 - Peak loading summer without MML solar and Sanctioned load in service.

Figure B-2: Base Year 2025 - Peak loading summer with MML solar and Sanctioned load in service.

Annex C: Assessment of Bus Voltages.

Annex C-1: Without MML solar and with Sanctioned Load In Service.

Annex C-2: With MML solar and with Sanctioned Load In Service.



# Annexure-A

Sec. Product

# Project Specific Data



# Annexure-A-1

:0

· · · · · ·

Project Site Map



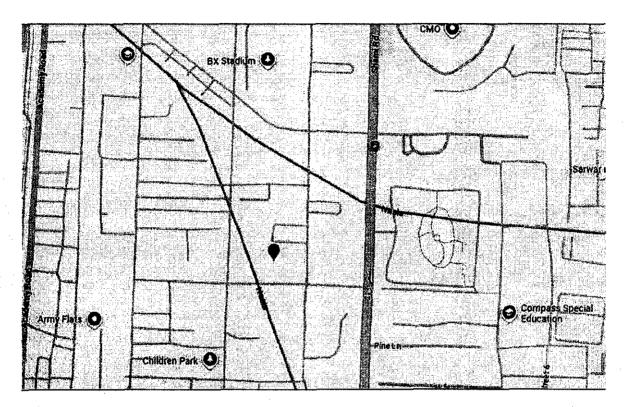


Figure 1.1: Google Site Map of the Solar PV Power Generation Project.



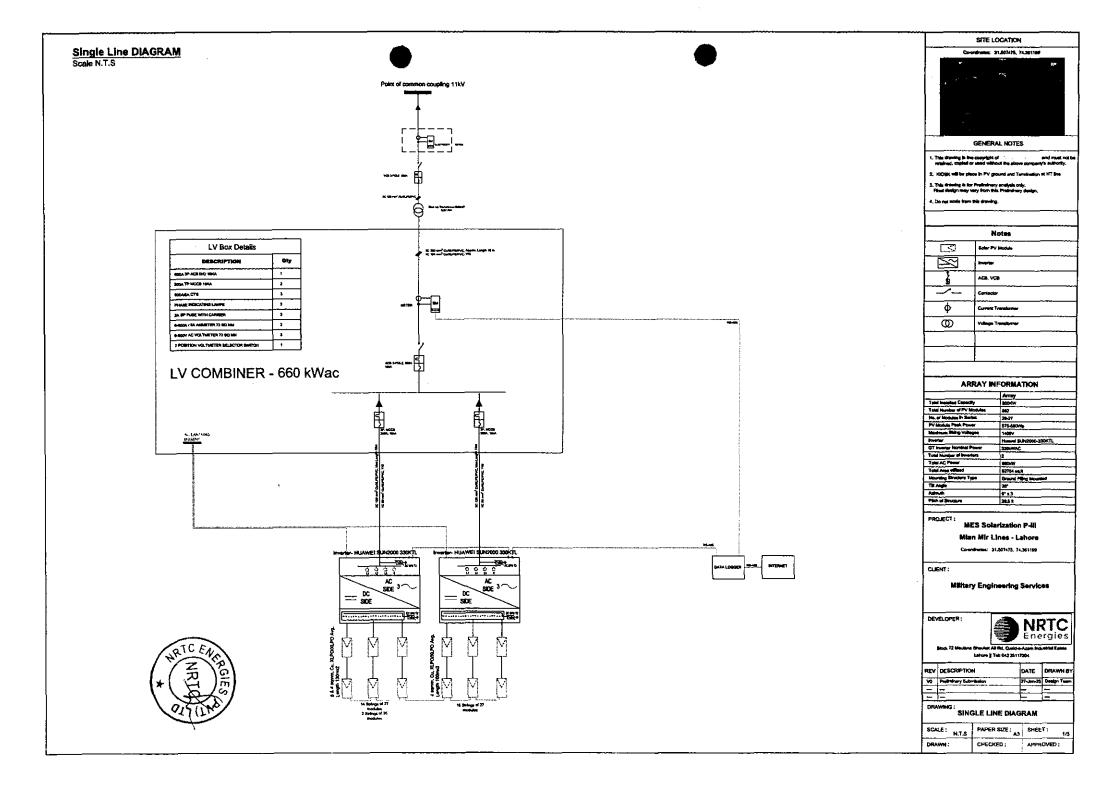
# Annexure-A-2

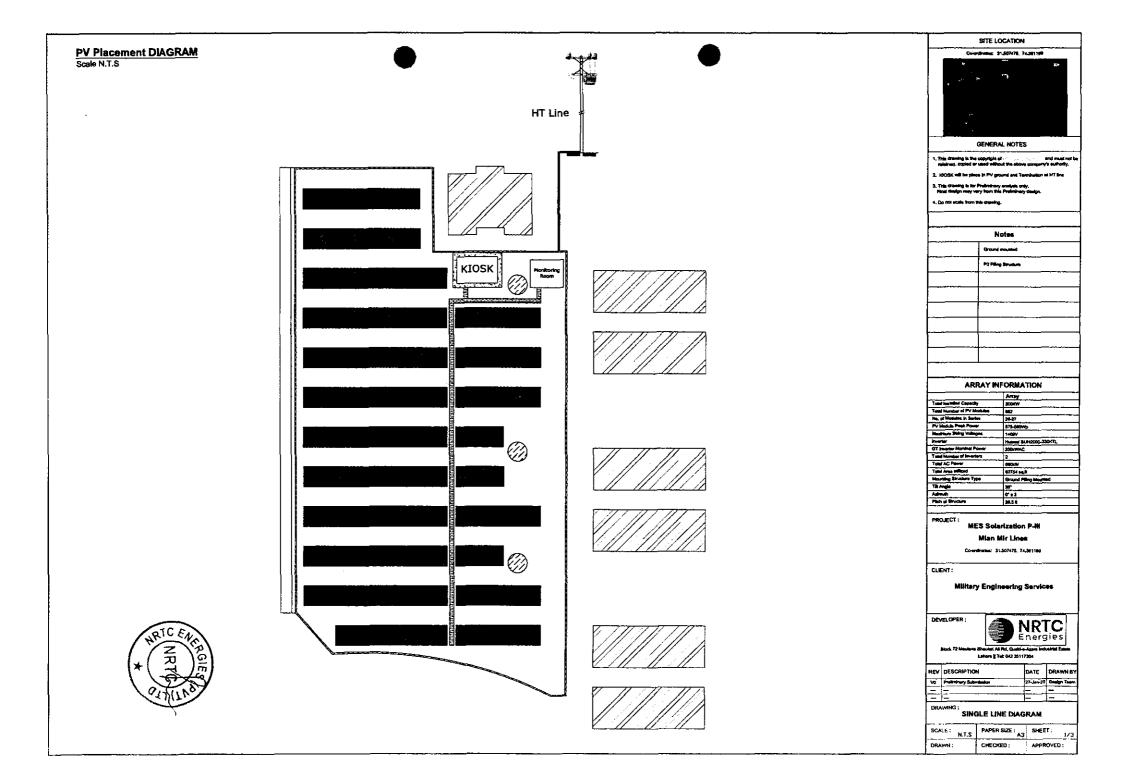
i e serve

.

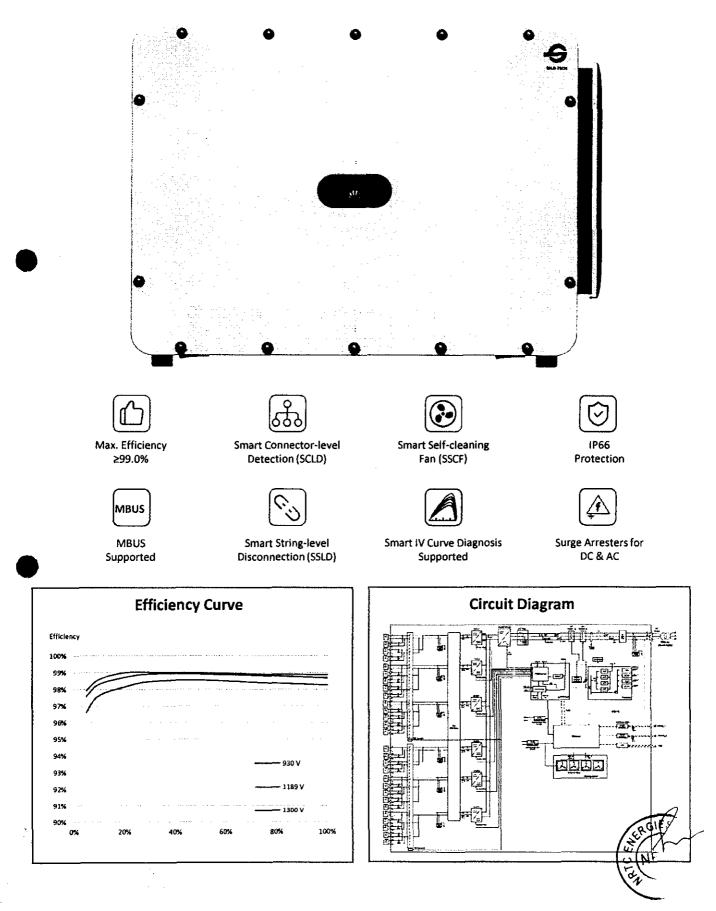
Power Plant Data







### SUN2000-330KTL-H1 Smart String Inverter



SOLAR.HUAWEI.COM

### sun2000-330ктL-н1 Technical Specifications

| Max. Efficiency  | ≥99.0%   |
|--|--|
| European Efficiency                                    | ≥98.8%   |
|  | Input  |
| Max. Input Voltage                                     | 1,500 V  |
| Number of MPP Trackers                                 | 6  |
| Max. Current per MPPT                                  | 65 A   |
| Max. Short Circuit Current per MPPT                    | 115A   |
| Max. PV Inputs per MPPT                                | 4/5/5/4/5/5  |
| Start Voltage  | 550 V  |
| MPPT Operating Voltage Range                           | 500 V ~ 1,500 V  |
| Nominal Input Voltage                                  | 1,080 V  |
|  | Output   |
| Nominal AC Active Power                                | 300,000 W  |
| Max. AC Apparent Power                                 |  |
| Max. AC Active Power (cos $\phi$ =1)                   | 330,000 VA   |
| Nominal Output Voltage                                 | 330,000 W  |
|  | 800 V, 3W + PE   |
| Rated AC Grid Frequency                                | 50 Hz / 60 Hz  |
| Nominal Output Current                                 | 216.6 A  |
| Max. Output Current                                    | 238.2 A  |
| Adjustable Power Factor Range                          | 0.8 LG 0.8 LD  |
| Total Harmonic Distortion                              | 1%   |
|  | Protection   |
| Smart String-Level Disconnector(SSLD)                  | Yes  |
| Anti-Islanding Protection                              | Yes  |
| AC Overcurrent Protection                              | Yes  |
| DC Reverse-polarity Protection                         | Yes  |
| PV-array String Fault Monitoring                       | Yes  |
| DC Surge Arrester                                      | Type II  |
| AC Surge Arrester                                      | Type II  |
| DC Insulation Resistance Detection                     | Yes  |
| AC Grounding Fault Protection                          | Yes  |
| Residual Current Monitoring Unit                       | Yes  |
|  | Communication  |
| Display  | LED Indicators, WLAN + APP   |
| USB  | Yes  |
| MBUS   | Yes  |
| R\$485   | Yes  |
|  | General  |
| Dimensions (W x H x D)                                 | 1,048 x 732 x 395 mm   |
| Weight (with mounting plate)                           | ≤112 kg  |
| Operating Temperature Range                            | -25 ℃ ~ 60 ℃   |
| Cooling Method   | Smart Air Cooling  |
| e waa Taa ila ah   | new reaction of the second |
| Max. Operating Altitude without Derating               | 4,000 m (13,123 ft.)   |
| Zelative Humiditu                                      | 0~100%   |
| Relative Humidity                                      |  |
| Relative Humidity<br>AC Connector<br>Protection Degree | 0 ~ 100%<br>Waterproof Connector + OT/DT Terminal  |

UNRTCHILL DIENTY +



# LR5-72HTH 560~575M

- Suitable for distributed projects
- Excellent outdoor power generation performance
- High module quality ensures long-term reliability



15-year Warranty for Materials and Processing

25

25-year Warranty for Extra Linear Power Output

#### Complete System and Product Certifications

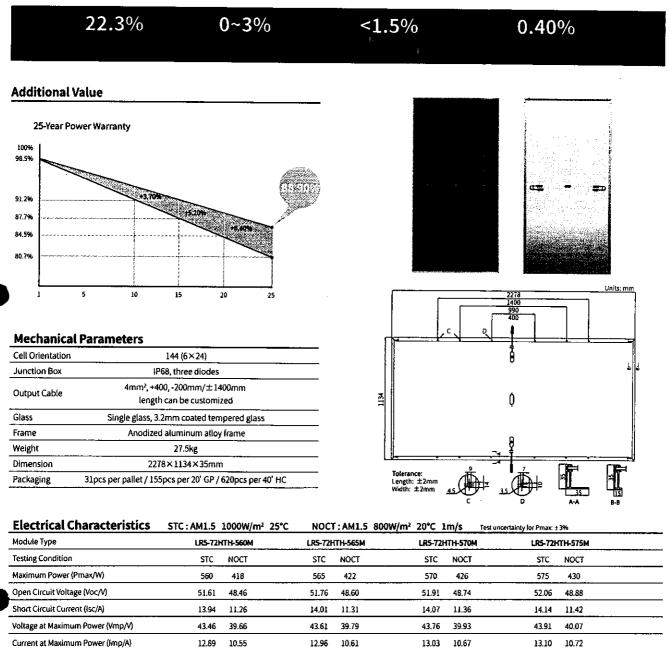
IEC 61215, IEC 61730, UL 61730 ISO9001:2015: ISO Quality Management System ISO14001: 2015: ISO Environment Management System ISO45001: 2018: Occupational Health and Safety IEC62941: Guideline for module design qualification and type approval





# Hi-MO

### LR5-72HTH 560~575M



21.9

#### **Operating Parameters**

Module Efficiency(%)

| Operational Temperature            | -40*C ~ +85*C    |  |
|------------------------------------|------------------|--|
| Power Output Tolerance             | 0 ~ 3%           |  |
| Voc and Isc Tolerance              | ±3%              |  |
| Maximum System Voltage             | DC1500V (IEC/UL) |  |
| Maximum Series Fuse Rating         | 25A              |  |
| Nominal Operating Cell Temperature | 45±2°C           |  |
| Protection Class                   | Class 1          |  |
| Size Desting                       | UL type 1 or 2   |  |
| Fire Rating                        | IEC Class C      |  |

21.7

#### **Mechanical Loading**

| Hailstone Test                    | 25mm Hailstone at the speed of 23m/s |
|-----------------------------------|--------------------------------------|
| Rear Side Maximum Static Loading  | 2400Pa                               |
| Front Side Maximum Static Loading | 5400Pa                               |

22.3

#### Temperature Ratings (STC)

22.1

| Temperature Coefficient of Isc  | +0.050%/°C |
|---------------------------------|------------|
| Temperature Coefficient of Voc  | -0.230%/°C |
| Temperature Coefficient of Pmax | 0.290%/°C  |
|                                 | CROICS A   |



No.8369 Shangyuan Road, Xi'an Economic And Technological Development Zone, Xi'an, Shaanxi, China. **Web:** www.longi.com Specificat An Brinz Lucied To this datasheet are unret to change without notice. LONG Reserves the right of final interpretation. 120221920DraftV03) DG

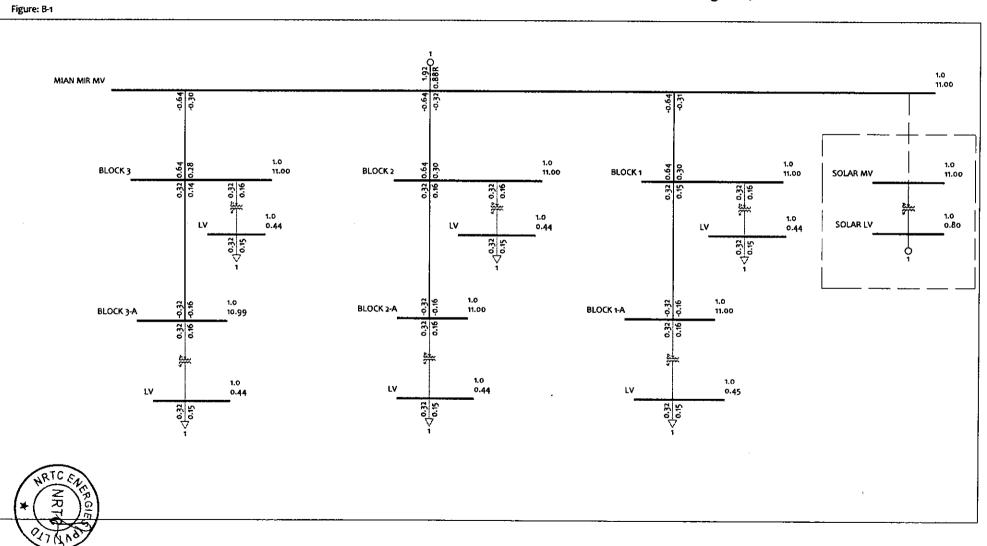
### Annexure-B

and the second second

Steady State Analysis Results

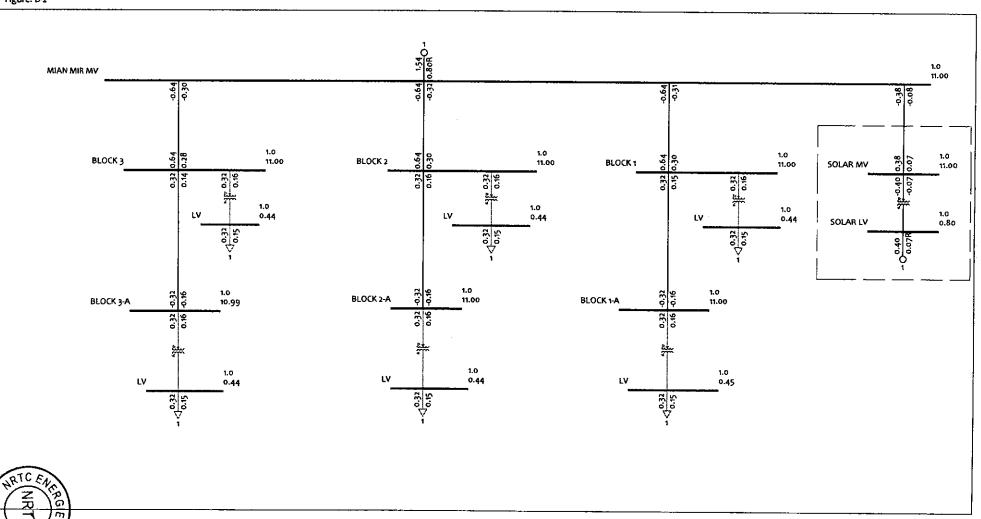


# Load Flow Analysis of 500kW Solar PV System at Mian Mir (MM)



Pre Project Steady State Analysis Results: Base Year 2025 / Peak Loading 2025

# Load Flow Analysis of 500kW Solar PV System at Mian Mir (MM)



Post Project Steady State Analysis Results: Base Year 2025 / Peak Loading 2025

Figure: B-2

# Annexure-C

Se 👌 🗤 🖓

# Assessment of bus voltages



### Annexure-C-1

E Market I

Sale

. 14.

### Without MML PP and With Sanctioned Load

In Service



| X FROM BUS X AF  | EA VOLT  |       | GEN     | LOAD    | SHUNT   | X     | TO B      | us                                      | x    |     |      |      |
|--|----------|-------|---------|---------|---------|-------|-----------|---|------|-----|------|------|
| TRANSFORMER RATING<br>BUS# X NAMEX BASKV ZC<br>RATIO ANGLE % SET A | NE PU/KV | ANGLE | MW/MVAR | MW/MVAR | MW/MVAR | BUS#  | X NAME    | X BASKV                                 | AREA | СКТ | MW   | MVAF |
| 4100 MIAN MEER MV11.000  | 4 1.0000 | 0.0   | 1.9     | 0.0     | 0.0     |       |           |   |      |     |      |      |
| 7 10   | 1 11.000 |       | 0.9R    | 0.0     | 0.0     | 41001 | BLOCK 1   | 11.000                                  | 4    | 1   | 0.6  | 0.   |
| 7 10   |          |       |         |         |         | 41005 | BLOCK 2   | 11.000                                  | 4    | 1   | 0.6  | 0.   |
|  |          |       |         |         |         | 41009 | BLOCK 3   | 11.000                                  | 4    | 1   | 0.6  | ο.   |
| 7 10<br>41001 BLOCK 1 11.000                                       | 4 0.9999 | ~0.0  | 0.0     | 0.0     | 0.0     |       |           |   |      |     |      | ·    |
| 7 10   | 1 10.998 |       | 0.0     | 0.0     | 0.0     | 4100  | MIAN MEER | MV11.000                                | 4    | 1   | -0.6 | -0.  |
|  |          |       |         |         |         | 41002 | LV        | 0.4400                                  | 4    | 1   | 0.3  | 0.   |
| 1.000LK 22 2   |          |       |         |         |         | 41003 | BLOCK 1-A | 11.000                                  | 4    | 1   | 0.3  | 0.   |
| 4 10<br>41002 LV 0.4400  | 4 0.9949 | -0.6  | 0.0     | 0.3     | 0.0     |       |           |   |      |     |      |      |
| 1.000UN 22 2   | 1 0.4378 |       | 0.0     | 0.2     | 0.0     | 41001 | BLOCK 1   | 11.000                                  | 4    | 1   | -0.3 | -0   |
| 41003 BLOCK 1-A 11.000   | 4 0.9998 | -0.0  | 0.0     | 0.0     | 0.0     |       | *         |   |      |     |      |      |
| 4 10   | 1 10.998 |       | 0.0     | 0.0     | 0.0     | 41001 | BLOCK 1   | 11.000                                  | 4    | 1   | -0.3 | -0,  |
|  |          |       |         |         |         | 41004 | LV        | 0.4400                                  | 4    | 1   | 0.3  | 0.   |
| 0.975LK 22 2<br>41004 LV 0.4400                                    | 4 1.0206 | -0.6  | 0.0     | 0.3     | 0.0     |       |           |   |      |     |      |      |
| 1.000UN 22 2   | 1 0.4491 |       | 0.0     | 0.2     | 0.0     | 41003 | BLOCK 1-A | 11.000                                  | 4    | 1   | -0.3 | -0.  |
| 41005 BLOCK 2 11.000   | 4 0.9997 | -0.0  | 0.0     | 0.0     | 0.0     |       |           | و میں مرد اندر اندر میں جون مزن مرد مرد | +    |     |      |      |
| EN.  | 1 10.997 |       | 0.0     | 0.0     | 0.0     | 4100  | MIAN MEER | MV11.000                                | 4    | 1   | -0.6 | -0.  |
| 10   |          |       |         |         |         | 41006 | LV        | 0.4400                                  | 4    | 1   | 03   | 0.   |

| 4 10                |                  |          | -    |     |     | 4      | 1007 BLOCK 2-A | 11,000   | 4 | 1 | 0.3  | 0.2  |
|---------------------|------------------|----------|------|-----|-----|--------|----------------|----------|---|---|------|------|
| 41006 LV            | 0.4400           | 4 0.9948 | -0.6 | 0.0 | 0.3 | 0.0    |                |          |   |   |      |      |
|                     | 22 2             | 1 0.4377 |      | 0.0 | 0.2 | 0.0 4  | 1005 BLOCK 2   | 11.000   | 4 | 1 | -0.3 | -0.2 |
| 41007 BLOCK 2-A     | 11.000           | 4 0.9997 | -0.0 | 0.0 | 0.0 | 0.0    |                |          |   |   | *    |      |
| 10                  |                  | 1 10.997 |      | 0.0 | 0.0 | 0.0 43 | 1005 BLOCK 2   | 11.000   | 4 | 1 | -0.3 | -0.2 |
| ).988LK<br>41008 LV | 22 2             | 4 1.0075 | -0.6 | 0.0 | 0.3 |        | 1008 LV        |          |   |   |      | 0.2  |
| 1.000UN             |                  | 1 0.4433 | •••  | 0.0 | 0.2 |        | LOO7 BLOCK 2-A |          |   |   |      |      |
| 41009 BLOCK 3       | 11.000           | 4 0.9996 | -0.0 | 0.0 | 0.0 | 0.0    |                |          |   |   |      |      |
| 10                  | - gin gin gin an | 1 10.996 |      | 0.0 | 0.0 | 0.0    | 100 MIAN MEER  | MV11.000 | 4 | 1 | -0.6 | -0.3 |
| 1.000LK             | 22 2             |          |      |     |     |        | 0010 LV        | ••       |   |   | 0.3  | 0.2  |
| 3 10<br>410010 LV   | 0.4400           | 4 0.9946 | -0.6 | 0.0 | 0.3 |        | 0011 BLOCK 3-A |          | _ | _ |      | 0.1  |
| 1.000UN             |                  | 1 0.4376 |      | 0.0 | 0.2 | 0.0 4: | 1009 BLOCK 3   | 11.000   | 4 | 1 | -0.3 | -0.2 |
| 410011 BLOCK 3-A    | 11.000           | 4 0.9994 | -0.0 | 0.0 | 0.0 | 0.0    |                |          |   |   |      |      |
| 4 10                |                  | 1 10.993 |      | 0.0 | 0.0 | 0.0 41 | 1009 BLOCK 3   | 11.000   | 4 | 1 | -0.3 | -0.2 |
|                     | 12 3             | 4 1.0089 | -0.4 | 0.0 | 0.3 |        | )012 LV        |          |   | - |      | 0.2  |
| 410012 LV           |                  | 4 1.0089 |      | 0.0 | 0.3 |        | 011 BLOCK 3-A  |          |   |   |      |      |



# Annexure-C-2

# With MML PP and With Sanctioned Load In Service



|                                      | 1                                  | MIAN M | PTI<br>EER SOLA |       | CTIVE PO<br>STEM | WER SYSTI | EM SIMUL | ATORPS | SS (R) E   | SAT, FEB<br>%MVA FC<br>% I FC | DR TRA | ANSFO |      | BRANCHES |
|--------------------------------------|------------------------------------|--------|-----------------|-------|------------------|-----------|----------|--------|------------|-------------------------------|--------|-------|------|----------|
|                                      | DM BUS                             | AREA   | VOLT            |       | GEN              | LOAD      | SHUNT    | x      | TO E       | us                            | x      |       |      |          |
| TRANSFORMER<br>BUS#XN<br>RATIO ANGLE | RATING<br>NAMEX BASKN<br>S % SET A | 7 ZONE | PU/KV           | ANGLE | MW/MVAR          | MW/MVAR   | MW/MVAR  | BUS#   | X NAME     | X BASKV                       | AREA   | СКТ   | MW   | MVAR     |
| 4100 MIAN                            | MEER MV11.000                      | ) 4    | 1.0000          | 0.0   | 1.5              | 0.0       | 0.0      |        |            |                               |        |       |      |          |
|                                      |                                    | 1      | 11.000          |       | 0.8R             | 0.0       | 0.0      | 41001  | BLOCK 1    | 11.000                        | 4      | 1     | 0.6  | 0.3      |
| 10                                   |                                    |        |                 |       |                  |           |          | 41005  | BLOCK 2    | 11.000                        | 4      | 1     | 0.6  | 0.3      |
| 10                                   |                                    |        |                 |       |                  |           |          | 41009  | BLOCK 3    | 11.000                        | 4      | 1     | 0.6  | 0.3      |
| 10                                   |                                    |        |                 |       |                  |           |          | 410013 | SOLAR MV   | 11.000                        | 4      | 1     | -0.4 | -0.1     |
| 10<br>41001 BLOCH                    | < 1 <b>11.00</b>                   | ) 4    | 0.9999          | -0.0  | 0.0              | 0.0       | 0.0      |        |            |                               |        |       |      |          |
|                                      |                                    | 1      | 10.998          |       | 0.0              | 0.0       | 0.0      | 4100   | MIAN MEER  | MV11.000                      | 4      | 1     | -0.6 | -0.3     |
| 10                                   |                                    |        |                 |       |                  |           |          |        |            | 0.4400                        |        |       | 0.3  | 0.2      |
| .000LK                               | 22 2                               |        |                 |       |                  |           |          |        |            | 11.000                        |        |       |      |          |
| 10<br>41002 LV                       | 0.440                              | ) 4    | 0.9949          | -0.6  | 0.0              | 0.3       | 0.0      |        |            |                               |        | _     |      |          |
|                                      |                                    |        | 0.4378          |       | 0.0              | 0.2       |          |        |            | 11.000                        |        |       |      | -0.2     |
| .000UN                               | 22 2                               | _      | 0.1010          |       |                  | 0.2       | 0.0      | 41001  | BLOCK I    | 11.000                        | -      | 1     | -0.5 | -0.2     |
| 41003 BLOCH                          | K 1-A 11.00                        | ) 4    | 0.9998          | -0.0  | 0.0              | 0.0       | 0.0      |        |            |                               |        |       | *    |          |
|                                      |                                    | 1      | 10.998          |       | 0.0              | 0.0       | 0.0      | 41001  | BLOCK 1    | 11.000                        | 4      | 1     | -0.3 | -0.2     |
| 10                                   |                                    |        |                 |       |                  |           |          | 41004  | Γ <b>Λ</b> | 0.4400                        | 4      | 1     | 0.3  | 0.2      |
| 41004 LV                             | 22 2<br>0.440                      | ) 4    | 1.0206          | -0.6  | 0.0              | 0.3       | 0.0      |        |            |                               |        |       |      |          |
| . 000UN                              | 22 2                               |        | 0.4491          |       | 0.0              | 0.2       | 0.0      | 41003  | BLOCK 1-A  | 11.000                        | 4      | 1     | -0.3 | -0.2     |
| 41005 BLOCH                          | K 2 11.00                          | ) 4    | 0.9997          | -0.0  | 0.0              | 0.0       | 0.0      |        |            |                               |        |       |      |          |
| 10                                   | ****                               | 1      | 10.997          |       | 0.0              | 0.0       | 0.0      | 4100   | MIAN MEER  | MV11.000                      | 4      | 1     | -0.6 | -0.3     |

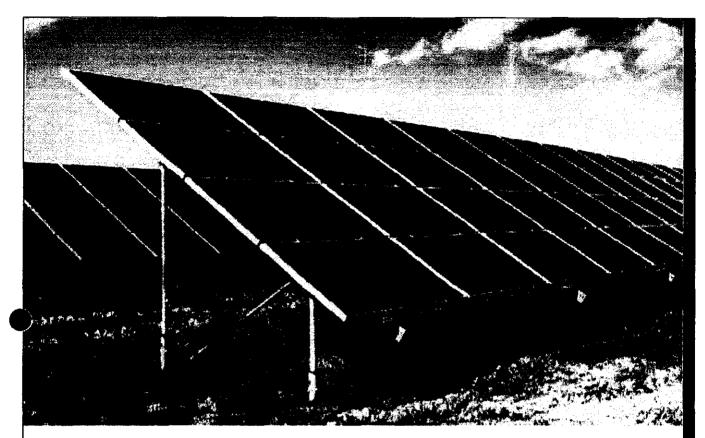
TC ENCROLES \*

| 1.000LK             | 22 | 2      |          |      |     |     | 41006 LV 0.4400 4 1 0.3<br>41007 BLOCK 2-A 11.000 4 1 0.3 |
|---------------------|----|--------|----------|------|-----|-----|---|
| 4 10<br>41006 LV    |    | 0.4400 | 4 0.9948 | -0.6 | 0.0 | 0.3 | 41007 BLOCK 2-A 11.000 4 1 0.3                            |
| 1.000UN             |    |        | 1 0.4377 |      | 0.0 | 0.2 | 0.0 41005 BLOCK 2 11.000 4 1 -0.3 -                       |
| 41007 BLOCK 2       |    |        | 4 0.9997 | -0.0 | 0.0 | 0.0 | 0.0   |
| 4 10                |    |        | 1 10.997 |      | 0.0 | 0.0 | 0.0 41005 BLOCK 2 11.000 4 1 -0.3 -                       |
| 0.988LK<br>41008 LV |    | 0.4400 | 4 1.0075 | -0.6 | 0.0 | 0.3 | 41008 LV 0.4400 4 1 0.3                                   |
| 1.000UN             |    |        | 1 0.4433 |      | 0.0 | 0.2 | 0.0 41007 BLOCK 2-A 11.000 4 1 -0.3 -                     |
| 41009 BLOCK 3       |    |        | 4 0.9996 | -0.0 | 0.0 | 0.0 | 0.0   |
| 7 10                |    |        | 1 10.996 |      | 0.0 | 0.0 | 0.0 4100 MIAN MEER MV11.000 4 1 -0.6 -                    |
| 1.000LK             | 22 | 2      |          |      |     |     | 410010 LV 0.4400 4 1 0.3                                  |
| 3 10                |    |        |          |      |     |     | 410011 BLOCK 3-A 11.000 4 1 0.3                           |
| 410010 LV           |    | 0.4400 | 4 0.9946 | -0.6 | 0.0 | 0.3 | 0.0   |
| 1.000UN             | 22 | 2      | 1 0.4376 |      | 0.0 | 0.2 | 0.0 41009 BLOCK 3 11.000 4 1 -0.3 -                       |
| 410011 BLOCK 3      |    |        | 4 0.9994 | -0.0 | 0.0 | 0.0 | 0.0   |
| 4 10                |    |        | 1 10.993 |      | 0.0 | 0.0 | 0.0 41009 BLOCK 3 11.000 4 1 -0.3 -                       |
| 0.988LK             | 12 | 3      |          |      |     |     | 410012 LV 0.4400 4 1 0.3                                  |
| 410012 LV           |    | 0.4400 | 4 1.0089 | -0.4 | 0.0 | 0.3 | 0.0   |
| 1.000UN             |    |        | 1 0.4439 |      | 0.0 | 0.2 | 0.0 410011 BLOCK 3-A 11.000 4 1 -0.3 -6                   |
| 410013 SOLAR M      |    |        | 4 1.0001 | 0.0  | 0.0 | 0.0 | 0.0   |
| $\lambda$           |    |        | 1 11.001 |      | 0.0 | 0.0 | 0.0 4100 MIAN MEER MV11.000 4 1 0.4 (                     |



410014 SOLAR LV 0.8000 4 1 -0.4 -0.1 1.000LK 64 1 410014 SOLAR LV 0.8000 4 1.0015 0.4 0.5 0.0 0.0 6 36 <u>2</u> 6 2 1 0.8012 0.1R 0.0 0.0 410013 SOLAR MV 11.000 0.1 1.000UN 0.4 64 4 1

Sec. 20





# SYSTEM STUDY ANALYSIS OF MEHFOOZ SHAHEED GARRISON (MSG) 500kW SOLAR PV SYSTEM

Report

ARCO Energy

**PAKISTAN** Tel: +92-300-8827101





### CONTENTS

|            | VE SUMMARY 1   |
|------------|--|
| 1 INTRO    | ODUCTION   |
| 1.1 Pr     | oject Description  |
| 1.2 In     | terconnection Arrangement  |
| 1.3 O      | bjective of System Study Analysis                                      |
| 1.4 Sta    | udy Components   |
| 2 STUD     | Y METHODOLOGY  |
| 2.1 Stu    | udy Criteria 6   |
| 2.2 Ste    | eady State Analysis  |
| 2.2.1      | System Intact Analysis   |
| 2.2.2      | Transmission Line Loading Analysis 6                                   |
| 2.2.3      | Voltage Analysis   |
| 3 STEAL    | DY STATE ANALYSIS  |
| 3.1 Mo     | odel Development   |
| 3.2 Po     | wer Flow Assessment Without MSG PP and with Sanctioned Load In Service |
| 3.2.1      | Base Year 2025: Peak Loading Summer with Sanctioned Load in Service    |
| 3.3 Po     | wer Flow Assessment with MSG PP9                                       |
| 3.3.1      | Base Year 2025: Peak Loading Summer with Sanctioned Load In Service    |
| 3.4 Co     | onclusion9   |
| 4 CONC     | LUSION   |
| 4.1 Ste    | eady State Assessment  |
| LIST OF AI | NNEXURES   |





### **EXECUTIVE SUMMARY**

This report provides the documentation of an assessment that has been performed for the interconnection of a 500kW Solar PV Power Generation project at Mehfooz Shaheed Garrison (MSG) distribution system at 11kV project of "Military Engineering Services" (MES). The project will be a Grid tied 500kW Solar PV based system connected with the power network of MSG. The '500kW MSG solar PV Power Generation project' is located at GCWM+2G5, Aziz Bhatti Town, Lahore, Pakistan.

The integration of solar power generation at the MSG premises necessitates a comprehensive system study analysis to ensure optimal operation of the electrical network. MSG currently receives a single point supply from LESCO with a sanctioned load of 2.690MW. The introduction of solar power generation will influence the flow of electricity within the premises, impacting both consumption and injection dynamics.

The existing setup includes transformers, switchgear, and distribution panels to distribute electricity throughout the premises. The sanctioned load of 2.690MW is the maximum load that can be drawn from LESCO's grid.

The entire solar generation within the MSG premises will be consumed internally without exporting any power to the grid. To ensure the safe and efficient integration of solar power, a load flow study is required to analyze the impact of this interconnection on the existing electrical network. This study will assist in obtaining solar generation concurrence and ensuring compliance with relevant technical and regulatory requirements.

The analyses have been carried out in following scenarios;

- Without 500kW MSG solar PV with sanctioned load in service.
- With 500kW MSG solar PV with sanctioned load in service.

Steady state power flow assessment has been performed using the network data of MSG. Power flow study was conducted without Solar Project with sanctioned load in service to analyze the magnitude and phase angles of bus voltages, line loadings and power flows under steady-state conditions. Power flow analysis was also conducted with sanctioned load in service after the interconnection of the Solar project with the MSG distribution system. The power flow results for the system intact shows that





the power flows on all the MSG transmission and distribution line branches are within their normal line loading limit. There is no capacity constraint in terms of power flow or voltage ratings within the study area.

This systems study is a critical step in obtaining solar generation concurrence for MSG. By ensuring the stability and reliability of the electrical system, the study facilitates seamless solar power integration while maintaining compliance with MSG and regulatory requirements.

Based on the study results, it is concluded that proposed generation interconnection assessment for 500kW MSG solar PV Power Generation project meets the NEPRA grid code planning criteria.





### **1 INTRODUCTION**

### 1.1 Project Description

This report provides the documentation of an assessment that has been performed by ARCO Energy in response to a request made by Mehfooz Shaheed Garrison (MSG) ("Project Owner" or "PO") for the interconnection of a 500kWp Solar PV Power Generation project ("Project") to the MSG power System at 11kV.

The '500kW MSG solar PV Power Generation project' is located at GCWM+2G5, Aziz Bhatti Town, Lahore, Pakistan. Figure 1.1 shows Google site map of the project.

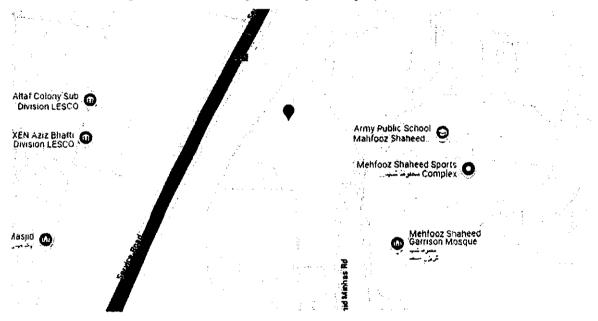


Figure 1.1: Google Site Map of the Solar PV Power Generation Project.





### 1.2 Interconnection Arrangement

MSG aims to integrate solar power generation into its existing electrical infrastructure. MSG currently receives a single-point power supply from LESCO with a sanctioned load of 2.690MW. The entire solar generation within the MSG premises will be consumed internally without exporting any power to the grid. The objective of the analyses is to evaluate the impact of the solar power plant on the MSG transmission and distribution system.

### 1.3 Objective of System Study Analysis

The primary objectives of the load flow study are:

- To evaluate the impact of solar power injection on the voltage levels and power distribution within MSG premises.
- To determine the changes in power flow patterns resulting from the integration of solar generation.
- To ensure that the existing electrical infrastructure can support the additional solar power without causing instability or operational issues.
- To verify compliance with regulatory requirements for solar power interconnection and obtain concurrence for solar generation.

### 1.4 Study Components

500kW solar PV system is modelled into the MSG distribution system by ARCO Energy. Technical analysis includes:

- i) Data gathering and modelling
- ii) Steady state analysis
- iii) Conclusion

The above scope of work involved in the technical analysis has been carried to demonstrate that connection assessment of this PV system meets the National Electric Power Regulatory Authority (NEPRA) distribution code.

The analyses have been carried out in following scenarios;

- Without 500kW MSG solar PV with sanctioned load in service.
- With 500kW MSG solar PV with sanctioned load in service.





This report documents the results of the steady state analyses. The principal objective of these analyses is to evaluate the impact of 500kW solar PV system to the distribution system of MSG and vice versa.





### 2 STUDY METHODOLOGY

### 2.1 Study Criteria

The study has been carried out based on the National Electric Power Regulatory Authority (NEPRA) Grid Code planning criteria. Key parameters and their corresponding limits have been summarized in table below.

| Para           | ameter           | Range  |
|----------------|------------------|--|
| Voltage Level  | Normal Condition | ±5 % p.u at 132kV and below<br>+8%,-5% p.u at 220kVand above |
|                | Contingency      | ±10 % p.u  |
| T/Line Loading | Normal Condition | 100%   |
| Capacity       | Contingency      | 100%   |
|                | Nominal          | 50 Hz  |
| Frequency      | Normal Variation | 49.8 Hz - 50.2 Hz  |
|                | Contingency Band | 49.4 Hz - 50.5 Hz  |
| Power Factor   | Lagging          | 0.95   |
| FUWER FACIOF   | Leading          | 0.95   |

### 2.2 Steady State Analysis

The purpose of steady-state analysis is to analyse the impact of the proposed solar power plant on distribution system facilities under steady-state conditions. It involves two distinct analyses: line loading analysis and voltage analysis. Power flow solutions using the PSS/E® program (Version 33.4) has been performed.

A "study area" was defined to represent the areas of interest within MSG.

#### 2.2.1 System Intact Analysis

The incremental impact of the project on substations and transmission line loading under normal conditions was evaluated by comparing transmission and distribution system power flows through different scenarios for the project.

#### 2.2.2 Transmission Line Loading Analysis

11kV and 0.4kV rated transmission and distribution facilities in the study area have been monitored for line loadings.





#### 2.2.3 Voltage Analysis

Voltages at buses inside the study area have been monitored for possible for voltage violations in accordance with NEPRA Grid Code guidelines.





### **3 STEADY STATE ANALYSIS**

### 3.1 Model Development

Project specific data was provided by the plant owner and it has been compiled and presented in **Annexure-A**. The steady state model of the power plant is presented in table below:

|  | Generator                      |  |
|--|--------------------------------|--|
| No. of Collector Units                       | 1                              |  |
| Generation size of each<br>collector (kVA)   | 421                            |  |
| Active Power of each<br>collector Pgen. (kW) | 400                            |  |
| Power Factor                                 | 0.95 lagging, 0.95 leading     |  |
| Qmin, Qmax (kVAR)                            | - 0.1315, 0.1315               |  |
| Rated Frequency                              | 50 Hz                          |  |
| Generation Voltage                           | 0.8V                           |  |
| Xsource                                      | 00                             |  |
|  | Generation Step Up Transformer |  |
| No of Transformer                            | 1                              |  |
| kVA Capacity of each<br>GSU                  | 630                            |  |
| % Reactance (X)                              | 5 %                            |  |
| ,  | Mehfooz Shaheed Garrison       |  |
| Sanctioned Load (LESCO)                      | 2690 kW                        |  |

Steady state power flow assessment has been performed using the network data of MSG.

### 3.2 Power Flow Assessment Without MSG PP and with Sanctioned Load In Service

Power flow study without MSG solar and with sanctioned load in service, was conducted to analyze the magnitude and phase angles of bus voltages, line loadings and power flows under steady-state conditions.

The result of this power flow analysis is in Annexure-B.





#### 3.2.1 Base Year 2025: Peak Loading Summer with Sanctioned Load in Service

Power flow analysis has been performed on the peak loading summer (June) 2025 case of MSG network. This base case included a detailed representation of the MSG transmission and distribution system in the study area.

The steady state results, depicts that the power flows on all the MSG distribution line branches are within their normal loading limits. There is no capacity constraint in terms of load flow or voltage ratings around the study area. Result of the power flow analysis is attached in **Figure B-1**.

### 3.3 Power Flow Assessment with MSG PP

Power flow study of MSG solar project was conducted with sanctioned load (in service and out of service) to determine the reliability impact of the 500kW MSG solar project on the MSG distribution system. This includes the performance of load flow analysis to identify any facility overload or voltage condition that violates the NEPRA planning criteria. Any such violation that is either directly attributable to this project or for which it will have a shared responsibility is included in this report.

The results of the project power flow analysis are plotted in Annexure-B.

#### 3.3.1 Base Year 2025: Peak Loading Summer with Sanctioned Load In Service

A base case has been developed with sanctioned load in service at MSG solar for peak loading summer (June) 2025 that allow us to judge the impact of MSG solar project on the MSG network. Project power flow analysis has been performed after the connection of the project with the MSG distribution system. This includes the detailed representation of the power plant.

The steady state result, with sanctioned load in service at MSG solar depicts that the power flows on all the transmission line branches are within their normal loading limits. There is no capacity constraint in terms of load flow or voltage ratings around the study area. Result of the power flow analysis is attached in Figure B-2.

The results of the project bus voltages analysis are attached in Annexure-C.

### 3.4 Conclusion

Steady state power flow assessment has been performed. Power flow study was conducted without solar Project with sanctioned load in service to analyze the magnitude and phase angles of bus voltages, line loadings and power flows under steady-state conditions. Power flow analysis was also conducted



with sanctioned load in service after the interconnection of the Solar project with the MSG distribution system. The power flow results for the system intact shows that the power flows on all the MSG distribution line branches are within their normal line loading limit. There is no capacity constraint in terms of power flow or voltage ratings within the study area.





### 4 CONCLUSION

### 4.1 Steady State Assessment

Steady state power flow assessment has been performed. Power flow study was conducted without MSG solar with sanctioned load in service, to analyze the magnitude and phase angles of bus voltages, line loadings, and power flows under steady-state conditions. Power flow analysis was also conducted with MSG solar and with sanctioned load in service with MSG distribution system. Power flow results showed that the power flows on all the MSG distribution branches are within their normal loading limit. There is no capacity constraint in terms of power flow or voltage ratings within the study area.

The steady state results found no capacity constraint in terms of power flow and voltage ranges.

Hence, it is concluded that based on the study results the Interconnection Assessment for 500kW Mehfooz Shaheed Garrison solar PV system with MSG Transmission and Distribution Network, meets the NEPRA grid code planning criteria.





### LIST OF ANNEXURES

Annex A: Project Specific Data.

Annex A-1: Project Site Map.

Annex A-2: Power Plant Data.

Annex B: Power Flow Steady State Analysis Result

Figure B-1: Base Year 2025 - Peak loading summer without MSG solar and Sanctioned load in service.

Figure B-2: Base Year 2025 - Peak loading summer with MSG solar and Sanctioned load in service.

Annex C: Assessment of Bus Voltages.

Annex C-1: Without MSG solar and with Sanctioned Load In Service.

Annex C-2: With MSG solar and with Sanctioned Load In Service.



## Annexure-A

get in

11

## Project Specific Data



## Annexure-A-1

Project Site Map



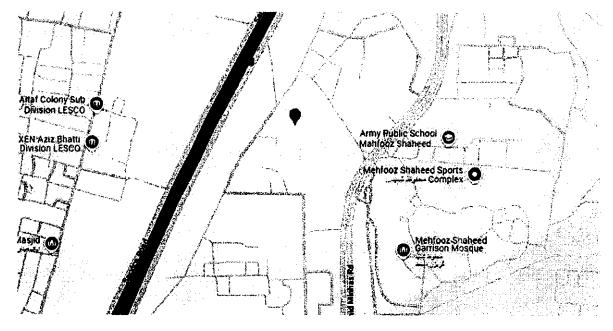


Figure 1.1: Google Site Map of the Solar PV Power Generation Project.

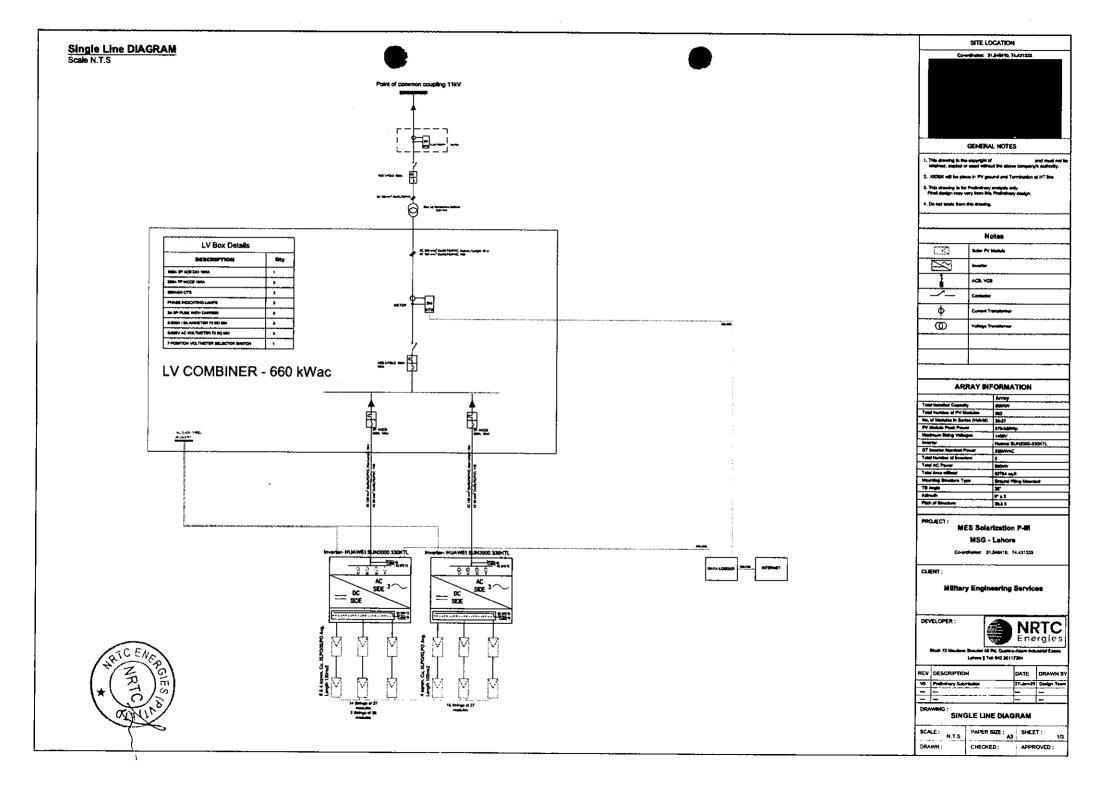


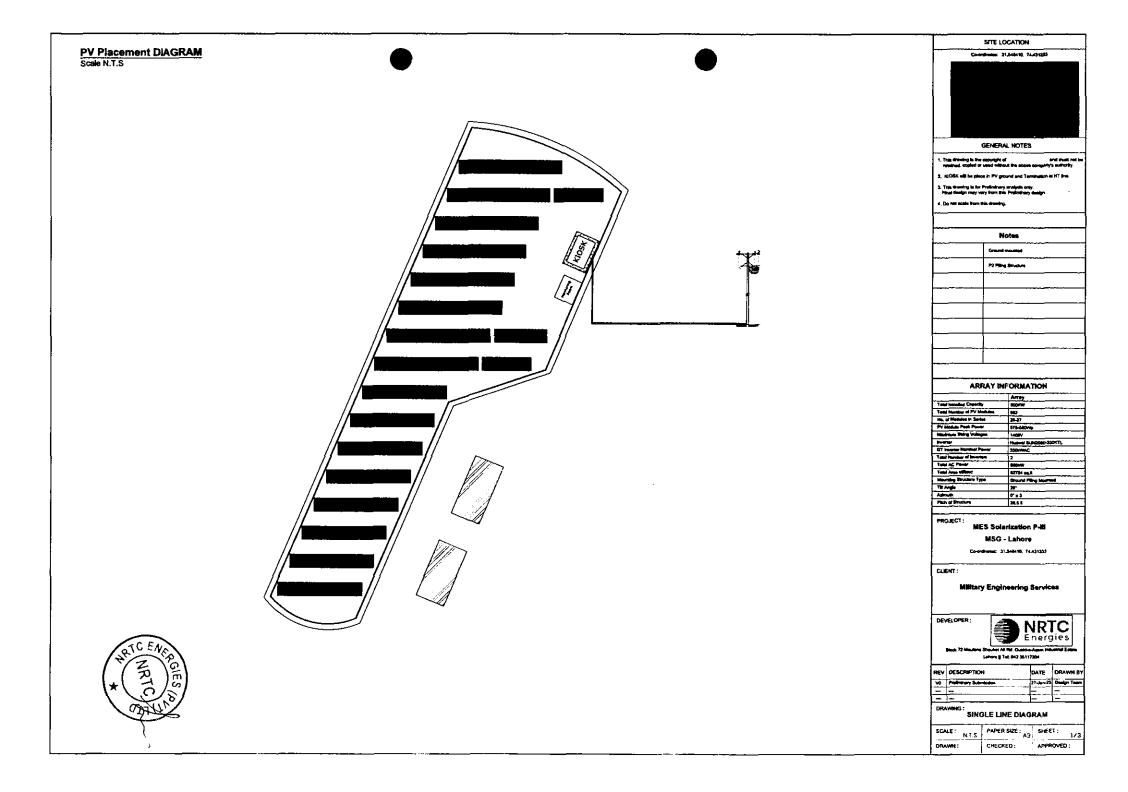
### Annexure-A-2

1

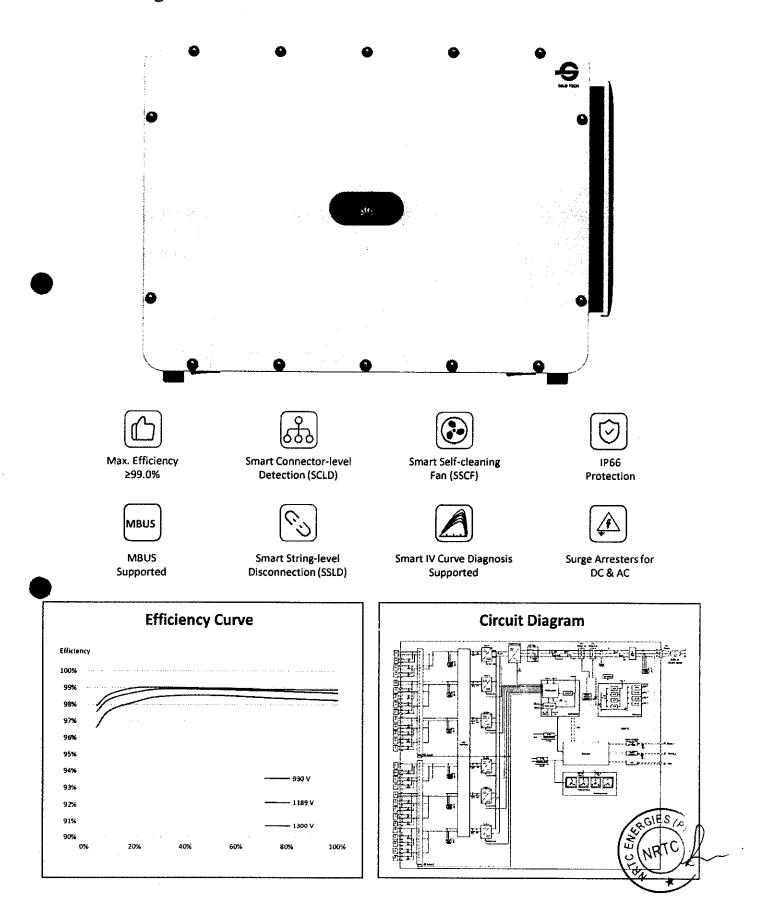
Power Plant Data







### SUN2000-330KTL-H1 Smart String Inverter



### sun2000-330ктL-н1 Technical Specifications

| Annanin i mara ana ang ang ang ang ang ang ang ang an  | Efficiency   |
|--|--|
| Max. Efficiency  | ≥99.0%   |
| European Efficiency  | ≥98.8%   |
|  | Input . The later of the second se  |
| Max. Input Voltage   | 1,500 V  |
| Number of MPP Trackers   | 6  |
| Max. Current per MPPT  | 65 A   |
| Max. Short Circuit Current per MPPT  | 115A   |
| Max. PV Inputs per MPPT  | 4/5/5/4/5/5  |
| Start Voltage  | 550 V  |
| e a contra de la contra de   | · · · · · · · · · · · · · · · · · · ·  |
| MPPT Operating Voltage Range   | 500 V ~ 1,500 V  |
| Nominal Input Voltage  | 1,080 V  |
| et en<br>Alterniterio en antico tato en anternet en en en en alterniterio en antico menore en antico en en antico en en a  | Output   |
| Nominal AC Active Power  | 300,000 W  |
| Max. AC Apparent Power   | 330,000 VA   |
| Max. AC Active Power (cosφ=1)  | 330,000 W  |
| Nominal Output Voltage   | 800 V, 3W + PE   |
| Rated AC Grid Frequency  | 50 Hz / 60 Hz  |
| Nominal Output Current   | 216.6 A  |
| Max. Output Current  | 238.2 A  |
| Adjustable Power Factor Range  | 0.8 LG 0.8 LD  |
| Total Harmonic Distortion  | <1%  |
|  | and the second   |
|  | Protection was the second structure of a sec |
| Smart String-Level Disconnector(SSLD)  | Yes  |
| Anti-islanding Protection  | Yes  |
| AC Overcurrent Protection  | Yes  |
| DC Reverse-polarity Protection   | Yes  |
| PV-array String Fault Monitoring   | Yes  |
| DC Surge Arrester  | Type II  |
| AC Surge Arrester  | Туре II  |
| DC Insulation Resistance Detection   | Yes  |
| AC Grounding Fault Protection  | Yes  |
| Residual Current Monitoring Unit   | Yes  |
| weeks a manager of the state of | Communication  |
| และผู้หนึ่ง และการจึงใหญ่ และ รางการ เพราะการการการการที่ไปต้องการรางแป้ง กล้ายและการการการผู้สารราช ประชาวิตต<br>   | LED Indicators, WLAN + APP   |
| Display  |  |
| USB  | Yes  |
| MBUS   | Yes  |
| RS485  | Yes  |
|  | General  |
| Dimensions (W x H x D)   | 1,048 x 732 x 395 mm   |
| Weight (with mounting plate)   | ≤112 kg  |
| Operating Temperature Range  | -25 °C ~ 60 °C   |
| Cooling Method   | Smart Air Cooling  |
| Max. Operating Altitude without Derating   | 4,000 m (13,123 ft.)   |
| Relative Humidity  | 4,000 m (13,123 ft.)<br>0 ~ 100%<br>Waterproof Connector + 0T/DT Terminal  |
| AC Connector   | Waterproof Connector + OT/DT Terminal  |
| Protection Degree  | IP 66  |
|  |  |



## LR5-72HTH 560~575M

- Suitable for distributed projects
- Excellent outdoor power generation performance
- High module quality ensures long-term reliability



15-year Warranty for Materials and Processing



25-year Warranty for Extra Linear Power Output

#### Complete System and Product Certifications

IEC 61215, IEC 61730, UL 61730 ISO9001:2015: ISO Quality Management System ISO14001: 2015: ISO Environment Management System ISO45001: 2018: Occupational Health and Safety IEC62941: Guideline for module design qualification and type approval

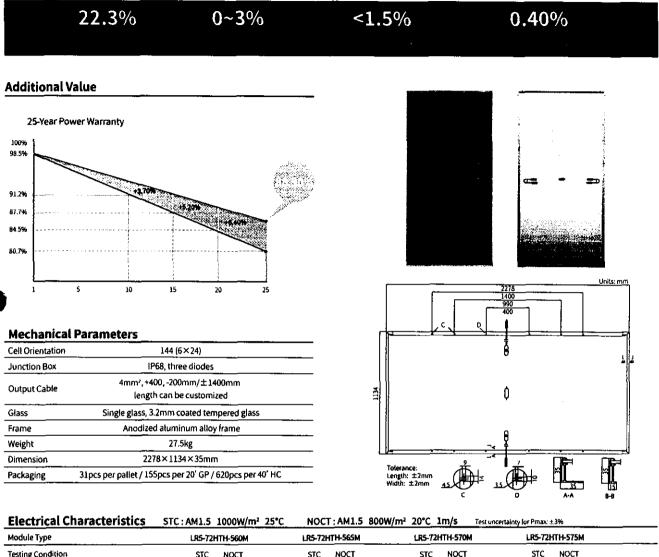




2

## Hi-MO 🗗

### LR5-72HTH 560~575M



| Testing Condition                | STC   | NOCT  | STC   | NOCT  | STC   | NOCT  | STC   | NOCT  |  |
|----------------------------------|-------|-------|-------|-------|-------|-------|-------|-------|--|
| Maximum Power (Pmax/W)           | 560   | 418   | 565   | 422   | 570   | 426   | 575   | 430   |  |
| Open Circuit Voltage (Voc/V)     | 51,61 | 48.46 | 51.76 | 48.60 | 51.91 | 48.74 | 52.06 | 48.88 |  |
| Short Circuit Current (Isc/A)    | 13.94 | 11.26 | 14.01 | 11.31 | 14.07 | 11.36 | 14.14 | 11.42 |  |
| Voltage at Maximum Power (Vmp/V) | 43.46 | 39.66 | 43.61 | 39.79 | 43.76 | 39.93 | 43.91 | 40.07 |  |
| Current at Maximum Power (Imp/A) | 12.89 | 10.55 | 12.96 | 10.61 | 13.03 | 10.67 | 13.10 | 10.72 |  |
| Module Efficiency(%)             | 2     | 1.7   | 2     | 1.9   | 2     | 2.1   | 22    | 2.3   |  |

#### **Operating Parameters**

| Operational Temperature            | -40°C - +85°C    |  |
|------------------------------------|------------------|--|
| Power Output Tolerance             | 0~3%             |  |
| Voc and isc Tolerance              | ±3%              |  |
| Maximum System Voltage             | DC1500V (IEC/UL) |  |
| Maximum Series Fuse Rating         | 25A              |  |
| Nominal Operating Cell Temperature | 45±2*C           |  |
| Protection Class                   | Class II         |  |
|                                    | UL type 1 or 2   |  |
| Fire Rating                        | IEC Class C      |  |

#### **Mechanical Loading**

| Hailstone Test                    | 25mm Hailstone at the speed of 23m/s |
|-----------------------------------|--------------------------------------|
| Rear Side Maximum Static Loading  | 2400Pa                               |
| Front Side Maximum Static Loading | 5400Pa                               |

#### Temperature Ratings (STC)

| Temperature Coefficient of Isc  | +0.050%/°C |
|---------------------------------|------------|
| Temperature Coefficient of Voc  | -0.230%/°C |
| Temperature Coefficient of Pmax | -0.290%/*C |



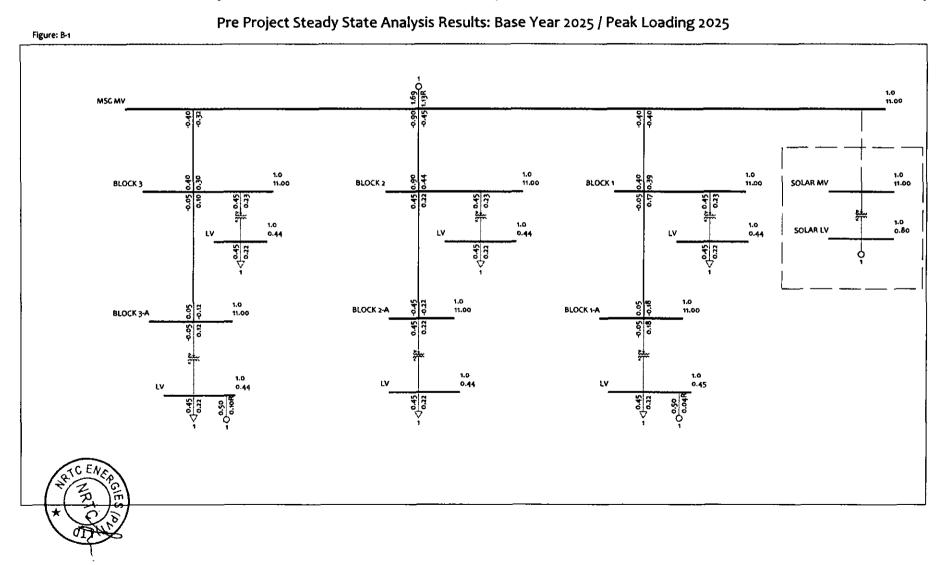
No.8369 Shangyuan Road, Xi'an Economic And Technological Development Zone, Xi'an, Shaanxi, China. Web: www.longi.com Specifications includent in Mispatashee are subjective change without inter-LONGi reserves the Water Hinal interpretation. (22210208) (inters) DG

### Annexure-B

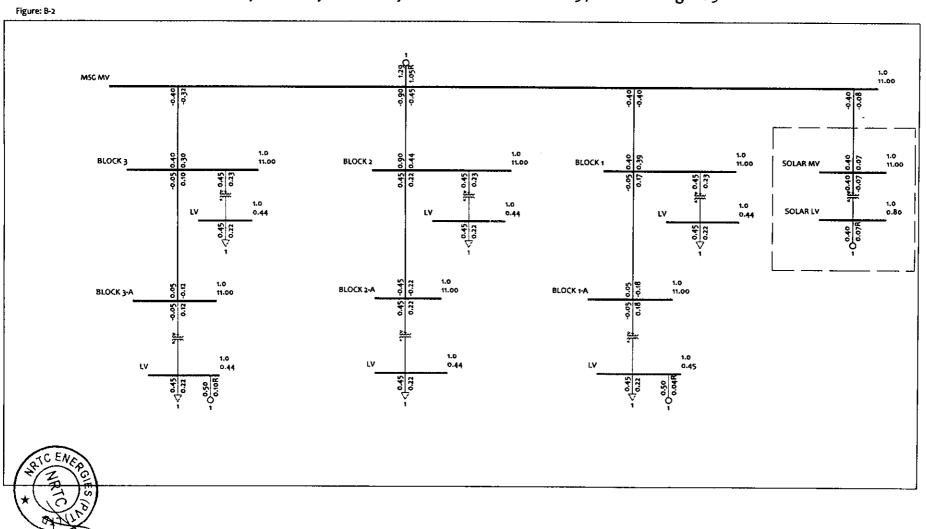
Steady State Analysis Results



### Load Flow Analysis of 500kW Solar PV System at Mehfooz Shaheed Garrison (MSG)



### Load Flow Analysis of 500kW Solar PV System at Mehfooz Shaheed Garison (MSG)



Post Project Steady State Analysis Results: Base Year 2025 / Peak Loading 2025

### Annexure-C

ian. Zen

## Assessment of bus voltages



## Annexure-C-1

### Without MSG PP and With Sanctioned Load

In Service



|        | X F                                |   |                           | AREA | VOLT   |       | GEN     | LOAD    | SHUNT   | Х ТО В          | us      | x    |     |      |      |
|--------|------------------------------------|---|---------------------------|------|--------|-------|---------|---------|---------|-----------------|---------|------|-----|------|------|
|        | TRANSFORMER<br>BUS# X<br>RATIO ANG | NAME                                    | ATING<br>X BASKV<br>SET A | ZONE | PU/KV  | ANGLE | MW/MVAR | MW/MVAR | MW/MVAR | BUS# X NAME     | X BASKV | AREA | СКТ | MW   | MVAF |
|        | 4100 MSG                           |   | 11.000                    | 4    | 1.0000 | 0.0   | 1.7     | 0.0     | 0.0     |                 | *       |      |     |      |      |
|        | 6 10                               |   |                           | 1    | 11.000 |       | 1.1R    | 0.0     | 0.0     | 41001 BLOCK 1   | 11.000  | 4    | 1   | 0.4  | 0.   |
|        | 10 10                              |   |                           |      |        |       |         |         |         | 41005 BLOCK 2   | 11.000  | 4    | 1   | 0.9  | 0.   |
|        | 5 10                               |   |                           |      |        |       |         |         |         | 41009 BLOCK 3   | 11.000  | 4    | 1   | 0.4  | 0.   |
|        | 41001 BLO                          | СК 1                                    | 11.000                    | 4    | 0.9999 | -0.0  | 0.0     | 0.0     | 0.0     |                 |         |      |     |      |      |
|        | 6 10                               |   |                           | 1    | 10.998 |       | 0.0     | 0.0     | 0.0     | 4100 MSG MV     | 11.000  | 4    | 1   | -0.4 | -0.  |
|        |                                    |   | 31 2                      |      |        |       |         |         |         | 41002 LV        | 0.4400  | 4    | 1   | 0.4  | 0.   |
|        | 2 10                               |   | 51 2                      |      |        |       |         |         |         | 41003 BLOCK 1-A | 11.000  | 4    | 1   | -0.1 | 0.   |
|        | 41002 LV                           |   | 0.4400                    | 4    | 0.9929 | -0.8  | 0.0     | 0.4     | 0.0     |                 |         |      |     |      |      |
|        | 1.000UN                            | ::::::::::::::::::::::::::::::::::::::: | <br>31 2                  | 1    | 0.4369 |       | 0.0     | 0.2     | 0.0     | 41001 BLOCK 1   | 11.000  | 4    | 1   | -0.4 | -0.  |
|        | 41003 BLO                          |   |                           | 4    | 0.9998 | ~0.0  | 0.0     | 0.0     | 0.0     |                 |         |      |     |      |      |
|        |                                    |   |                           | 1    | 10.998 |       | 0.0     | 0.0     | 0.0     | 41001 BLOCK 1   | 11.000  | 4    | 1   | 0.1  | -0.  |
|        | 2 10                               | -                                       |                           |      |        |       |         |         |         | 41004 LV        | 0.4400  | 4    | 1   | -0.1 | 0.   |
|        | 0.975LK<br>41004 LV                | -                                       | 12 2<br>0.4400            | 4    | 1.0199 | 0.1   | 0.5     | 0.4     | 0.0     |                 |         |      |     |      |      |
|        | 1.000UN                            |   |                           | 1    | 0.4488 |       | 0.0R    | 0.2     | 0.0     | 41003 BLOCK 1-A | 11.000  | 4    | 1   | 0.1  | -0.  |
|        | 41005 BLO                          | СК 2                                    | 11.000                    | 4    | 0.9996 | -0.0  | 0.0     | 0.0     | 0.0     |                 |         |      |     |      |      |
| ATC EN | VER                                |   |                           | 1    | 10.996 |       | 0.0     | 0.0     | 0.0     | 4100 MSG MV     | 11.000  | 4    | 1   | -0.9 | -0.  |
| 1×12   | 10                                 |   |                           |      |        |       |         |         |         | 41006 LV        | 0.4400  |      | 1   | 0.4  | 0.3  |

| 5 10             |                |          |      |      |     |       | 41007 BLOCK 2-A | 11.000 | 4 | 1 | 0.4  | 0.2  |
|------------------|----------------|----------|------|------|-----|-------|-----------------|--------|---|---|------|------|
| 41006 LV         |                | 4 0.9926 | -0.8 | 0.0  | 0.4 | 0.0   |                 |        |   |   |      |      |
| 1.000UN          |                | 1 0.4367 |      | 0.0  | 0.2 | 0.0   | 41005 BLOCK 2   | 11.000 | 4 | 1 | -0.4 | -0.2 |
| 41007 BLOCK 2-4  |                | 4 0.9996 | -0.0 | 0.0  | 0.0 | 0.0   |                 |        |   |   |      |      |
| 5 10             |                | 1 10.996 |      | 0.0  | 0.0 | 0.0   | 41005 BLOCK 2   | 11.000 | 4 | 1 | -0.4 | -0.2 |
|                  | ~ ~            |          |      |      |     |       | 41008 LV        | 0.4400 | 4 | 1 | 0.4  | 0.2  |
| 41008 LV         | 31 2<br>0.4400 | 4 1.0053 | -0.8 | 0.0  | 0.4 | 0.0   |                 |        |   |   |      |      |
| 1.000UN          |                | 1 0.4424 |      | 0.0  | 0.2 | 0.0   | 41007 BLOCK 2-A | 11.000 | 4 | 1 | -0.4 | -0.2 |
| 41009 BLOCK 3    |                | 4 0.9996 | -0.0 | 0.0  | 0.0 | 0.0   |                 |        |   |   |      |      |
| 5 10             |                | 1 10.996 |      | 0.0  | 0.0 | 0.0   | 4100 MSG MV     | 11.000 | 4 | 1 | -0.4 | -0.3 |
| 1.000LK          | 31 2           |          |      |      |     |       | 410010 LV       | 0.4400 | 4 | 1 | 0.4  | 0.2  |
|                  | JI 2           |          |      |      |     |       | 10011 BLOCK 3-A | 11.000 | 4 | 1 | -0.1 | 0.1  |
|                  | 0.4400         | 4 0.9927 | -0.8 | 0.0  | 0.4 | 0.0 - |                 |        |   |   |      |      |
| 1.000UN          | 31 2           | 1 0.4368 |      | 0.0  | 0.2 | 0.0   | 41009 BLOCK 3   | 11.000 | 4 | 1 | -0.4 | -0.2 |
| 410011 BLOCK 3-2 |                | 4 0.9996 | -0.0 | 0.0  | 0.0 | 0.0 - |                 |        |   |   |      |      |
| 1 10             |                | 1 10.995 |      | 0.0  | 0.0 | 0.0   | 41009 BLOCK 3   | 11.000 | 4 | 1 | 0.1  | -0.1 |
| 0.988LK          | 4 3            |          |      |      |     | 4     | 10012 LV        | 0.4400 | 4 | 1 | -0.1 | 0.1  |
|                  | 0.4400         | 4 1.0099 | 0.1  | 0.5  | 0.4 | 0.0 - |                 |        |   |   |      |      |
| 1.000UN          | 4 3            | 1 0.4444 |      | 0.1R | 0.2 | 0.0 4 | 10011 BLOCK 3-A | 11.000 | 4 | 1 | 0.1  | -0.1 |

.

•



## Annexure-C-2

المريد والمعروفة

## With MSG PP and With Sanctioned Load In Service



|  | MSG SC  | LAR PV S | SYSTEM |         |         |         |        |           |          | R TRANSFO<br>R NON-TRA |      | BRANCHE |
|--|---------|----------|--------|---------|---------|---------|--------|-----------|----------|------------------------|------|---------|
| X FROM BUS<br>TRANSFORMER RATING         | -X AREA | VOLT     |        | GEN     | LOAD    | SHUNT   | X      | то        | BUS      | X                      |      |         |
| BUS# X NAMEX BASI<br>RATIO ANGLE % SET A |         | PU/KV    | ANGLE  | MW/MVAR | MW/MVAR | MW/MVAR | BUS#   | X NAME    | X BASKV  | AREA CKT               | MW   | MVAR    |
| 4100 MSG MV 11.00                        | 00 4    | 1.0000   | 0.0    | 1.3     | 0.0     | 0.0     |        |           |          |                        |      |         |
| 6 10                                     | 1       | 11.000   |        | 1.1R    | 0.0     | 0.0     | 41001  | BLOCK 1   | 11.000   | 4 1                    | 0.4  | 0.4     |
| 10 10                                    |         |          |        |         |         |         | 41005  | BLOCK 2   | 11.000   | 4 1                    | 0.9  | 0.4     |
| 5 10                                     |         |          |        |         |         |         | 41009  | BLOCK 3   | 11.000   | 4 1                    | 0.4  | 0.3     |
| 4 10                                     |         |          |        |         |         |         |        |           | 11.000   |                        |      |         |
| 41001 BLOCK 1 11.00                      |         |          |        | 0.0     | 0.0     | 0.0     | **     |           |          |                        |      |         |
| 6 10                                     | 1       | 10.998   |        | 0.0     | 0.0     | 0.0     | 4100   | MSG MV    | 11.000   | 4 1                    | -0.4 | -0.4    |
| 1.000LK 31 2                             | 2       |          |        |         |         | 9.      | 41002  | LV        | 0.4400   | 4 1                    | 0.4  | 0.2     |
| 2 10                                     |         |          |        |         |         |         | 41003  | BLOCK 1-  | A 11.000 | 4 1                    | -0.1 | 0.2     |
| 41002 LV 0.440                           | 00 4    | 0.9929   | -0.8   | 0.0     | 0.4     | 0.0     |        |           |          |                        |      |         |
| 1.000un 31 2                             | _       | 0.4369   |        | 0.0     | 0.2     | 0.0     | 41001  | BLOCK 1   | 11.000   | 4 1                    | -0.4 | -0.2    |
| 41003 BLOCK 1-A 11.00                    | 00 4    | 0.9998   | -0.0   | 0.0     | 0.0     | 0.0     |        |           |          |                        |      |         |
| 2 10                                     | 1       | 10.998   |        | 0.0     | 0.0     | 0.0     | 41001  | BLOCK 1   | 11.000   | 4 1                    | 0.1  | -0.2    |
| 0.975LK 12 2                             | ,       |          |        |         |         |         | 41004  | ΓΛ        | 0.4400   | 4 1                    | -0.1 | 0.2     |
| 41004 LV 0.440                           |         | 1.0199   | 0.1    | 0.5     | 0.4     | 0.0     |        |           |          |                        |      |         |
| 1.000UN 12 2                             |         | 0.4488   |        | 0.0R    | 0.2     | 0.0     | 41003  | BLOCK 1-3 | A 11.000 | 4 1                    | 0.1  | -0.2    |
| 41005 BLOCK 2 11.00                      | 00 4    | 0.9996   | -0.0   | 0.0     | 0.0     | 0.0     |        |           |          |                        |      |         |
| 10 10                                    | 1       | 10.996   |        | 0.0     | 0.0     | 0.0     | 4100 1 | MSG MV    | 11.000   | 4 1                    | -0.9 | -0.5    |

.

ATC ENER

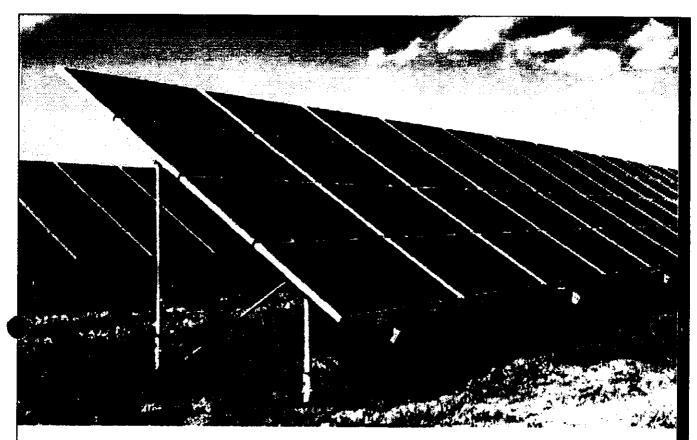
16

| 1.000LK 31 2             |            |          |     | 41006 LV             | 0.4400 | 4 1 | 0.4  | (   |
|--------------------------|------------|----------|-----|----------------------|--------|-----|------|-----|
| 5 10                     |            |          |     | 41007 BLOCK 2-A      | 11.000 | 4 1 | 0.4  | C   |
| 41006 LV 0.4400          | 4 0.9926   | -0.8 0.0 | 0.4 | 0.0                  |        |     |      |     |
| 1.000UN 31 2             | 1 0.4367   | 0.0      | 0.2 | 0.0 41005 BLOCK 2    | 11.000 | 4 1 | -0.4 | -0  |
| 41007 BLOCK 2-A 11.000   | 4 0.9996   | -0.0 0.0 | 0.0 | 0.0                  |        |     |      |     |
| 5 10                     | 1 10.996   | 0.0      | 0.0 | 0.0 41005 BLOCK 2    | 11.000 | 4 1 | -0.4 | -0  |
| 0.988LK 31 2             |            |          |     | 41008 LV             | 0.4400 | 4 1 | 0.4  | 0   |
| 41008 LV 0.4400          | 4 1.0053 - | -0.8 0.0 | 0.4 | 0.0                  |        |     |      |     |
| 1.000UN 31 2             | 1 0.4424   | 0.0      | 0.2 | 0.0 41007 BLOCK 2-A  | 11.000 | 4 1 | -0.4 | -0  |
| 41009 BLOCK 3 11.000     | 4 0.9996 - | -0.0 0.0 | 0.0 | 0.0                  |        |     |      |     |
|                          | 1 10.996   | 0.0      | 0.0 | 0.0 4100 MSG MV      | 11.000 | 4 1 | -0.4 | -0  |
| 5 10                     |            |          |     | 410010 LV            | 0.4400 | 4 1 | 0.4  | 0   |
| 1.000LK 31 2             |            |          |     | 410011 BLOCK 3-A     | 11.000 | 4 1 | -0.1 | 0   |
| 1 10<br>410010 LV 0.4400 | 4 0.9927 - | -0.8 0.0 | 0.4 | 0.0                  |        |     |      | -   |
| 1.000UN 31 2             | 1 0.4368   | 0.0      | 0.2 | 0.0 41009 BLOCK 3    | 11.000 | 4 1 | -0.4 | -0  |
| 410011 BLOCK 3-A 11.000  | 4 0.9996 - | -0.0 0.0 | 0.0 | 0.0                  |        |     |      |     |
| 1 10                     | 1 10.995   | 0.0      | 0.0 | 0.0 41009 BLOCK 3    | 11.000 | 41  | 0.1  | -0. |
| 0.988LK 4 3              |            |          |     | 410012 LV            | 0.4400 | 41  | -0.1 | 0   |
| 410012 LV 0.4400         | 4 1.0099   | 0.1 0.5  | 0.4 | 0.0                  |        |     |      |     |
| 1.000UN 4 3              | 1 0.4444   | 0.1R     | 0.2 | 0.0 410011 BLOCK 3-A | 11.000 | 4 1 | 0.1  | -0  |
| 410013 SOLAR MV 11.000   | 4 1.0001   | 0.0 0.0  | 0.0 | 0.0                  |        |     |      |     |
| 4 10                     | 1 11.001   | 0.0      | 0.0 | 0.0 4100 MSG MV      | 11.000 | 41  | 0.4  | 0.  |

410014 SOLAR LV 0.8000 1 -0.4 -0.1 1.000LK 410014 SOLAR LV 1 6 0.8000 4 1.0015 0.4 0.5 0.0 1 0.8012 0.1R 0.0 0.0 410013 SOLAR MV 11.000 0.4 0.1 4 1 1.000UN 64 1

. .

TC ENERGY CONTROL OF





NRT

## SYSTEM STUDY ANALYSIS OF OKARA CANTT (OC) 999kW SOLAR PV SYSTEM

Report

ARCO Energy

PAKISTAN Tel: +92-300-8827101



### CONTENTS

| EXECUTIVE SUMMARY   |
|---|
| 1 INTRODUCTION  |
| 1.1 Project Description   |
| 1.2 Interconnection Arrangement   |
| 1.3 Objective of System Study Analysis  |
| 1.4 Study Components  |
| 2 STUDY METHODOLOGY   |
| 2.1 Study Criteria  |
| 2.2 Steady State Analysis   |
| 2.2.1 System Intact Analysis  |
| 2.2.2 Transmission Line Loading Analysis  |
| 2.2.3 Voltage Analysis  |
| 3 STEADY STATE ANALYSIS   |
| 3.1 Model Development   |
| 3.2 Power Flow Assessment Without Okara Cantt PP and with Sanctioned Load In Service8 |
| 3.2.1 Base Year 2025: Peak Loading Summer with Sanctioned Load in Service             |
| 3.3 Power Flow Assessment with Okara Cantt PP   |
| 3.3.1 Base Year 2025: Peak Loading Summer with Sanctioned Load In Service             |
| 3.4 Conclusion  |
| 4 CONCLUSION  |
| 4.1 Steady State Assessment   |
| LIST OF ANNEXURES 12  |





#### **EXECUTIVE SUMMARY**

This report provides the documentation of an assessment that has been performed for the interconnection of a 999kW Solar PV Power Generation project at Okara Cantt (OC) distribution system at 11kV project of "Military Engineering Services" (MES). The project will be a Grid tied 999kW Solar PV based system connected with the power network of OC. The '999kW OC solar PV Power Generation project' is located at Q943+J56, Okara Cantonment, Okara, Pakistan.

The integration of solar power generation at the Okara Cantt premises necessitates a comprehensive system study analysis to ensure optimal operation of the electrical network. Okara Cantt currently receives a single point supply from LESCO with a sanctioned load of 4.5MW. The introduction of solar power generation will influence the flow of electricity within the premises, impacting both consumption and injection dynamics.

The existing setup includes transformers, switchgear, and distribution panels to distribute electricity throughout the premises. The sanctioned load of 4.5MW is the maximum load that can be drawn from LESCO's grid.

The entire solar generation within the Okara Cantt premises will be consumed internally without exporting any power to the grid. To ensure the safe and efficient integration of solar power, a load flow study is required to analyze the impact of this interconnection on the existing electrical network. This study will assist in obtaining solar generation concurrence and ensuring compliance with relevant technical and regulatory requirements.

The analyses have been carried out in following scenarios;

- Without 999kW Okara Cantt solar PV with sanctioned load in service.
- With 999kW Okara Cantt solar PV with sanctioned load in service.

Steady state power flow assessment has been performed using the network data of Okara Cantt. Power flow study was conducted without Solar Project with sanctioned load in service to analyze the magnitude and phase angles of bus voltages, line loadings and power flows under steady-state conditions. Power flow analysis was also conducted with sanctioned load in service after the interconnection of the Solar project with the Okara Cantt distribution system. The power flow results for the system intact shows that the power flows on all the Okara Cantt transmission and distribution





line branches are within their normal line loading limit. There is no capacity constraint in terms of power flow or voltage ratings within the study area.

This systems study is a critical step in obtaining solar generation concurrence for Okara Cantt. By ensuring the stability and reliability of the electrical system, the study facilitates seamless solar power integration while maintaining compliance with Okara Cantt and regulatory requirements.

Based on the study results, it is concluded that proposed generation interconnection assessment for 999kW Okara Cantt solar PV Power Generation project meets the NEPRA grid code planning criteria.





#### **1** INTRODUCTION

#### 1.1 Project Description

This report provides the documentation of an assessment that has been performed by ARCO Energy in response to a request made by Okara Cantt (OC) ("Project Owner" or "PO") for the interconnection of a 999kWp Solar PV Power Generation project ("Project") to the OC power System at 11kV.

The '999kW Okara Cantt solar PV Power Generation project' is located at Q943+J56, Okara Cantonment, Okara, Pakistan. Figure 1.1 shows Google site map of the project.

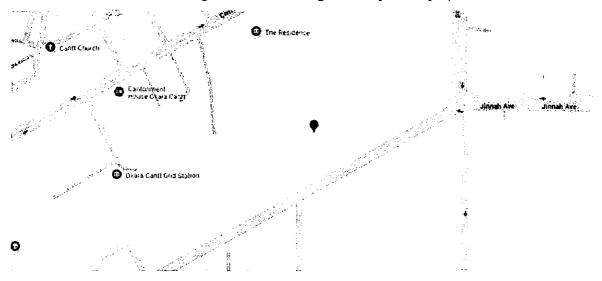


Figure 1.1: Google Site Map of the Solar PV Power Generation Project.





#### 1.2 Interconnection Arrangement

Okara Cantt aims to integrate solar power generation into its existing electrical infrastructure. Okara Cantt currently receives a single-point power supply from LESCO with a sanctioned load of 4.5MW. The entire solar generation within the Okara Cantt premises will be consumed internally without exporting any power to the grid. The objective of the analyses is to evaluate the impact of the solar power plant on the Okara Cantt transmission and distribution system.

#### 1.3 Objective of System Study Analysis

The primary objectives of the load flow study are:

- To evaluate the impact of solar power injection on the voltage levels and power distribution within Okara Cantt premises.
- To determine the changes in power flow patterns resulting from the integration of solar generation.
- To ensure that the existing electrical infrastructure can support the additional solar power without causing instability or operational issues.
- To verify compliance with regulatory requirements for solar power interconnection and obtain concurrence for solar generation.

#### 1.4 Study Components

999kW solar PV system is modelled into the Okara Cantt distribution system by ARCO Energy. Technical analysis includes:

- i) Data gathering and modelling
- ii) Steady state analysis
- iii) Conclusion

The above scope of work involved in the technical analysis has been carried to demonstrate that connection assessment of this PV system meets the National Electric Power Regulatory Authority (NEPRA) distribution code.

The analyses have been carried out in following scenarios;

- Without 999kW Okara Cantt solar PV with sanctioned load in service.
- With 999kW Okara Cantt solar PV with sanctioned load in service.





This report documents the results of the steady state analyses. The principal objective of these analyses is to evaluate the impact of 999kW solar PV system to the distribution system of Okara Cantt and vice versa.





#### 2 STUDY METHODOLOGY

#### 2.1 Study Criteria

The study has been carried out based on the National Electric Power Regulatory Authority (NEPRA) Grid Code planning criteria. Key parameters and their corresponding limits have been summarized in table below.

| Para           | ameter           | Range  |
|----------------|------------------|--|
| Voltage Level  | Normal Condition | ±5 % p.u at 132kV and below<br>+8%,-5% p.u at 220kVand above |
|                | Contingency      | ±10 % p.u  |
| T/Line Loading | Normal Condition | 100%   |
| Capacity       | Contingency      | 100%   |
|                | Nominal          | 50 Hz  |
| Frequency      | Normal Variation | 49.8 Hz - 50.2 Hz  |
|                | Contingency Band | 49.4 Hz - 50.5 Hz  |
| Power Factor   | Lagging          | 0.95   |
| rower ractor   | Leading          | 0.95   |

#### 2.2 Steady State Analysis

The purpose of steady-state analysis is to analyse the impact of the proposed solar power plant on distribution system facilities under steady-state conditions. It involves two distinct analyses: line loading analysis and voltage analysis. Power flow solutions using the PSS/E® program (Version 33.4) has been performed.

A "study area" was defined to represent the areas of interest within Okara Cantt.

#### 2.2.1 System Intact Analysis

The incremental impact of the project on substations and transmission line loading under normal conditions was evaluated by comparing transmission and distribution system power flows through different scenarios for the project.

#### 2.2.2 Transmission Line Loading Analysis

11kV and 0.4kV rated transmission and distribution facilities in the study area have been monitored for line loadings.





#### 2.2.3 Voltage Analysis

Voltages at buses inside the study area have been monitored for possible for voltage violations in accordance with NEPRA Grid Code guidelines.





#### **3 STEADY STATE ANALYSIS**

#### 3.1 Model Development

Project specific data was provided by the plant owner and it has been compiled and presented in **Annexure-A**. The steady state model of the power plant is presented in table below:

|                         | Generator                      |
|-------------------------|--------------------------------|
| No. of Collector Units  | 1                              |
| Generation size of each | 841                            |
| collector (kVA)         |                                |
| Active Power of each    | 799                            |
| collector Pgen. (kW)    | 199                            |
| Power Factor            | 0.95 lagging, 0.95 leading     |
| Qmin, Qmax (kVAR)       | - 0.2626, 0.2626               |
| Rated Frequency         | 50 Hz                          |
| Generation Voltage      | 0.8V                           |
| Xsource                 | 00                             |
|                         | Generation Step Up Transformer |
| No of Transformer       | 1                              |
| kVA Capacity of each    | 1250                           |
| GSU                     |                                |
| % Reactance (X)         | 5 %                            |
|                         | Okara Cantt                    |
| Sanctioned Load (LESCO) | 4500 kW                        |

Steady state power flow assessment has been performed using the network data of OC.

#### 3.2 Power Flow Assessment Without Okara Cantt PP and with Sanctioned Load In Service

Power flow study without Okara Cantt solar and with sanctioned load in service, was conducted to analyze the magnitude and phase angles of bus voltages, line loadings and power flows under steadystate conditions.

The result of this power flow analysis is in Annexure-B.





#### 3.2.1 Base Year 2025: Peak Loading Summer with Sanctioned Load in Service

Power flow analysis has been performed on the peak loading summer (June) 2025 case of Okara Cantt network. This base case included a detailed representation of the Okara Cantt transmission and distribution system in the study area.

The steady state results, depicts that the power flows on all the Okara Cantt distribution line branches are within their normal loading limits. There is no capacity constraint in terms of load flow or voltage ratings around the study area. Result of the power flow analysis is attached in **Figure B-1**.

#### 3.3 Power Flow Assessment with Okara Cantt PP

Power flow study of Okara Cantt solar project was conducted with sanctioned load (in service and out of service) to determine the reliability impact of the 999kW Okara Cantt solar project on the Okara Cantt distribution system. This includes the performance of load flow analysis to identify any facility overload or voltage condition that violates the NEPRA planning criteria. Any such violation that is either directly attributable to this project or for which it will have a shared responsibility is included in this report.

The results of the project power flow analysis are plotted in Annexure-B.

#### 3.3.1 Base Year 2025: Peak Loading Summer with Sanctioned Load In Service

A base case has been developed with sanctioned load in service at Okara Cantt solar for peak loading summer (June) 2025 that allow us to judge the impact of Okara Cantt solar project on the Okara Cantt network.

Project power flow analysis has been performed after the connection of the project with the Okara Cantt distribution system. This includes the detailed representation of the power plant.

The steady state result, with sanctioned load in service at Okara Cantt solar depicts that the power flows on all the transmission line branches are within their normal loading limits. There is no capacity constraint in terms of load flow or voltage ratings around the study area.

Result of the power flow analysis is attached in Figure B-2.

The results of the project bus voltages analysis are attached in Annexure-C.





#### 3.4 Conclusion

Steady state power flow assessment has been performed. Power flow study was conducted without solar Project with sanctioned load in service to analyze the magnitude and phase angles of bus voltages, line loadings and power flows under steady-state conditions. Power flow analysis was also conducted with sanctioned load in service after the interconnection of the Solar project with the Okara Cantt distribution system. The power flow results for the system intact shows that the power flows on all the Okara Cantt distribution line branches are within their normal line loading limit. There is no capacity constraint in terms of power flow or voltage ratings within the study area.







#### 4 CONCLUSION

#### 4.1 Steady State Assessment

Steady state power flow assessment has been performed. Power flow study was conducted without Okara Cantt solar with sanctioned load in service, to analyze the magnitude and phase angles of bus voltages, line loadings, and power flows under steady-state conditions. Power flow analysis was also conducted with Okara Cantt solar and with sanctioned load in service with Okara Cantt distribution system. Power flow results showed that the power flows on all the Okara Cantt distribution branches are within their normal loading limit. There is no capacity constraint in terms of power flow or voltage ratings within the study area.

The steady state results found no capacity constraint in terms of power flow and voltage ranges.

Hence, it is concluded that based on the study results the Interconnection Assessment for 999kW Okara Cantt solar PV system with Okara Cantt Transmission and Distribution Network, meets the NEPRA grid code planning criteria.





#### LIST OF ANNEXURES

Annex A: Project Specific Data.

Annex A-1: Project Site Map.

Annex A-2: Power Plant Data.

Annex B: Power Flow Steady State Analysis Result

Figure B-1: Base Year 2025 - Peak loading summer without Okara Cantt solar and Sanctioned load in service.

Figure B-2: Base Year 2025 - Peak loading summer with Okara Cantt solar and Sanctioned load in service.

Annex C: Assessment of Bus Voltages.

Annex C-1: Without Okara Cantt solar and with Sanctioned Load In Service. Annex C-2: With Okara Cantt solar and with Sanctioned Load In Service.



### Annexure-A

I.S. main

## Project Specific Data



# Annexure-A-1

i.

Project Site Map



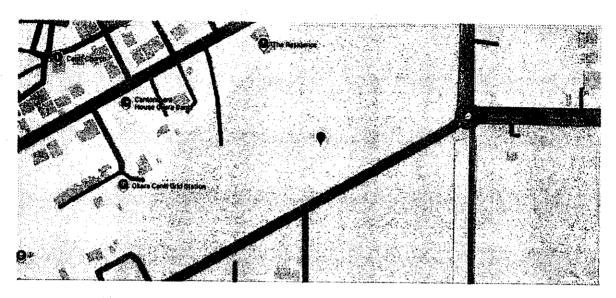


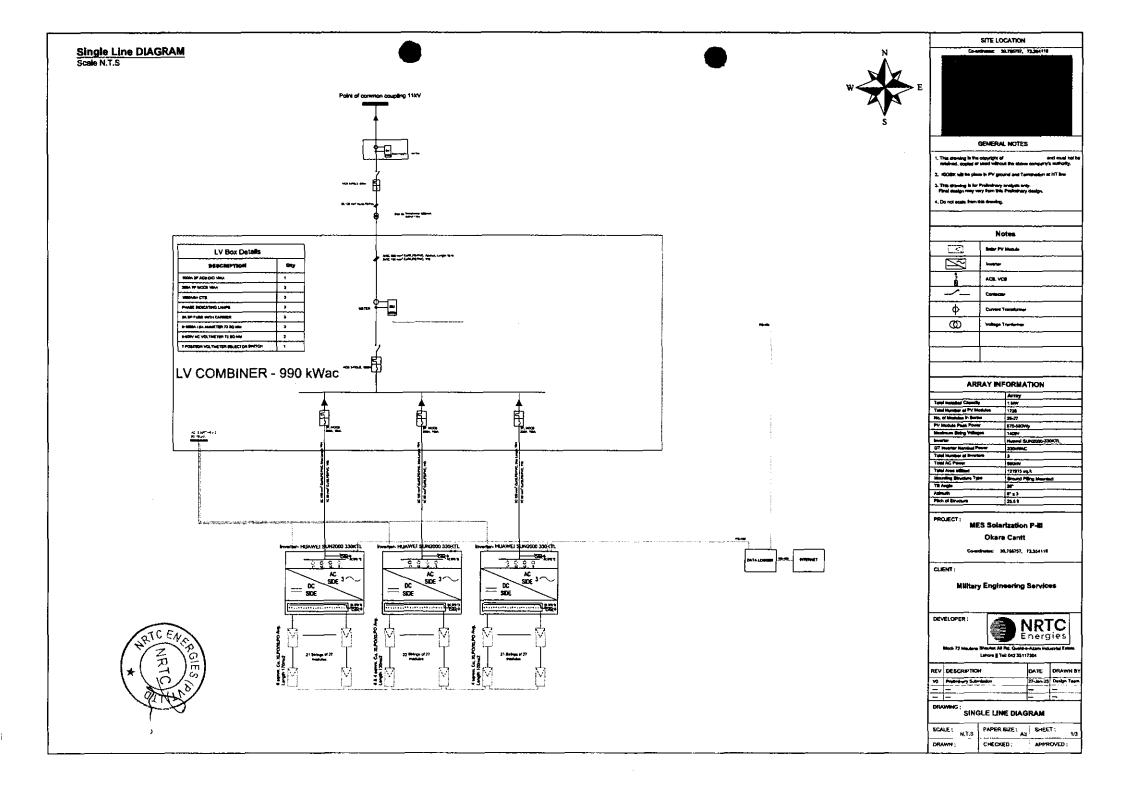
Figure 1.1: Google Site Map of the Solar PV Power Generation Project.

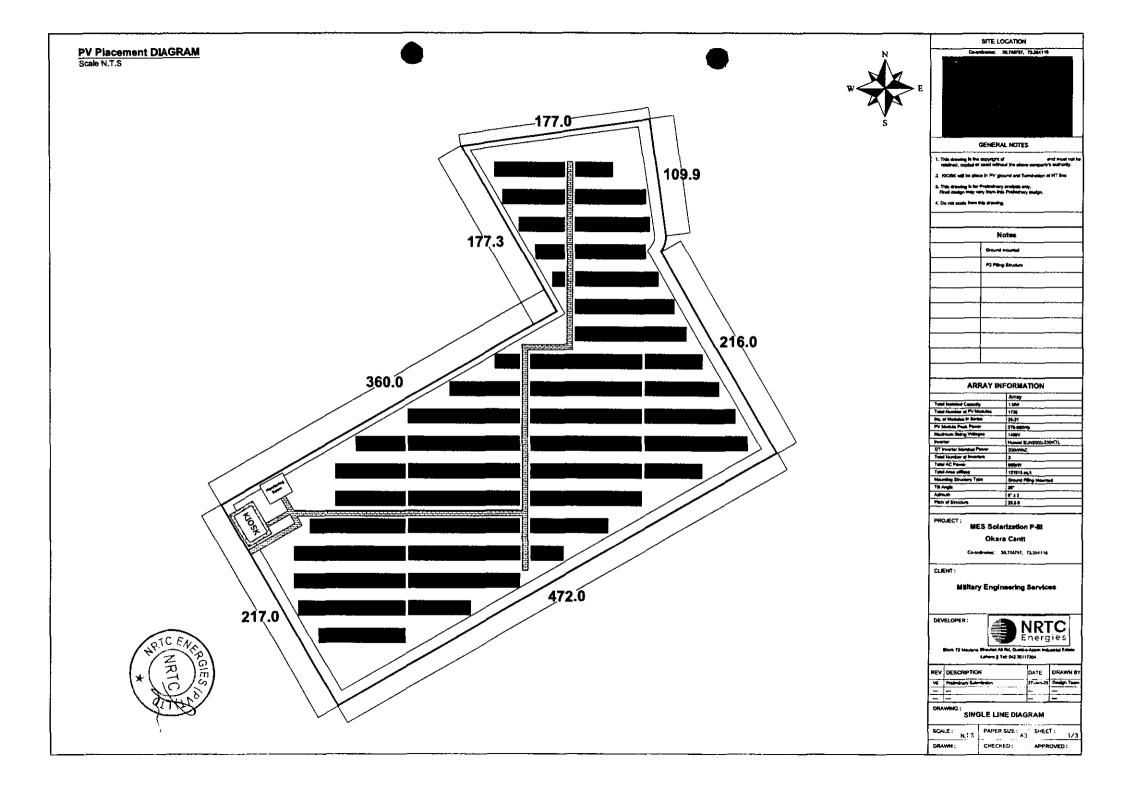


## Annexure-A-2

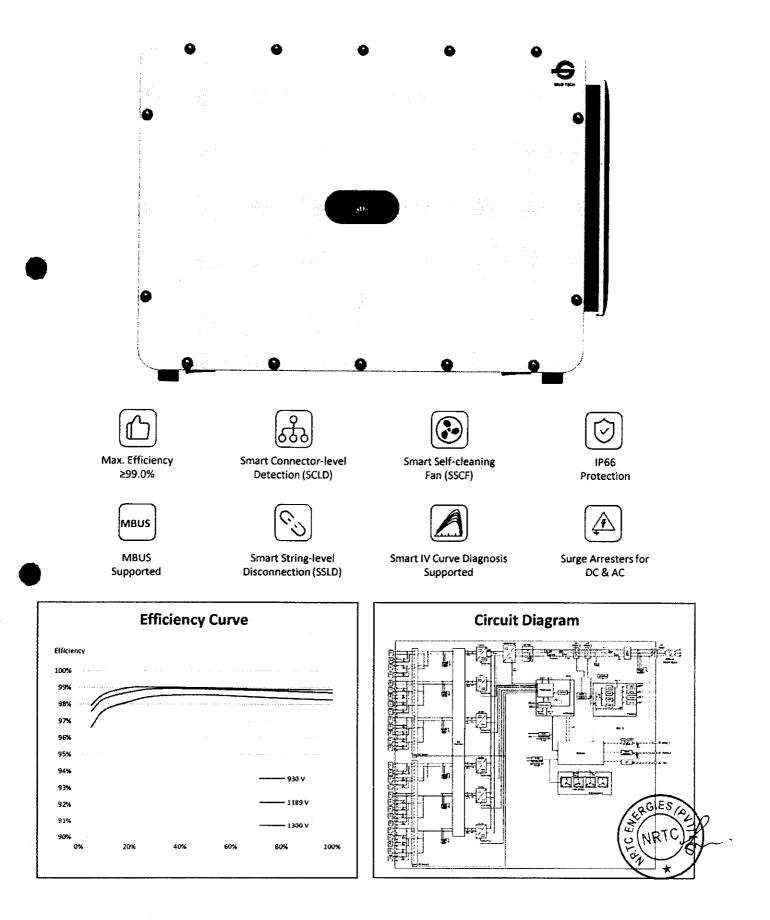
Power Plant Data







### SUN2000-330KTL-H1 Smart String Inverter



### SUN2000-330KTL-H1 Technical Specifications

| Max. Efficiency   | ≥99.0%   |
|---|--|
| European Efficiency   | ≥98.8%   |
| Input   |  |
| Max. Input Voltage  | 1,500 V  |
| Number of MPP Trackers  | 6  |
| Max. Current per MPPT   | 65 A   |
| Max. Short Circuit Current per MPPT   | 115 A  |
| Max. PV Inputs per MPPT   | 4/5/5/4/5/5  |
|   | · ·  |
| Start Voltage   | 550 V  |
| MPPT Operating Voltage Range  | 500 V ~ 1,500 V  |
| Nominal Input Voltage   | 1,080 V  |
| Outpu   | t <u>e se se</u>  |
| Nominal AC Active Power   | 300,000 W  |
| Max. AC Apparent Power  | 330,000 VA   |
| Max. AC Active Power (coso=1)   | 330,000 W  |
| Nominal Output Voltage  | 800 V, 3W + PE   |
| Rated AC Grid Frequency   | 50 Hz / 60 Hz  |
| Nominal Output Current  | 216.6 A  |
| Max. Output Current   | 238.2 A  |
| Adjustable Power Factor Range   | 0.8 LG 0.8 LD  |
| Total Harmonic Distortion   | < 1%   |
| Protecti  |  |
| an a  | станая на волька с столода с на на сторите са ставо добава ставит сантора, ба санае обла базат с на кайто стар<br>По на вола с област с стара с на става на ставо добава ставит сантора, ба става обла базат с на кайто стара, с |
| imart String-Level Disconnector(SSLD)   | Yes  |
| Anti-Islanding Protection   | Yes  |
| AC Overcurrent Protection   | Yes  |
| DC Reverse-polarity Protection  | Yes  |
| PV-array String Fault Monitoring  | Yes  |
| DC Surge Arrester   | Type II  |
| AC Surge Arrester   | Type II  |
| DC insulation Resistance Detection  | Yes  |
| AC Grounding Fault Protection   | Yes  |
| Residual Current Monitoring Unit  | Yes  |
| Communic  | ation  |
| tariainen oli internationalen eritti tule entre etteralen erittiinen erittiinen erittiinen erittiinen erittiine<br>Display  | LED Indicators, WLAN + APP   |
| JSB   | Yes  |
| ABUS  | Yes  |
| к саставить в Сменяния в составляется воду с составляется в водимальность в на образование составляется составляется составляется в со | Yes  |
|   |  |
| Genera  | and the main the construction of the second  |
| Dimensions (W x H x D)  | 1,048 x 732 x 395 mm   |
| Veight (with mounting plate)  | ≤112 kg  |
| Operating Temperature Range   | -25 °C ~ 60 °C   |
| Cooling Method  | Smart Air Cooling  |
| Max. Operating Altitude without Derating  | 4,000 m (13,123 ft.)<br>0~100%<br>Waterproof Connector + OI/DI Terminal  |
| Relative Humidity   | 0~100%   |
|   | Waterproof Connector + OT/DT Terminal  |
| AC Connector  |  |



# LR5-72HTH 560~575M

- Suitable for distributed projects
- Excellent outdoor power generation performance
- High module quality ensures long-term reliability



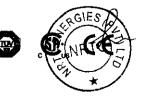
15-year Warranty for Materials and Processing

25-year Warranty for Extra Linear Power Output

#### Complete System and Product Certifications

IEC 61215, IEC 61730, UL 61730 ISO9001:2015: ISO Quality Management System ISO14001: 2015: ISO Environment Management System ISO45001: 2018: Occupational Health and Safety IEC62941: Guideline for module design qualification and type approval

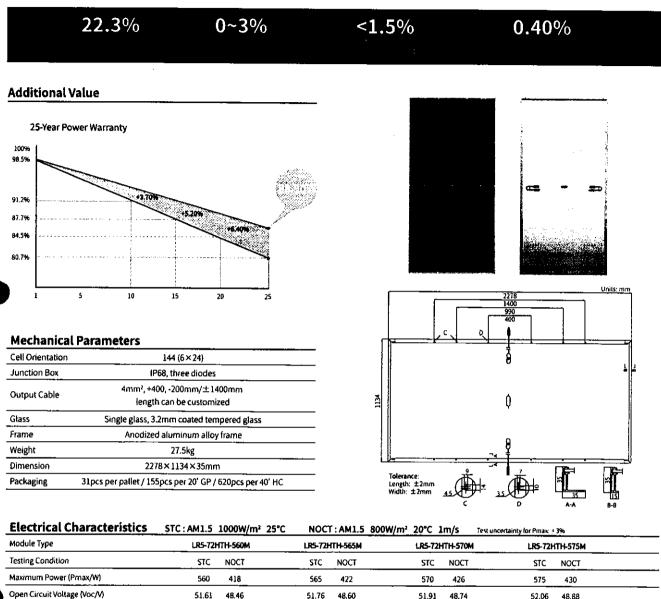




Mind Comment

# Hi-MO 🗗

### LR5-72HTH 560~575M



|                                  |             | 51:10 10100 | 51.91 40.14 | 52.00 40.00 |  |
|----------------------------------|-------------|-------------|-------------|-------------|--|
| Short Circuit Current (Isc/A)    | 13.94 11.26 | 14.01 11.31 | 14.07 11.36 | 14.14 11.42 |  |
| Voltage at Maximum Power (Vmp/V) | 43.46 39.66 | 43,61 39.79 | 43.76 39.93 | 43.91 40.07 |  |
| Current at Maximum Power (Imp/A) | 12.89 10.55 | 12.96 10.61 | 13.03 10.67 | 13.10 10.72 |  |
| Module Efficiency(%)             | 21.7        | 21.9        | 22.1        | 22.3        |  |

#### **Operating Parameters**

| Operational Temperature            | -40°C ~ +85°C    |  |
|------------------------------------|------------------|--|
| Power Output Tolerance             | 0~3%             |  |
| Voc and Isc Tolerance              | ±3%              |  |
| Maximum System Voltage             | DC1500V (IEC/UL) |  |
| Maximum Series Fuse Rating         | 25A              |  |
| Nominal Operating Cell Temperature | 45±2°C           |  |
| Protection Class                   | Class II         |  |
| Fire Paties                        | UL type 1 or 2   |  |
| Fire Rating                        | IEC Class C      |  |

#### Mechanical Loading

| Front Side Maximum Static Loading | 5400Pa                               |
|-----------------------------------|--------------------------------------|
| Rear Side Maximum Static Loading  | 2400Pa                               |
| Hailstone Test                    | 25mm Hailstone at the speed of 23m/s |

#### Temperature Ratings (STC)

| Temperature Coefficient of Isc  | +0.050%/°C |
|---------------------------------|------------|
| Temperature Coefficient of Voc  | -0.230%/*C |
| Temperature Coefficient of Pmax | -0.290%/°C |



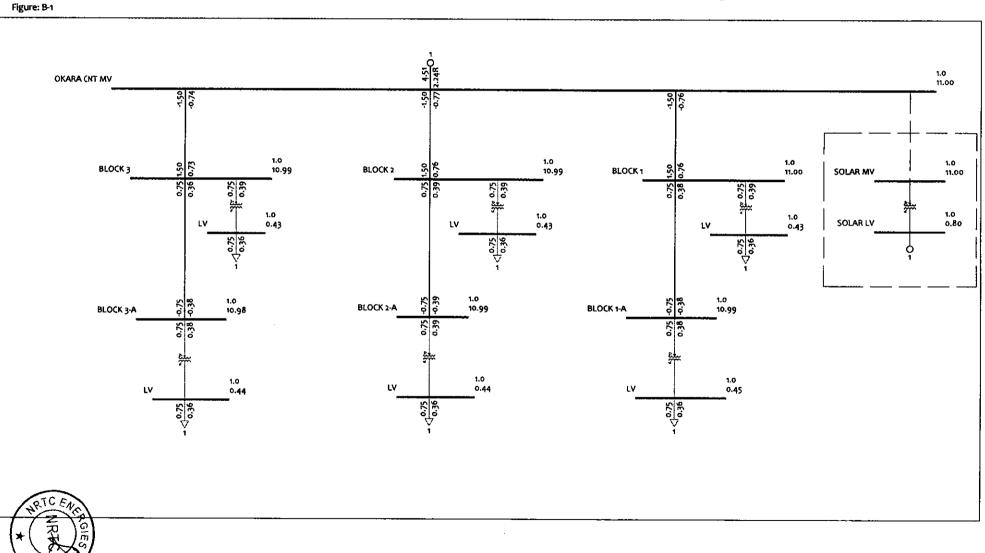
No.8369 Shangyuan Road, Xi'an Economic And Technological Development Zone, Xi'an, Shaanxi, China. Web: www.longi.com Specifications included in this patients are subject to change without notice. LONGI reserves the rights final interpretation. (202210200 aftv03006

## Annexure-B

Steady State Analysis Results



# Load Flow Analysis of 999kW Solar PV System at Okara Cantt (OC)



Pre Project Steady State Analysis Results: Base Year 2025 / Peak Loading 2025

### Load Flow Analysis of 999kW Solar PV System at Okara Cantt (OC)

Figure: B-2 1.0 OKARA CNT MV 11.00 1.50 ŝ -1.50 0.80 1.0 1.0 1.0 1.0 BLOCK 3 2 양 BLOCK 2 10.99 10.99 BLOCK 1 11.00 SOLAR MV 11.00 0.75 0.75 0.39 0.75 0.75 0.75 0.39 3<u>5 0.75</u> <u>\*\*</u>\*\* 1.0 1.0 1.0 1.0 SOLAR LV LV 0.80 0.43 LV 0.43 ιv 0.43 <0.75 0.36 0.75 0.80 1.0 1.0 10.99 1.0 5 0.38 BLOCK 2-A 515 10.99 BLOCK 1-A BLOCK 3-A 10.98 0.75 1.0 1.0 1.0 0.44 LV 0.44 ιv 0.45 LV 0.75 0.36 0.36 0.75

Post Project Steady State Analysis Results: Base Year 2025 / Peak Loading 2025

### Annexure-C

Assessment of bus voltages



### Annexure-C-1

# Without Okara Cantt PP and With Sanctioned Load In Service



PTI INTERACTIVE POWER SYSTEM SIMULATOR--PSS(R)E SAT, FEB 15 2025 17:25 OKARA CANTT SOLAR PV SYSTEM **%MVA FOR TRANSFORMERS** % I FOR NON-TRANSFORMER BRANCHES X----- FROM BUS ----X AREA VOLT GEN LOAD SHUNT X----- TO BUS -----X TRANSFORMER RATING BUS# X-- NAME --- X BASKV ZONE PU/KV ANGLE MW/MVAR MW/MVAR MW/MVAR BUS# X-- NAME -- X BASKV AREA CKT MW MVAR RATIO ANGLE % SET A

| 4100 OKARA CNT MV11.000         | 4 1.0000 | 0.0  | 4.5  | 0.0 | 0.0                                       |
|---------------------------------|----------|------|------|-----|---|
| 17 10                           | 1 11.000 |      | 2.2R | 0.0 | 0.0 41001 BLOCK 1 11.000 4 1 1.5 0.8      |
| 17 10                           |          |      |      |     | 41005 BLOCK 2 11.000 4 1 1.5 0.8          |
| 17 10                           |          |      |      |     | 41009 BLOCK 3 11.000 4 1 1.5 0.7          |
| 41001 BLOCK 1 11.000            | 4 0.9997 | -0.0 | 0.0  | 0.0 | 0.0                                       |
| 17 10                           | 1 10.996 |      | 0.0  | 0.0 | 0.0 4100 OKARA CNT MV11.000 4 1 -1.5 -0.8 |
|                                 |          |      |      |     | 41002 LV 0.4400 4 1 0.7 0.4               |
| 1.000LK 53 2                    |          |      |      |     | 41003 BLOCK 1-A 11.000 4 1 0.7 0.4        |
| 8 10<br>41002 LV 0.4400         | 4 0.9878 | -1.4 | 0.0  | 0.8 | 0.0                                       |
| 1.000UN 52 2                    | 1 0.4346 |      | 0.0  | 0.4 | 0.0 41001 BLOCK 1 11.000 4 1 -0.7 -0.4    |
| 41003 BLOCK 1-A 11.000          | 4 0.9995 | -0.0 | 0.0  | 0.0 | 0.0                                       |
|                                 | 1 10.994 |      | 0.0  | 0.0 | 0.0 41001 BLOCK 1 11.000 4 1 -0.7 -0.4    |
| 8 10                            |          |      |      |     | 41004 LV 0.4400 4 1 0.7 0.4               |
| 0.975LK 53 2<br>41004 LV 0.4400 | 4 1.0136 | -1.3 | 0.0  | 0.8 | 0.0                                       |
| 1.000UN 52 2                    | 1 0.4460 |      | 0.0  | 0.4 | 0.0 41003 BLOCK 1-A 11.000 4 1 -0.7 -0.4  |
| 41005 BLOCK 2 11.000            | 4 0.9993 | -0.0 | 0.0  | 0.0 | 0.0                                       |
|                                 | 1 10.992 |      | 0.0  | 0.0 | 0.0 4100 OKARA CNT MV11.000 4 1 -1.5 -0.8 |
| 17 10<br>1.000LK 53 2           |          |      |      |     | 41006 LV 0.4400 4 1 0.7 0.4               |

1

|                             |                 |      |     |     | 41007 BLOCK 2-A 11.000 4 1 0.8       | 0.4  |
|-----------------------------|-----------------|------|-----|-----|--------------------------------------|------|
| 8 10<br>41006 LV 0.44       | 00 4 0.9874     | -1.4 | 0.0 | 0.8 | 0.0                                  |      |
| 1.000UN 52                  | 1 0.4345        |      | 0.0 | 0.4 | 0.0 41005 BLOCK 2 11.000 4 1 -0.7    | -0.4 |
| 41007 BLOCK 2-A 11.0        | 00 4 0.9993     | -0.0 | 0.0 | 0.0 | 0.0                                  |      |
| 10                          | 1 10.992        |      | 0.0 | 0.0 | 0.0 41005 BLOCK 2 11.000 4 1 -0.8    | -0.4 |
|                             |                 |      |     |     | 41008 LV 0.4400 4 1 0.7              | 0.4  |
| 0.988LK 53<br>41008 LV 0.44 |                 | -1.4 | 0.0 | 0.8 | 0.0                                  |      |
|                             | 1 0.4401        |      | 0.0 | 0.4 | 0.0 41007 BLOCK 2-A 11.000 4 1 -0.7  | -0.4 |
| 41009 BLOCK 3 11.0          | 0 4 0.9990      | -0.1 | 0.0 | 0.0 | 0.0                                  |      |
| 17 10                       | 1 10.989        |      | 0.0 | 0.0 | 0.0 4100 OKARA CNT MV11.000 4 1 -1.5 | -0.7 |
| 1.000LK 53                  | 2               |      |     |     | 410010 LV 0.4400 4 1 0.7             | 0.4  |
|                             | <u>-</u>        |      |     |     | 410011 BLOCK 3-A 11.000 4 1 0.7      | 0.4  |
| B 10<br>410010 LV 0.44      | 0 4 0.9871      | -1.4 | 0.0 | 0.8 | 0.0                                  |      |
| 1.000UN 52                  | 1 0.4343        |      | 0.0 | 0.4 | 0.0 41009 BLOCK 3 11.000 4 1 -0.7    | -0.4 |
| 410011 BLOCK 3-A 11.0       | 0 4 0.9985      | -0.1 | 0.0 | 0.0 | 0.0                                  |      |
| 3 10                        | 1 10.983        |      | 0.0 | 0.0 | 0.0 41009 BLOCK 3 11.000 4 1 -0.7    | -0.4 |
| ).988LK 28                  | 3               |      |     |     | 410012 LV 0.4400 4 1 0.8             | 0.4  |
| 410012 LV 0.44              | ,<br>0 4 1.0038 | -0.9 | 0.0 | 0.8 | 0.0                                  |      |
| 1.000UN 28                  | 1 0.4417        |      | 0.0 | 0.4 | 0.0 410011 BLOCK 3-A 11.000 4 1 -0.8 | -0.4 |



## Annexure-C-2

# With Okara Cantt PP and With Sanctioned Load In Service



| OKA   | ARAR C |        |       | CTIVE POU<br>SYSTEM | ER SYSTI | em simulj | ATORP:   | SS (R) E |           | A FO  | R TRANSFO | ORMERS | BRANCHES |
|---|--------|--------|-------|---------------------|----------|-----------|----------|----------|-----------|-------|-----------|--------|----------|
| X FROM BUSX A   | REA    | VOLT   |       | GEN                 | LOAD     | SHUNT     | x        | T        | 0 BUS     |       | x         |        |          |
| IRANSFORMER RATING<br>BUS# X-~ NAMEX BASKV Z<br>RATIO ANGLE % SET A | ONE    | PU/KV  | ANGLE | MW/MVAR             | MW/MVAR  | MW/MVAR   | BUS#     | X NA     | MEX BA    | SKV I | AREA CKT  | MW     | MVAR     |
| 4100 OKARA CNT MV11.000   | 4 1    | .0000  | 0.0   | 3.7                 | 0.0      | 0.0       |          |          |           |       |           |        |          |
|   | 1 1    | 1.000  |       | 2.OR                | 0.0      | 0.0       | 41001    | BLOCK    | 1 11.     | 000   | 41        | 1.5    | 0.8      |
| 7 10  |        |        |       |                     |          |           | 41005    | BLOCK    | 2 11.     | 000   | 41        | 1.5    | 0.8      |
| 7 10  |        |        |       |                     |          |           | 41009    | BLOCK    | 3 11.     | 000   | 41        | 1.5    | 0.7      |
| 7 10  |        |        |       |                     |          |           | 410013   | SOLAR    | MV 11.    | 000   | 4 1       | -0.8   | -0.3     |
| 10<br>41001 BLOCK 1 11.000  | 40     | .9997  | -0.0  | 0.0                 | 0.0      | 0.0       | <b>-</b> |          |           |       |           |        |          |
|   | 11     | 0.996  |       | 0.0                 | 0.0      | 0.0       | 4100     | okara    | CNT MV11. | 000   | 4 1       | -1.5   | -0.8     |
| 7 10  |        |        |       |                     | · .      |           | 41002    | LV       | 0.4       | 400   | 4 1       | 0.7    | 0.4      |
| .000LK 53 2   |        |        |       |                     |          |           | 41003    | BLOCK    | 1-a 11.   | 000   | 4 1       | 0.7    | 0.4      |
| 10<br>41002 LV 0.4400   | 40     | .9878  | -1.4  | 0.0                 | 0.8      | 0.0       |          |          |           |       |           |        |          |
| .000UN 52 2   | 10     | .4346  |       | 0.0                 | 0.4      | 0.0       | 41001    | BLOCK    | 1 11.     | 000   | 41        | -0.7   | -0.4     |
| 41003 BLOCK 1-A 11.000  | 40     | . 9995 | -0.0  | 0.0                 | 0.0      | 0.0       |          |          |           |       |           |        |          |
|   | 11     | 0.994  |       | 0.0                 | 0.0      | 0.0       | 41001    | BLOCK    | 1 11.     | 000   | 41        | -0.7   | -0.4     |
| 10  |        |        |       |                     |          |           | 41004    | ΓN       | 0.4       | 400   | 4 1       | 0.7    | 0.4      |
| .975LK 53 2<br>41004 LV 0.4400                                      | 41     | .0136  | -1.3  | 0.0                 | 0.8      | 0.0       |          |          |           |       |           |        |          |
| .000UN 52 2   | 10     | .4460  |       | 0.0                 | 0.4      | 0.0       | 41003    | BLOCK    | 1-A 11.   | 000   | 4 1       | -0.7   | -0.4     |
| 41005 BLOCK 2 11.000  | 40     | . 9993 | -0.0  | 0.0                 | 0.0      | 0.0       |          |          |           |       |           |        |          |
| 7 10  | 1 1    | 0.992  |       | 0.0                 | 0.0      | 0.0       | 4100     | OKARA (  | CNT MV11. | 000   | 4 1       | -1.5   | -0.8     |

TC ENERGIES

| 1.000LK 53 2                     |          |      |     |     | 41006 LV 0.4400 4 1 0.7 0.4               |
|----------------------------------|----------|------|-----|-----|---|
| 8 10                             |          |      |     |     | 41007 BLOCK 2-A 11.000 4 1 0.8 0.4        |
|                                  | 4 0.9874 | ~1.4 | 0.0 | 0.8 | 0.0                                       |
| 1.000 <b>un</b> 52 2             | 1 0.4345 |      | 0.0 | 0.4 | 0.0 41005 BLOCK 2 11.000 4 1 -0.7 -0.4    |
| 41007 BLOCK 2-A 11.000           | 4 0.9993 | -0.0 | 0.0 | 0.0 | 0.0                                       |
| 8 10                             | 1 10.992 |      | 0.0 | 0.0 | 0.0 41005 BLOCK 2 11.000 4 1 -0.8 -0.4    |
| 0.988LK 53 2<br>41008 LV 0.4400  | 4 1.0002 | -1.4 | 0.0 | 0.8 | 41008 LV 0.4400 4 1 0.7 0.4<br>0.0        |
| 1.000UN 52 2                     | 1 0.4401 |      | 0.0 | 0.4 | 0.0 41007 BLOCK 2-A 11.000 4 1 -0.7 -0.4  |
| 41009 BLOCK 3 11.000             | 4 0.9990 | -0.1 | 0.0 | 0.0 | 0.0                                       |
| 17 10                            | 1 10.989 |      | 0.0 | 0.0 | 0.0 4100 OKARA CNT MV11.000 4 1 -1.5 -0.7 |
| 1.000LK 53 2                     |          |      |     |     | 410010 LV 0.4400 4 1 0.7 0.4              |
| 8 10<br>410010 LV 0.4400         | 4 0.9871 | -1.4 | 0.0 | 0.8 | 410011 BLOCK 3-A 11.000 4 1 0.7 0.4       |
| 1.000UN 52 2                     | 1 0.4343 |      | 0.0 | 0.4 | 0.0 41009 BLOCK 3 11.000 4 1 -0.7 -0.4    |
| 410011 BLOCK 3-A 11.000          | 4 0.9985 | -0.1 | 0.0 | 0.0 | 0.0                                       |
| 8 10                             | 1 10.983 |      | 0.0 | 0.0 | 0.0 41009 BLOCK 3 11.000 4 1 -0.7 -0.4    |
| 0.988LK 28 3<br>410012 LV 0.4400 | 4 1.0038 | -0.9 | 0.0 | 0.8 | 410012 LV 0.4400 4 1 0.8 0.4<br>0.0       |
| 1.000UN 28 3                     | 1 0.4417 |      | 0.0 | 0.4 | 0.0 410011 BLOCK 3-A 11.000 4 1 -0.8 -0.4 |
| 410013 SOLAR MV 11.000           | 4 1.0003 | 0.0  | 0.0 | 0.0 | 0.0                                       |
| 10                               | 1 11.003 |      | 0.0 | 0.0 | 0.0 4100 OKARA CNT MV11.000 4 1 0.8 0.2   |

ATC EAK POILES

.

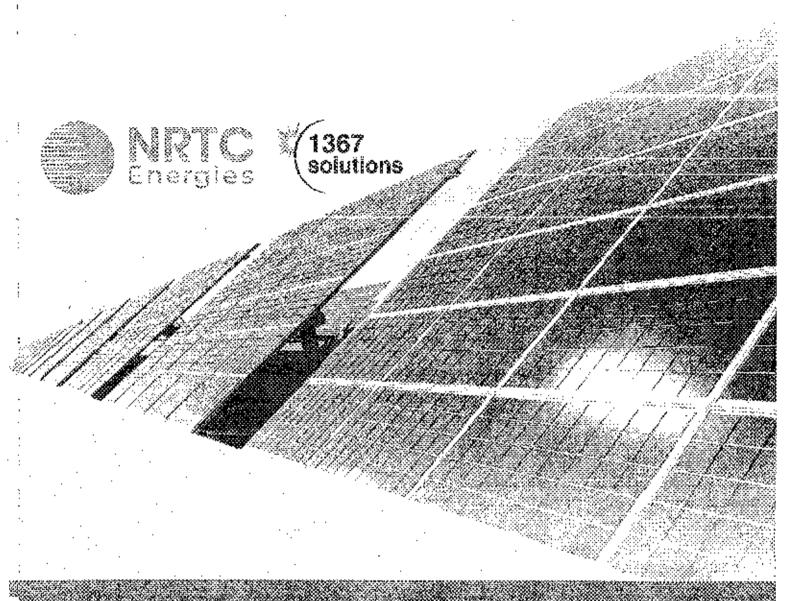




|             | · · · · · · ·                     |          |     | - 1<br>- |     | 410014 SOLAR LV  | 0.8000 | 4 | 1 | -0.8 | -0.2 |  |
|-------------|-----------------------------------|----------|-----|----------|-----|--|--------|---|---|------|------|--|
| 1.000LK     | 67 1                              |          |     |          |     | · · · · · · · · · · · · · · · · · · ·  |        |   | - |      |      |  |
| 410014 SOLA | R LV 0.8000                       | 4 1.0053 | 0.9 | 0.8      | 0.0 | 0.0  |        |   |   |      |      |  |
| *********   | والوحف عفيه خزوا حزل ويواجون مراد |          |     |          | •   | and a second | · .    |   |   |      |      |  |
|             | <i>(</i> <b>)</b>                 | 1 0.8042 |     | 0.3R     | 0.0 | 0.0 410013 SOLAR MV  | 11.000 | 4 | 1 | 0.8  | 0.3  |  |
| 1.000UN     | 67 1                              |          |     |          |     |  |        |   |   |      |      |  |



η.



# Feasibility Study 5.5 MWp

**Head Office:** 

72 Block, PECO Road, Lahore - Pakistan

**Regional Offices:** 

Islamabad i Karachi | Peshawar | Quetta | Multan





### FEASIBILITY STUDY 3.5 MWp SOLAR PLANT INSTALLATION

AT

### MILITARY ENGINEERING SERVICES (MES) PAKISTAN

By 👘

NRTC Energies (Pvt.) Ltd.



#### 1. Executive Summary



The feasibility examines the costs, practicality, and likely outcome of a Solar Photovoltaic (PV) installation at MES Pakistan sites.

The main outcomes of the feasibility report are given below;

Technical Site Analysis: The project site (s) is suitable for a solar PV energy system. For the purpose of estimation of power generation potential, solar insolation is assumed to be "good" (1,705 kWh/ square meter/ year). Panel azimuths (0 degrees), panel tilt (26 degrees) and satisfactory ground and roof condition and structure are also assumed.

Anticipated System information: The project will accommodate a 3.5 MWp solar PV system with a projected annual production of 5,110 MWh/ year. Use of a JA Solar JAM72D40-580/G B (580 Watt) n-type bifacial double glass high efficiency mono PV module, the system will offset approximately 2,366 tons of carbon dioxide annually.

**Financial Analysis:** The total estimated project cost is USD 1,796,164. The sponsors of NRTC Energies (Private) Limited have agreed to finance the project on 80:20% equity. Based on the technical and financial analysis, the installation of a 3.5 MWp Solar PV System at MES Pakistan sites is deemed to be feasible.

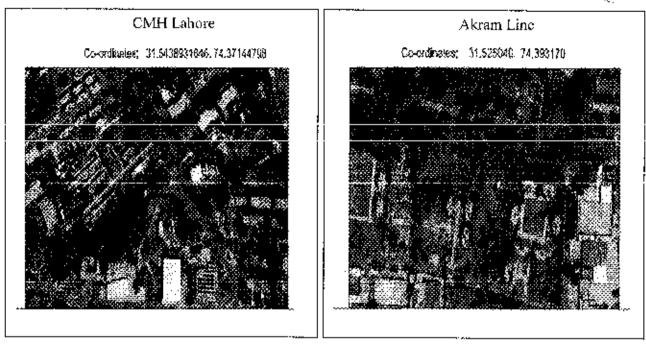
#### 2. Introduction

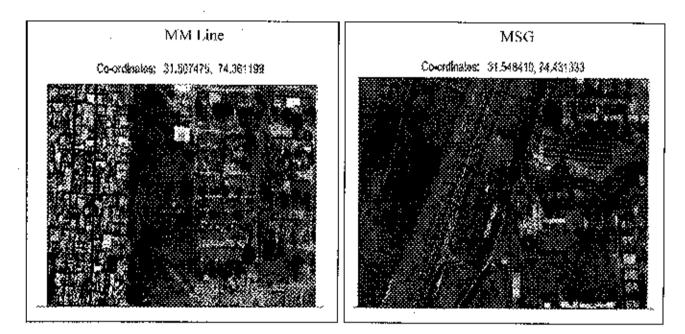
A 3.5 MWp Solar PV system will be installed at five (05) site of MES, Pakistan including four (04) nos. sites in Lahore and One (01) no in Okara.

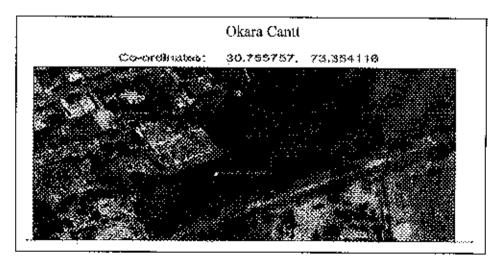
| Sr. No. | Site                 | Capacity<br>(MW) |
|---------|----------------------|------------------|
| 1       | CMH (Lahore)         | 1                |
| 2       | MM Lines (Lahore)    | 0.5              |
| 3       | Akram Lines (Lahore) | 0.5              |
| 4       | MSG (Lahore)         | 0.5              |
| 5       | Okara Canit (Okara)  | . I              |
|         | Total                | 3.5              |













÷.,

3. Technical Details

#### 3.1 Site Conditions:

The following tasks were carried out;

- Global Horizontal Irradiation, annual and inter-annual variation was assessed.
- Near shading objects were taken into account for placement of PV modules.
- Area required for selected module technology was calculated. Keeping in view available area and minimum inter row shading, tilt angle and appropriate spacing was calculated from near shading objects.

#### 3.2 Technology Review and Selection:

3:2.1 Technology Selection

| Type of<br>Technology            |                   |                   | Photovoltaic (PV) C                                    | ell                          |  |  |  |  |  |  |
|----------------------------------|-------------------|-------------------|--|------------------------------|--|--|--|--|--|--|
| System Type                      | Op-Grid           |                   |  |                              |  |  |  |  |  |  |
| Site                             | MM LINE           | MSG               | CMII Labore  | Akram Line                   | Ökara Cantt  |  |  |  |  |  |
| Installed Capacity<br>(MW)       | 0.5               | 0.5               | ···  | 0.5                          | L  |  |  |  |  |  |
| Modules (No.)                    | 864               | 864               | .726   | 864                          | 1726   |  |  |  |  |  |
| PV Array (No.)                   | ]                 | ÷                 | 2  | 1                            | 2  |  |  |  |  |  |
| Strings (No.)                    | 32 X 27 in series | 32 X 27 in series | 31 Strings x 28 in series<br>33 Strings x 26 in series | 27 Strings x 32 in<br>series | 31 Serings x 28 in series<br>33 Strings x 26 in series |  |  |  |  |  |
| Invertees (kW Ac)                | 300               | 300               | 300  | 300                          | 300  |  |  |  |  |  |
| Quantity (Nos.)                  | 2                 | 2                 | 3  | 2                            | 3  |  |  |  |  |  |
| Make                             |                   |                   | Iluawei Technologie                                    |                              | J  |  |  |  |  |  |
| Module area<br>(m <sup>‡</sup> ) | 2,445             | 2,445             | 4,885  | 2,445                        | 4,885  |  |  |  |  |  |

#### 3.2.2 Technical Details of Equipment

|   | Solar Panels - PV Modules       |                               |  |  |
|---|---------------------------------|-------------------------------|--|--|
| 1 | Type of Module                  | JAM72D40-580/GB               |  |  |
| 2 | Type of Cell                    | Monocrystalline N-Type (16BB) |  |  |
| 3 | Dimensions of each<br>Module    | 2278 x 1134 x 30              |  |  |
| 4 | Weight                          | 31.8 kg                       |  |  |
| 7 | Module frame anodized           | Anodized Aluminum Alloy       |  |  |
| 8 | Nominal Max. Power (P<br>Max)   | 580 W                         |  |  |
| 9 | Opt. Operating Voltage<br>(Vmp) | 43.03 V                       |  |  |





| 5    |  |                                    |
|------|--|------------------------------------|
| 10   | Opt. Operating Current<br>(Imp)        | 13,48 A                            |
| 11   | Open Circuit Voltage<br>(Voc)          | 51.30 V                            |
| 12   | Short Circuit Current<br>(ISC)         | 15.51 A                            |
| 13   | Module Efficiency                      | 22.5 %                             |
| 14   | Operating Temperature                  | -40 °C ~ + 85 °C                   |
| 15   | Max. System Voltage                    | 1500 V DC                          |
| 16   | Module Fire Performance                | UL Type 29                         |
|      | PV                                     | Capacity                           |
| 17   | Total Site                             | 3.5 MWp                            |
| 18   | Net Capacity Factor                    | 3.5 MW                             |
|      | <b>b</b>                               | overters                           |
| 1    | Manufactures                           | Huawei Technologies                |
| 2    | Capacity of each unit                  | 300 kW Ac                          |
| 3    | No. of inverters                       | 12                                 |
| 4    | MPPT Operating<br>Voltage Range        | 500 V ~ 1,500 V                    |
| 5    | Start Voltage                          | 550 V                              |
| 6    | Max Input Voltage                      |                                    |
| 7    | Total Power                            | 330 kW                             |
| 8    | Max input current for<br>each MPPT     | 65 A                               |
| 9    | Max Output Current                     | 238.2 A                            |
| 10   | Adjustable P.F Range                   | 0.8 LG 0.8 LD                      |
| 1 I. | Nominal Input Voltage                  | 1,080 V                            |
| 12   | Rated Power Frequency                  | 50 Hz / 60 Hz                      |
| 13   | Efficiency                             | ≥99.0%                             |
| 14   | Relative Humidity (Non-<br>Condensing) | 0 100%                             |
| 15   | Weight                                 | ≤112 kg                            |
| 16   | Degree of Protection                   | IP 66                              |
|      | St                                     | rueture                            |
| 17   | Structure                              | Concrete Pile Structure   150km/hr |
| 18   | Tilt / Azimuth                         |                                    |
|      | Data Col                               | lection System                     |
| 19   | System Data                            | Huawei smart logger                |
| 20   | Weather Station                        | Seven Sensors Solutions            |
|      | <u></u>                                | er Details                         |
|      | Othe                                   | er Detains                         |
| 21   | COD of Project (tentative)             | 30 <sup>th</sup> June 2025         |

1367 solutions





#### 3.3 Energy Yield Estimation and Simulations

The aim of yield estimation is to predict the average annual energy output of the site. PvSyst software is used for simulation and near shading analysis. The energy yield prediction provides the basis for calculating project revenues. The aim is to predict the average annual energy output for the lifetime of the proposed power plant. To estimate accurately the energy produced from a PV power plant information is needed on the solar resource and temperature conditions of the site. Also required are the layout and technical specifications of the plant components. A number of solar energy yield prediction software packages are available in the market. These packages use time step simulation to model the performance of a project over the course of a year.

PVSyst software has been used for energy yield prediction for each site of MES Pakistan and results are in Annexure A to E.

#### 3.4 Working Conditions

The solar system will have export control device to make sure that PV power generated by the inverters is on par with power consumption of the site load. A device will measure load at injection point and the limit power of inverters by changing register values. AC output is implemented in reference to energy flow at grid connection point which will reduce inverter AC output of the Inverter if site load will be less than the solar production.

#### 3.5 Plant Characteristics

| Generation Voltage          | 800 V three phase four wire system   |
|-----------------------------|--|
| Power Factor at rated power | 1  |
| Frequency                   | 50 IIz   |
| Generation characteristic:  | Inverter has built-in features of controllable active power<br>ramp following grid disturbance or normal connection,<br>voltage regulation and frequency response. There are no<br>additional control metering and instrumentations. |

The seamless integration of Solar PV generation has been confirmed by detailed system studies conducted for each site of MES Pakistan (attached as Annex F-J)

#### 3.6 Design Parameters

The following tasks were carried out for PV layout and shading.

Assessment of shading (horizon and nearby building)



- Outline layout of area suitable for PV development
- Designing row spacing to reduce inter-row shading and associated shading losses
- Designing the layout to minimize cable runs and associated electrical losses
- Creating access routes and sufficient space to allow movement for maintenance purposes
- Choosing a tilt angle that optimizes the annual energy yield according to the latitude of the site and the annual distribution of solar resource
- Module clearing strategy
- Simulating annual energy losses associated with various configurations of tilt angle, orientation – d row spacing
- PV layouts of the site in 3D and 2D view

#### 3.7 Layout

The detailed layout (2D and 3D) of the solar panels is given in PySyst simulations attached as Annexure A to E. PV layout may change depending upon site constraints before or during installation.

#### 3.8 Electrical Design

The electrical system comprises the following components:

- Array(s) of PV modules
- DC/AC cabling (module, string and main cable)
- DC connectors (plugs and sockets)
- Disconnects / switches
- Protection devices e.g., VCBs, fuses, surge protective devices, beakers
- Energy Meters
- Smart Loggers for Monitoring
- Harthing

#### 3.9 Control, Metering, Instrumentation and Protection:

#### 3.9.1 Reverse Feed in Protection:

In PV Plants with 100 % self-consumption all the generated power has to be consumed by the connected site / load. In case the load is less and more PV Power is being generated, the excess power will go to the grid. In order to avoid feed-in to the grid, a special control system is needed to be installed.



The feedback control loop to limit the active power feed-in to grid is implemented by using Huawei's smart loggers. They will actively sense the electrical parameters at interconnection points and curtail invertor's output to restrict feed-in to the grid.

#### 3.9.2 Metering and Protection:

The distance of interconnection point to the PV plant is approximately 120 - 150 meters in case of each site. The metering of PV plant will be performed at the main MV busbar. Sensitivity class for meters will be at least 1 with bidirectional 4 quadrant calculations algorithm. Metering parameters, including total import and export units TOD Calculations, MDl, active and reactive power calculations etc. can be extracted over the period, Solar power plant is designed to have the following protections for the line and load side;

- Over and under voltage/frequency protections
- Phase Failure, Unbalance and Phase reversal protection
- Short Circuit protections
- Earth Fault detection
- Over current protection
- Surge Protection
- Transformer Protections

#### 4. Financial Analysis

The Capital cost shall include the cost borne by the Applicant Company on completion of feasibility, planning, designing, material, construction and installation of the Generation Facilities. The cost of switchgear protection and interconnection with distribution system of utility is included in this case.

The expected cost of the installations under has been estimated to be US\$ 0.513/Wp. This cost does not include the cost of land as facilities shall be installed at the premises of the Buyer.

| Sr. No. | Description                              | US\$/Wp |
|---------|--|---------|
| 1       | Civil Work                               | 0.095   |
| 2       | EPC                                      | 0,413   |
| 3       | Others<br>(including approvals<br>costs) | 0.005   |
|         | Total                                    | 0.513   |

Item wise break up of project cost is attached as Annexurc- K

#### 5. Safety and Emergency Plan



Detailed safety and emergency plan is attached as Annexure- L.

#### 6. Training & Capacity Development

Trained and qualified personnel will be available at site (s) 24/7 with proper safety and firefighting training. Training program will focus on - but not limited to - Solar Resource Assessment; Site Survey, Technology, Engineering Design, Regulation, Policy, Metering & Billing, and Project Management of Roofhop Solar System.

#### 7. Environmental Aspects

Detailed report on environmental aspects is attached as Annexure- M.

#### 8. Socio-Economic Aspects

In regard to the socio-economic viewpoint, the benefits of exploitation of solar PV system comprise of:

- Increase of the regional / national energy independency.
- Provision of significant work opportunities
- Diversification and security of energy supply.
- Support of the deregulation of energy markets

#### 9. Conclusion

The techno-commercial feasibility for installation of 3.5 MWp Solar PV Systems at various site of MES Pakistan across Punjab study confirms that the proposed project is both technically viable and commercially attractive. From a technical perspective, the required infrastructure, technology, and resources are readily available and align with industry standards, ensuring reliable and efficient operations. Commercially, project is financially viable with manageable risks and favorable market conditions supporting long-term profitability. Key regulatory, environmental, and logistical considerations have also been adequately considered. Based on these findings, the project is deemed feasible and recommended for further development and implementation.

\* \* \* \* \*

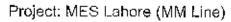


# **PVsyst - Simulation report**

Grid-Connected System

Project: MES Lahore (MM Line)

Variant: New simulation variant No 3D scene defined, no shadings System power: 501 kWp Lahore MES (MM Line) - Pakistan



#### Variant: New simulation variant

\_ \_

-----

#### PVsyst V7.3.1 VC0, Simulation date: 08/01/24 10:48 with v7.3.1

:

:

|   |                              | Project s  | ummary —                               |  |                              |
|---|------------------------------|--|--|--|------------------------------|
| Geographical Site<br>Lahore MES (MM Lir<br>Pakistan             |                              | <b>Situation</b><br>Latitude<br>Longitude<br>Altitude<br>Time zone | 31.51 °N<br>74.35 °E<br>207 m<br>UTC+5 | Project settings<br>Albado                   | 0.20                         |
| <b>Meteo data</b><br>Lahors MES (MM Lin:<br>Meteonorm 8.1 (1996 | ə)<br>-2015), Sat=100% - Syr | nthetic  |  |  |                              |
|   |                              | ——————————————————————————————————————                             | summary —                              |  |                              |
| Grid-Connected Sj<br>Simulation for year no                     |                              | No 3D scene defin  | ied, no shadings                       |  |                              |
| <b>PV Field Orientatic</b><br>Fixed plane<br>Tilt/Azimuth       | <b>26 / 0 ^</b>              | Near Shadings<br>No Shadings                                       |  | <b>User's needs</b><br>Unlimited load (grid) |                              |
| System Informatio   | 'n                           |  |  |  |                              |
| PV Array<br>Nb. of modules                                      |                              | <b>D</b> Ø /   | Inverters<br>Nb. of units              |  |                              |
| Prom total  |                              | 864 units<br>501 kWp   | Pnom total<br>Pnom retio               |  | 2 units<br>600 kWac<br>0.835 |
| <u>-</u> . <u>1</u> /   |                              |  | ummary                                 |  |                              |
| Produced Energy   | 593959 kWh/year              | Specific production  | 1185 kWh/kWp/year                      | Perf. Ratio PR                               | 72.74 %                      |
|   |                              | Table of d   | contents                               |  | - uz.                        |
| Project and results su  | mmary                        |  |  |  | 2                            |
| General parameters, f   | PV Array Characteristic:     | s, System lassas   |  |  | 3                            |
| Mein results<br>Loss discrem                                    | ·····                        |  |  |  | 5                            |
| Predef, graphs  |                              |  | ~~~~~                                  |  | Б                            |
|   |                              |  |  |  |                              |



.

ł

:

#### PVsyst V7.3.1 VC6, Simulation date: 09/01/24 10:48 with v7.3.1

### Project: MES Lahore (MM Line)

#### Variant: New simulation variant

|                            |                    | — General p                     | arameters —                       | · -                                  |                     |  |
|----------------------------|--------------------|---------------------------------|-----------------------------------|--------------------------------------|---------------------|--|
| Grid-Connected Syst        | em                 | No 3D scene defi                | ned, no shadings                  |                                      |                     |  |
| PV Field Orientation       |                    |                                 |                                   |                                      |                     |  |
| Orientation                |                    | Sheds configuration             | •                                 | Models used                          |                     |  |
| Fixed plane                |                    | No 3D scene defined             |                                   |                                      | <b>D</b>            |  |
| Tilt/Azimuth               | 26/0°              | NO DO SCENE GENNIQU             |                                   | Transposition                        | Perez               |  |
| The second second          | 20,0               |                                 |                                   | Diffuse Perez, Met                   |                     |  |
|                            |                    |                                 |                                   | Circumsolar s                        | eparat <del>e</del> |  |
| Horizon                    |                    | Near Shadings                   |                                   | User's needs                         |                     |  |
| Free Harizon               |                    | No Shadings                     |                                   | · Unlimited load (grld)              |                     |  |
|                            | •                  | <u> </u>                        | ·                                 |                                      |                     |  |
|                            | ·                  | - PV Array Ch                   | aracteristics –                   |                                      |                     |  |
| PV modulo                  |                    | _                               | Inverter                          |                                      |                     |  |
| Manufacturer               |                    | CSI Solar                       | Manufecturer                      | Linner i 1                           | Fechnologies        |  |
| Model                      | CS7L-5             | 80MB-AG 1500V                   | Model                             |                                      | -                   |  |
| (Original PVsyst data      |                    |                                 |                                   |                                      | I-330KTL-H2         |  |
| Unit Nom, Power            |                    | 580 Wp                          | (Custom parameta                  |                                      |                     |  |
| Number of PV modules       |                    |                                 | Unit Nom, Power                   |                                      | ) kWac              |  |
|                            |                    | 864 units                       | Number of invertors               | 2                                    | 2 units             |  |
| Nominal (STC)              |                    | 501 kWp                         | Total power                       | 600                                  | ) kWac              |  |
| Madules                    |                    | x 27 ln series                  | Operating voltage                 | 500-1500                             | ) V                 |  |
| At operating cond. (50°)   | 3)                 |                                 | Max. power (≂>30°C)               | 330                                  | ) kWac              |  |
| Pmpp                       |                    | 460 kWp                         | Phom ratio (DC:AC)                | 0.84                                 | Ļ                   |  |
| U трр                      |                    | 823 V                           | Power sharing within t            |                                      |                     |  |
| Гтөр                       |                    | 559 A                           | -                                 |                                      |                     |  |
| Total PV power             |                    |                                 | Total inverter powe               | er                                   |                     |  |
| Nominal (STC)              |                    | 501 kWp                         | Total power                       |                                      | kWac                |  |
| Total                      |                    | 864 modules Number of inverters |                                   | 2 units                              |                     |  |
| Module area                |                    | 2445 m²                         | Phom retio                        | 0.84                                 |                     |  |
|                            |                    |                                 | ·                                 | ·                                    | <u></u>             |  |
|                            |                    | Array I                         |                                   |                                      | , <u>.</u>          |  |
| Array Solling Losses       |                    | Thermal Loss factor             |                                   | DC wiring losses                     |                     |  |
| Loss Fraction              | 4.0 %              |                                 | ecording to irradiance            | Global away res.                     | 24 mΩ               |  |
|                            |                    | Uc (const)                      | 29.0 W/m²K                        | Loss Fraction                        | 1.5 % at STC        |  |
|                            |                    | Uv (wind)                       | 0.0 W/m²K/m/s                     |                                      |                     |  |
| Serie Diode Loss           |                    | LID - Light Induced Degradation |                                   | Modula Occ-libert                    |                     |  |
| Voltage drop               | 0.7 V              | Loss Fraction                   | 2.0 %                             | Module Quality Loss<br>Loss Fraction | 0.4.94              |  |
| Loss Fraction 0.1 % at STC |                    |                                 | r.U /6                            | LOSS HERCHON                         | -0.4 %              |  |
|                            |                    |                                 |                                   |                                      |                     |  |
| Module mismatch los        |                    | Strings Mismatch                |                                   | Module average degra                 | dation              |  |
| Loss Fraction 2.0 % at MPP |                    | Loss Fraction                   | 0.1 %                             | Year no                              | 10                  |  |
|                            |                    |                                 |                                   | Loss factor                          | 0.4 %/year          |  |
|                            |                    |                                 |                                   | Mismatch due to degrada              | -                   |  |
|                            |                    |                                 |                                   | Imp RMS dispersion                   | 0.4 %/year          |  |
|                            |                    |                                 |                                   | Vmp RMS dispersion                   | 0.4 %/year          |  |
| AM loss factor             |                    |                                 |                                   | •                                    | or anyour           |  |
| noldence effect (IAM): Us  | er defined profile |                                 |                                   |                                      |                     |  |
|                            |                    | 408 50                          | · · · <del> · · · -</del> · · · - | <u> </u>                             |                     |  |
| 10° 20°                    |                    |                                 |                                   |                                      |                     |  |
| 10° 20°<br>0.998 0.998     |                    | 40° 50<br>0.992 0.98            |                                   | 70° 80°<br>0.817 0.763               | 904                 |  |



### Project: MES Lahore (MM Line)

#### Variant: New simulation variant

#### **PVsyst V7.3.1** VC0. Simulation dato. 08/01/24 10:48 with v7.3.1

|  |                                       | System los   | 35es   |
|--|---------------------------------------|--|--|
| Unavaifability of the s<br>Time fraction | 9 <b>ystam</b><br>3.4 %<br>12.4 days, | Auxiliaries loss<br>Proportionnal to Power<br>0.0 kW from Power threst | 5.0 W/kW   |
|  | 3 periods                             | Night aux. cons.   | 500 W  |
|  |                                       | AC wiring lo   | 0\$503   |
| Inv. output line up to                   | MV transfo                            | -  |  |
| Inverter voltago                         |                                       | 800 Vac (ri  |  |
| Loss Fraction                            |                                       | 0.10 % at STC  |  |
| Inverter: SUN2000-330K                   | TL-H2                                 |  |  |
| Wire section (2 Inv.)                    |                                       | x 240 mm²  | entre al estarte estarte   |
| Average wirds length                     | 110220                                | 20 m   | and the second |
| MV line up to injection                  | п                                     |  |  |
| MV Voltage                               |                                       | 11 kV  |  |
| Wires                                    | Alu 3                                 | 3 X 95 mm²   |  |
| Length                                   |                                       | 100 m  |  |
| Loss Fraction                            |                                       | 0.01 % at STC  |  |
| · ·                                      |                                       | AC losses in tran  | nsformers  |
| MV transfo                               |                                       |  |  |
| Medium voltage                           |                                       | 11 kV  |  |
| Transformer from Datasi                  | heets                                 |  |  |
| Nominal power                            |                                       | 630 KVA  |  |
| Iron Loss (24/24 Connexi                 | or}                                   | 1.00 kVA   |  |
| Iron loss fraction                       | -                                     | 0.16 % of PNom   |  |
| Copper loss                              | :                                     | 20.00 kVA  |  |
| Copper loss fraction                     |                                       | 3.17 % at PNom   |  |
| Colls equivalent resistance              | e 3.x:                                | 32,25 mΩ   |  |

:



#### Project: MES Lahore (MM Line)

#### Variant: New simulation variant

#### PVsyst V7.3.1 VC0, Simulation date: 08/01/24 10:48 with v7.3,1

#### Main results

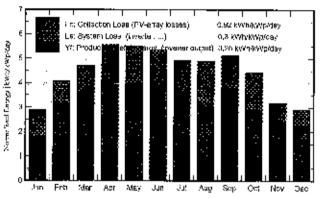
#### System Production

Produced Energy (P50) 593959 kWh/year Produced Energy (P90) 556330 kWh/year Produced Energy (P99) 525662 kWh/year

Specific production (P50) Produced Energy (P90) Produced Energy (P99)

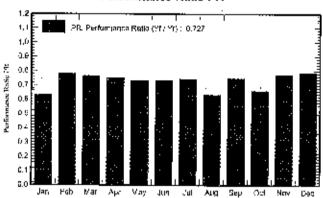
1185 kWh/kWp/yeer Performance Ratio PR 72.74 % 1110 kWh/kWp/yeer 1049 kWh/kWp/year

#### Normalized productions (per installed kWp)



1517.1

887.0



#### GlobHar DiffHor T\_Amb Globine GlobEff EAmay E\_Grid kWh/m² kWh/m² ۴C kWh/m² kWh/m² kWh k₩h January 6**9.8** 43.7 11.88 89.2 84.1 37531 28331 February 92.3 46.7 16.09 114.D 107.7 46962 44484 March 131.6 77.3 22.10 146.B 138.3 59265 56348 April 161.D 87,3 27.05 166,6 157.0 65711 82574 May 176.7 96,9 32.91 170.8 160.7 65704 62568 June 189.5 100.5 32.80 160.2 150.8 61926 58856 July 160.5 102.3 31.45 152.3 143.1 59594 56715 August 151.5 96.0 30.72 151.7 142.B 59496 48077 September 141.8 76.6 29.06 154.1 145.1 60591 57635 October 116.4 68.0 25.94 136.8 129.1 54502 45208 November 77.A 49.9 19.09 **96**.0 90.539361 37144 December 68.6 41.9 13.95 90.9 85.7 38037 35830

24.46

| Year      | 1517.1 887.0 24.46                           | 1629.4 | 1535.0 648681 593959 0.727                  |
|-----------|--|--------|---|
| Lananda   |  |        | · · · · · · · · · · · · · · · · · · ·       |
| Legends   |  |        |   |
| GlobHar   | Global horizontal irradiation                | EArray | Effective energy at the output of the array |
| DI'll-Ior | Horizontel diffuse irradiation               | E_Grld | Energy injected into orig                   |
| T_Amb     | Ambient Temperature                          | PR     | Performance Ratio                           |
| Glabine   | Global incident in colf. plane               |        |   |
| GlabEf(   | Effective Global, corr. for IAM and shadings |        |   |

1629.4

#### Balances and main results

Year

PR

ratio

0.634

0.779

0.766

0.749

0.731

0.735

0.743

0.633

0.748

0.661

0.772

0.786

### Performance Ratio PR



5

:

### Project: MES Lahore (MM Line)

Variant: New simulation variant

PVsyst V7.3.1 VC0, Simulation date; 08/01/24 10:48 with v7.3.1

| 1517 kWh/m²                 | Global horizontal Irradiation  |
|-----------------------------|--|
| +7.4%                       | Global incident in coll, plane   |
|                             |  |
| S) -1.87%                   | IAM factor on global   |
| -4.00%                      | Solling loss factor  |
| 1535 kWh/m² * 2445 m² coll. | Effective irradiation on collectors  |
| efficiency at STC = 20.58%  | PV conversion  |
| * 772688 kWh                | Array nominal energy (at STC effic.)   |
| 3.80%                       | Module Degradation Loss ( for year #10)  |
| 9-0.21%                     | PV loss due lo irradiance lovel  |
| N-6.47%                     | PV loss due to temperature   |
|                             | Module quality loss  |
| -2.00%                      | LID - Light Induced degradation  |
| N-4.00%                     |  |
| 4.00%                       | Mismatch loss, modules and strings<br>(including 1.9% for degradation dispersion |
|                             | Ohmic wiring loss  |
| 648681 kWh                  | Array virtual energy at MPP  |
| -1.89%                      | Inverter Loss during operation (efficiency)                                      |
| 90.00%                      | Inverter Loss over nominal inv. power  |
| 40.00%                      | Inverter Loss due to max, input current  |
| ¥ 0.00%                     | Inverter Loss over nominal inv. voltage  |
| ¥ 0.00%                     | Inverter Loss due to power threshold   |
| 9 0.00%                     | Inverter Loss due to voltage threshold   |
| 9 -0.01%                    | Night consumption  |
| 637660 kWh                  | Available Energy at Inverter Output  |
| 9-0.84%                     | Auxiliaries (fans, other)  |
| + -0.04%                    | AC ohmis lass  |
| 9-2.48%                     | Međium voltage transfo loss  |
| N+-0.01%                    | MV line chimic loss  |
| 3-3.64%                     |  |
| 593959 kWh                  | System unavallability<br>Energy injected into grid                               |

08/01/24

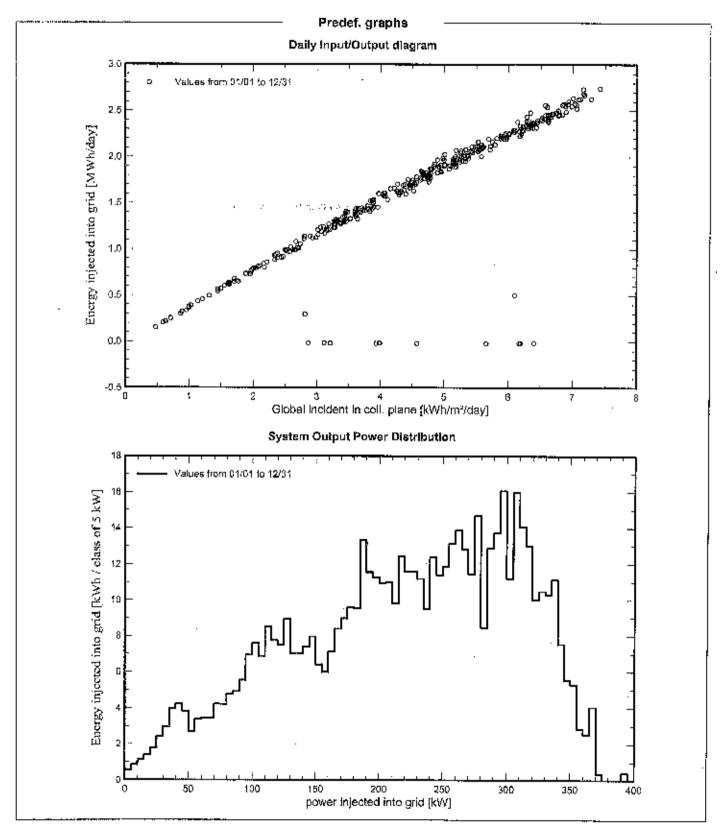
1.1



#### Project: MES Lahore (MM Line)

#### Variant: New simulation variant

PVsyst V7.3.1 VC0, Simulation date: 08/01/24 10:48 with v7.3.1





:

•

., <sup>1</sup>

# Project: MES Labore (MM Line)

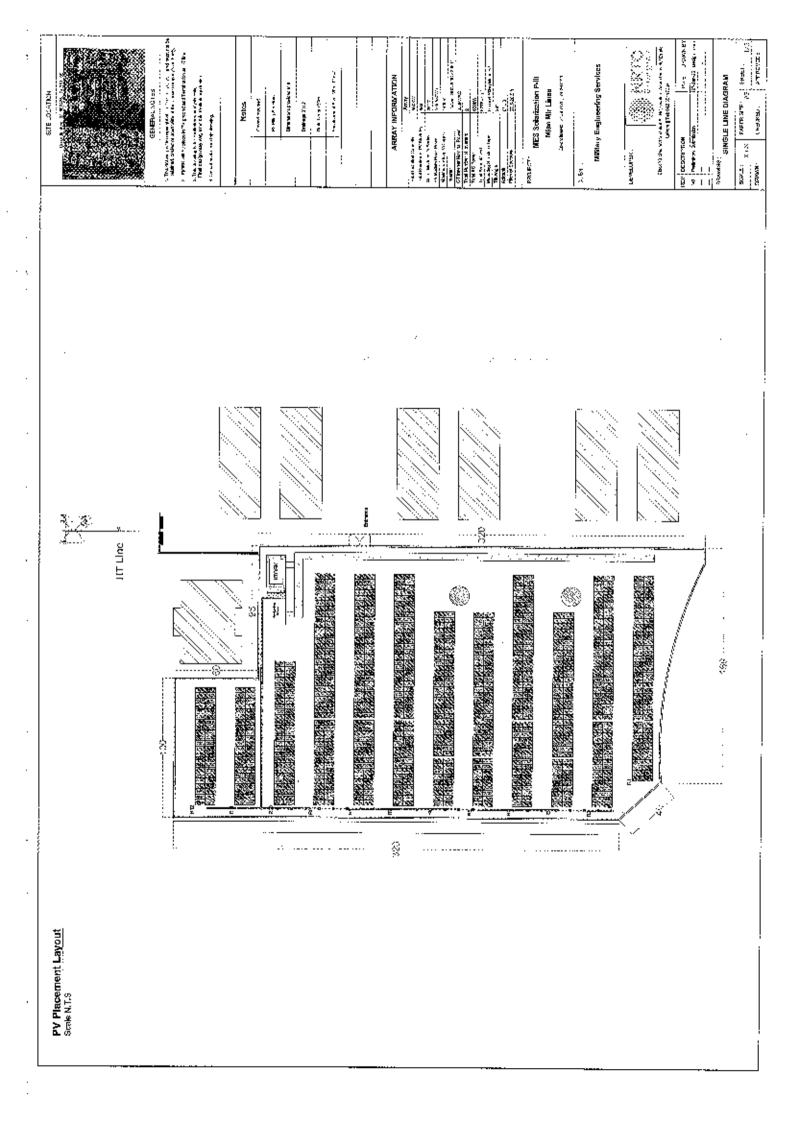
Variant: New simulation variant

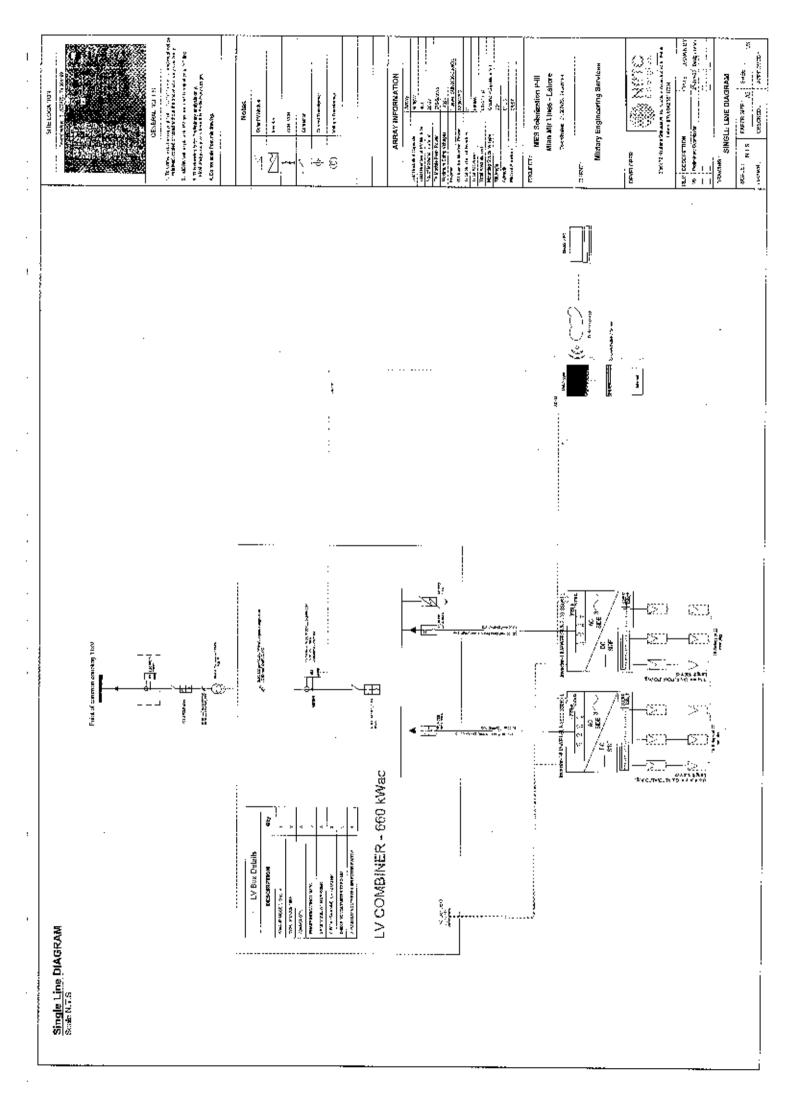
PVsyst V7.3.1 VC0, Simulation dato: 08/01/24 \$0:48 with v7.3.1

|  | P50 - P90 evaluation   |
|--|--|
| Neteo data                                   | Simulation and parameters uncertainties                      |
| Source Meteonorm 8,1 (1996-2015), Sat=100%   | PV module modelling/parameters 1.0 %                         |
| (Ind Monthly averages                        | Invertor officioney uncertainty 0.5 %                        |
| Synthetic - Multi-year average               | Solling and mismatch uncertainties 1.0 %                     |
| fear-to-year veriebility(Variance) 4.6 %     | Degradation uncertainty 1.0 %                                |
| Specified Deviation                          |  |
| Climate change 0.0 %                         | 'n   |
| Global variability (meteo + system)          | Annual production probability                                |
| /adability (Quadratic sum) 4.9 %             | Variability 28,3 MWh   |
|  | P50 584,0 MWh  |
|  | P90 558,3 MWh  |
|  | P99 525,7 MWh  |
|  | Probability distribution                                     |
| 0.50   |  |
|  |  |
| 0.45   | :  |
|  | 3  |
|  |  |
| 0.40   | P50 = 594.0 %Wh  |
| 0.40   | P50 = 594.0  kg/wh $P50 = 594.0  kg/wh$ $P50 = 594.0  kg/wh$ |
|  |  |
| 0.40<br>D.35                                 |  |
|  |  |
|  |  |
| D.35<br>D.30                                 |  |
| D.35<br>D.30                                 |  |
| D.35<br>D.30                                 |  |
| D.35   |  |
| D.35<br>D.30                                 | 5 (Ord person - 284 (* Miss);                                |
| D.35<br>D.30<br>0.25<br>0.20                 |  |
| D.35   | 5 (Ord person - 284 (* Miss);                                |
| D.30<br>0.30<br>0.25<br>0.25<br>0.25         | 5 (Ord person - 284 (* Miss);                                |
| D.35<br>D.30<br>0.25<br>0.20                 | 5 (Ord person - 284 (* Miss);                                |
| D.30<br>0.30<br>0.25<br>0.25<br>0.25         | 5 (Ord person - 284 (* Miss);                                |
| D.30<br>0.30<br>0.25<br>0.25<br>0.25         | 5 (Ord person - 284 (* Miss);                                |
| D.35<br>D.30<br>0.25<br>0.20<br>0.15<br>0.10 | P90 = 568.3 MWh  |
| D.36<br>D.30<br>0.25<br>0.25<br>0.15<br>0.10 | P90 = 568.3 MWh  |

;

.







# **PVsyst - Simulation report**

Grid-Connected System

Project: Lahore MES (MSG)

Variant: New simulation variant No 3D scene defined, no shadings System power: 501 kWp Lahore MES (MSG) - Pakistan



t

# Project: Lahore MES (MSG)

Variant: New simulation variant

#### PVsyst V7.3.1 VC0. Sintulation date: 08/01/24 10:33 with v7.3.1

|  | <b>.</b>              | Project s  | ummary —                                |  |                     |
|--|-----------------------|--|---|--|---------------------|
| Geographical Site<br>Lahore MES (MSG)<br>Pakistan              |                       | <b>Situation</b><br>Latitude<br>Longitude<br>Altitude<br>Time zon <del>a</del> | 31.65 "N<br>74.43 °E<br>210 m<br>UTC−5  | Project settings<br>Albedo                   | 0,20                |
| Meteo data<br>Lahore MES (MSG)<br>Meteonorm 8.1 (2016-2        | 2021), Sat=100% - Sy  | nthetic  |   |  |                     |
|  |                       | System s   | ummary —                                | ·  | <u>.</u> <u></u>    |
| Grid-Connected Sy:<br>Simulation for year no 1                 |                       | No 3D scene defin  | ed, no shadings                         |  |                     |
| PV Field Orientation<br>Fixed plane<br>Tilt/Azimuth            | n<br>26/0°            | <b>Near Shadings</b><br>No Shadirgs  |   | <b>User's needs</b><br>Unlimited load (grid) | )                   |
| System Information<br>PV Array<br>Nb. of modules<br>Pnom total |                       | 864 units<br>561 kWp   | Invertors<br>Nb. of units<br>Pnom tatal |  | 2 unita<br>600 kWac |
|  |                       |  | Phon- retio                             |  | 0.835               |
|  |                       |  | ummary —                                |  | ··                  |
| Produced Energy  | 589756 kWh/yoar       | Specific production  | 1177 kWh/kWp/year                       | Perf. Ratio PR                               | 72.50 %             |
|  |                       | Table of c   | contents                                | ·  |                     |
| Project and results sum  | mary                  |  |   |  | 2                   |
| General parameters, M  | Array Characteristics | s, System losses   |   |  |                     |
| Loss diagram   |                       |  |   | ~~~~~  | β                   |
|  |                       |  |   |  |                     |



:

ł

:

## Project: Lahore MES (MSG)

#### Variant: New simulation variant

#### PVsyst V7.3.1 VC0, Simulation date: 08/01/24 10:33 with v7.3.1

Horizon

Free Horizon

#### **General parameters**

No 3D scene defined, no shadings

**PV Array Characteristics** 

**PV** Field Orientation Orientation Fixed plane Til%AzImuth

**Grid-Connected System** 

28/0 \*

Sheds configuration No 3D scene dofined

Near Shadings No Shadings

Models used Transposition Perez Diffuse Perez, Meteonorm Circumsolar separate

User's needs Unlimited load (grid)

\_\_\_\_\_

.....

| V module  |                                   |                       | Inverter                               |  |                       |
|---|-----------------------------------|-----------------------|--|--|-----------------------|
| lanufacturer  |                                   | CSI Solar             | Manufacturer                           |  | Technologies          |
| lode]   |                                   | 80MB-AG 1500V         | Model                                  |  | 0-330KTL-H2           |
| (Original PVsyst databa   | ase)                              |                       | (Custom paramete                       |  |                       |
| nit Nom. Power  |                                   | 580 Wp                | Unit Nom, Power                        |  | 0 kWac                |
| umber of PV modulas   |                                   | 864 units             | Number of inverters                    |  | 2 unite               |
| ominal (STC)  |                                   | 561 kWp               | Total power                            |  | D kWac                |
| lodulos   | *                                 | x 27 In series        | Operating voltage                      | 500-150                                | DΥ                    |
| t operating cond. (50°C)  | ļ                                 | 1 1                   | Max. power (=>30°C)                    |  | 0 kWac                |
| mpp   |                                   | 460 kWp               | Pnom relia (DC:AC)                     | 8,0                                    | 1                     |
| mpp   |                                   | 823 V                 | Power sharing within I                 | his invertør                           |                       |
| mpp   |                                   | 559 A                 |  |  |                       |
| otal PV power   |                                   |                       | Total inverter pow                     | er .                                   |                       |
| ominal (STC)  |                                   | 501 kWp               | Total power                            |  | 0 kWac                |
| otal  |                                   | 864 modules           | Number of inverters                    |  | 2 unlis               |
| loculo area   |                                   | 2445 n <sup>.</sup> * | Phorn ratio                            | 0.8                                    |                       |
| rray Solling Losses   |                                   | Thermal Loss fa       |  | DC wiring losses                       |                       |
|   |                                   |                       |  |  |                       |
| oss Fracilion   | 4.0 %                             |                       | e according to irradiance              | Global array res.                      | 24 mΩ                 |
|   |                                   | Uc (const)            | 29.0 W/m²K                             | Loss Fraction                          | 1.5 % at ST           |
|   |                                   | Uv (wind)             | 0.0 W/m²K/m/s                          |  |                       |
| erle Diode Loss   |                                   | LID - Light Indu      | ced Degradation                        | Module Quality Loss                    |                       |
| oltage drop   | 0.7 V                             | Loss Fraction         | 2.0 %                                  | Loss Fraction                          | -0.4 %                |
| oss Fraction  | 0.1 % at STC                      |                       |  |  |                       |
| lodule mismatch loss  | es                                | Strings Mismate       | th loss                                | Module average degr                    | adation               |
| ess Fraction  | 2.0 % at MPP                      | Loss Fraction         | 0.1 %                                  | Yéár ng                                | 10                    |
|   |                                   |                       |  | Loss factor                            | 0.4 %/year            |
|   |                                   |                       |  | Mismatch due to degrad                 |                       |
|   |                                   |                       |  | Imp RMS dispersion                     | 0.4 %/year            |
|   |                                   |                       |  |  | -                     |
|   |                                   |                       |  | Vmp RMS disporsion                     | 0.4 %/year            |
|   | r defined profile                 |                       |  | Vmp RMS disporsion                     | 0.4 %/year            |
| cidence effect (IAM): Usa   |                                   |                       | 50° ente                               |  |                       |
| AM loss factor<br>cidence effect (IAM): Use<br>10° 20°<br>0.998 0.998 | r defined profile<br>30°<br>0.995 | <br>                  | 50° <u>60</u> ^<br>1.966 <b>0</b> .970 | Vmp RMS disporsion 70° 80° 0.917 0.763 | 0.4 %/year<br><br>90° |



# Project: Lahore MES (MSG)

#### Variant: Now simulation variant

#### PVsyst V7.3.1 VC0, Simulation date: 08/01/24 10:33 with v7.3.1

|                            |              | System lo:              | sses      | ······································ |
|----------------------------|--------------|-------------------------|-----------|--|
| Unavailability of the      | system       | Auxiliaries loss        |           |  |
| Time fraction              | 3.4 %        | Proportionnal to Power  | 5.0 W/kW  |  |
|                            | 12.4 days.   | 0.0 kW from Power thres | h.        |  |
|                            | 3 periods    | Night aux, cons.        | 500 W     |  |
|                            | ·            | AC wiring k             |           |  |
| Inv. output line up to     | W)/ travata  | / W Hanigh              |           |  |
| invester voltago           |              | 800 Vac tri             |           |  |
| Loss Fraction              |              | 0.10 % at STC           |           |  |
| Inverter: SUN2000-330k     | TI U2        | 0.10 % #1510            |           |  |
| Wire section (2 Inv.)      |              | x 240 mm²               |           |  |
| Average wiros length       | Alta 2 X 3 1 | 20 m                    |           |  |
| werbige wirds iblight:     |              | 20 In                   |           |  |
| MV line up to Injectio     | n            |                         |           |  |
| MV Voltage                 |              | 11 kV                   |           |  |
| Wires                      | Copper 3     | 3 x 95 :mm²             |           |  |
| Length                     |              | 100 m                   |           |  |
| Loss Fraction              |              | 0.01 % at STC           |           |  |
|                            |              | AC losses in tra        | nsformers |  |
| MV transfo                 |              |                         |           |  |
| Medium voltage             |              | 11 kV                   |           |  |
| Transformer from Dates     | heets        |                         |           |  |
| Nominal power              |              | 630 KVA                 |           |  |
| Iron Loss (24/24 Connex    | ion)         | 1.00 KVA                |           |  |
| Iron loss fraction         | •            | 0.16 % of PNom          |           |  |
| Copper loss                |              | 20.00 kVA               |           |  |
| Copper loss fraction       |              | 3.17 % at PNom          |           |  |
| Colls equivalent resistand |              | 12.25 mQ                |           |  |

. . .

÷

÷



#### Project: Lahore MES (MSG)

#### Variant: New simulation variant

PVsyst V7.3.1 VC0, Simulation date: 08/01/24 10:33 with v7.3.1

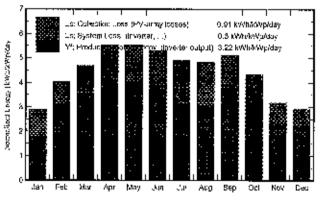
#### Main results

#### System Production

Produced Energy (P50) 589756 kWh/year Produced Energy (P90) 541653 kWh/year Produced Energy (P99) 502448 kWh/year

Specific production (P50) Produced Energy (P90) Produced Energy (P99)

#### Normalized productions (per Installed kWp)



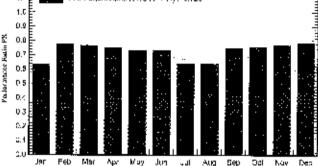
Effective Global, corr. for IAM and shadings

1003 kWh/kWp/year Performance Ratio PR 1.3 1.5 PX: Performance Retio (11/14): 0.726 1.0 0.2

72.60 %

1177 kWh/kWp/yeer Performance Ratio PR

1081 kWh/kWp/year



#### GlobHor DiffHor Globinc T\_Amb GlobEff EArray E\_Grid PR kWh/m² kWh/m² kWh/m² °C kWh/m<sup>z</sup> λWh kWh ratio January 69.6 42.4 11,54 89.6 84.5 37686 28419 0.63346.6 February 91.8 15.88 107.0 113.2 46619 44159 0.77B March 130.8 79.4 21.92 145.3 137.0 58713 65820 **0.767** 87.8 April 160.4 26.96 166.0 156.3 65390 62279 0.748 May 176.0 100.0 33.05 171.4 161.3 66009 62869 0.732 June 168.2 101.7 32.90 158.7 149.9 61304 58365 0.734 160.4 100.6 July 31.45 143.9 152.9 59650 48865 0.638 97.5 August 150.4 30,68 150.0 141.2 58865 47968 0.638 Septembor 141.1 79.3 28.86 153.3 144.5 60336 57400 0.747 Octobor 115.5 72.9 25.81134.3 126.7 53619 50928 0.757 76.7 49.6 November 18.79 95.6 90.1 39211 37010 0.772 68.8 Docember 42.1 13.61 90.6 85.5 37888 35679 0.786 1509.6 Year 900.0 24.33 1620.9 1527.1 645291 589756 0.726 Legends GlobHor Global horizontal irradiation EArray Effective energy at the output of the array Horizontal diffuse irradiation DiffHor E\_Grid Energy injected into grid T\_Amb Ambient Temperature PR Performance Ratio Globinc Global Incident in coll. plane

#### Balances and main results

GlobEff



. . . .

# Project: Lahore MES (MSG)

#### Variant: New simulation variant

- - -

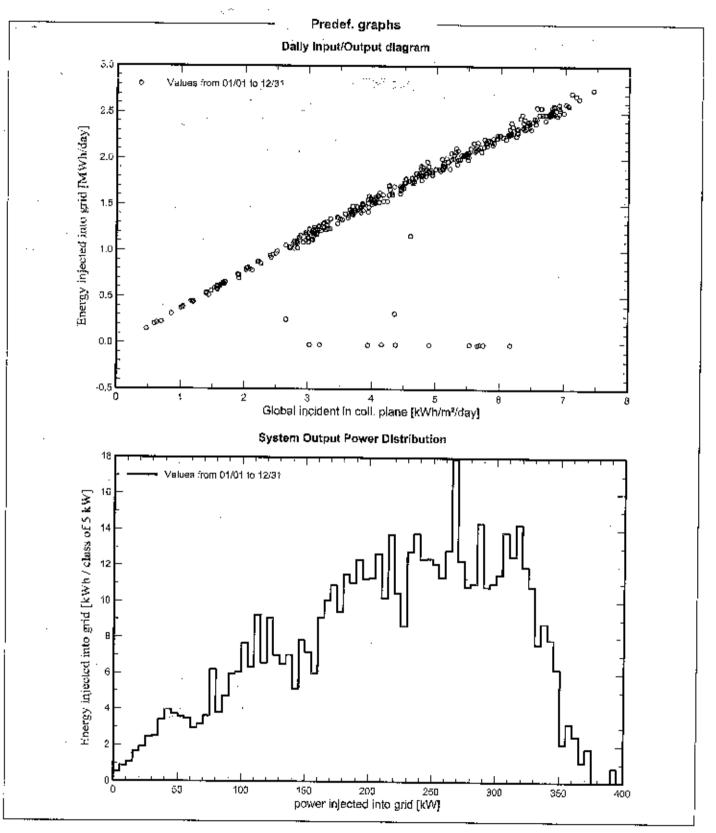
**PVsyst V7.3.1** VC0, Simulation date: 08/01/24 10:33 with v7.3.1

|           |                         |                | _  |
|-----------|-------------------------|----------------|--|
|           | 1510 kWh/m²             | <u>j</u>       | Global horizontal irradiation  |
|           |                         | لام +7.4%<br>ا | Global incident in coll. plane   |
|           |                         | 4-1.86%        | IAM factor on global   |
|           |                         | -4.00%         | Soiling loss factor  |
|           | 1527 kWh/m² * 2445 m    | ° doll.        | Effective irradiation on collectors  |
|           | efficiency at STC = 20. | 58%            | PV conversion  |
| et gevole | ∵ * · · · 768642 kWh    |                | Array nominal energy (at STC effic.)   |
|           |                         | ×3.80%         | Module Dogradation Lose ( for year #10)  |
|           |                         | 9-0.26%        | PV loss due to irradiance level  |
|           |                         | -6.39%         | PV loss due to temperature   |
|           |                         | < +0.43%       | Module quality loss  |
|           |                         | 9-2.00%        | LID - Light induced degradation  |
|           |                         | 9-4.10%        | Mismetch loss, modulos and strings<br>(including 2% for degradation dispension |
|           |                         | -0.97%         | Ohmic wiring loss  |
|           | 645291 kWh              |                | Array virtual enorgy at MPP  |
|           |                         | -1.69%         | Inverter Loss during operation (efficiency)                                    |
|           |                         | H 0.00%        | Inverter Loss over nominal lov, power  |
|           |                         | 40.00%         | Inverter Loss due to max, input current  |
|           |                         | 4 0.00%        | Invertor Loss over nominal Inv. voltage  |
|           |                         | 4 0.00%        | Inverter Loss due to power threshold   |
|           |                         | 9 0.00%        | Inverter Loss due to voltage threshold   |
|           |                         | 9-0.01%        | Night consumption  |
|           | 634331 kWh              |                | Available Energy at Inverter Output  |
|           |                         | 9-0.84%        | Auxillaries (fans, other)  |
|           |                         | 7-0.04%        | AC ohmic loss  |
|           |                         | 9-2.46%        | Medium voltage transfo loss  |
|           |                         | 10.00%         | MV fine of mic loss  |
|           |                         | 3.83%          | System unavailability  |
|           | 589756 kWh              |                | Energy injected into grid  |



# Project: Lahore MES (MSG)

#### Variant: New simulation variant





# Project: Lahore MES (MSG)

Variant: New simulation variant

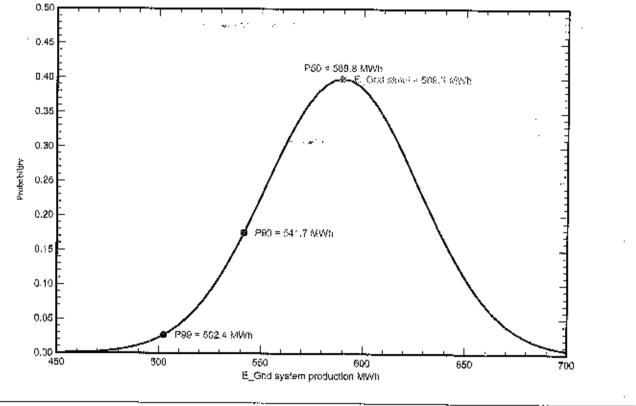
# PVsyst V7.3.1 VC0, Simulation date: 08/01/24 10:33 with v7.3.1

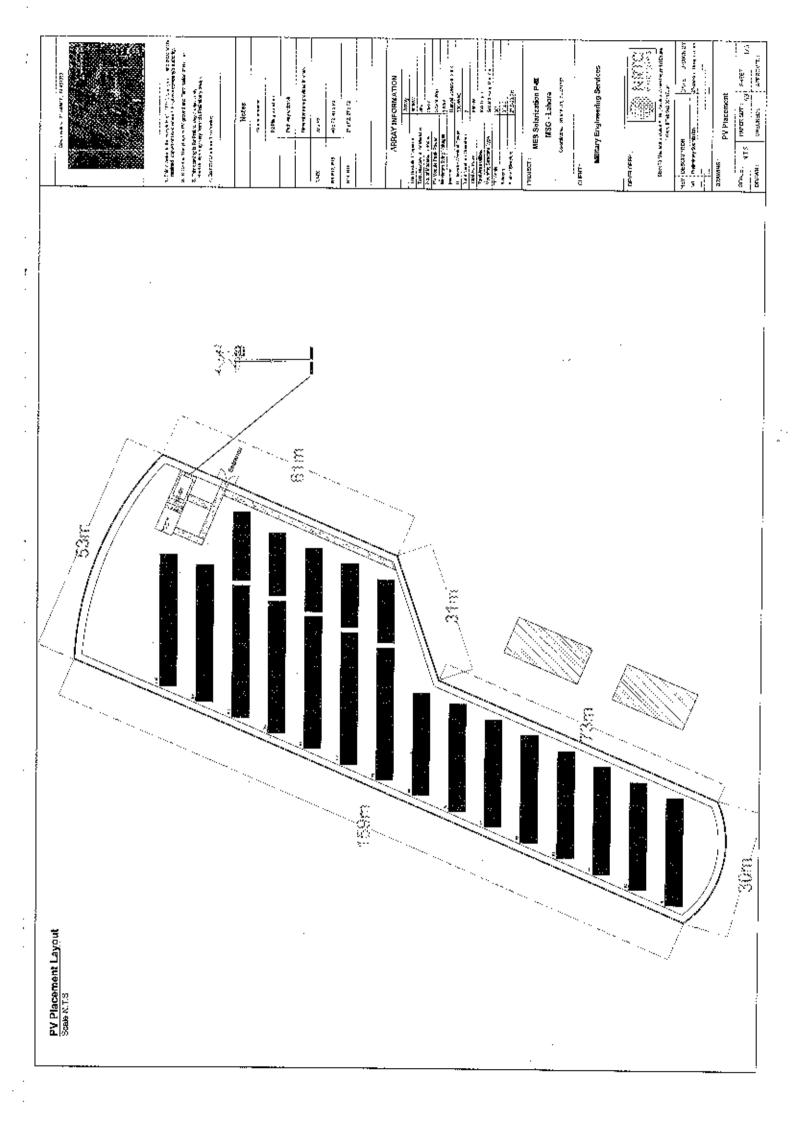
| a<br>Meleonorm 8,1 (2016-2021), -<br>Monthly |  |
|--|--|
|  |  |
| Monthly                                      |  |
|  | naveraĝes  |
| Aulti-year average                           |  |
| variability(Variance)                        | 6,1 %  |
| eviation                                     |  |
| កដូច   | 0.0 %  |
| lability (motor + suctors)                   | -  |
|  | 6.4 %  |
|  | r varlability(Variance)<br>eviation<br>nge<br>flability (meteo + system)<br>Quadratic sum) |

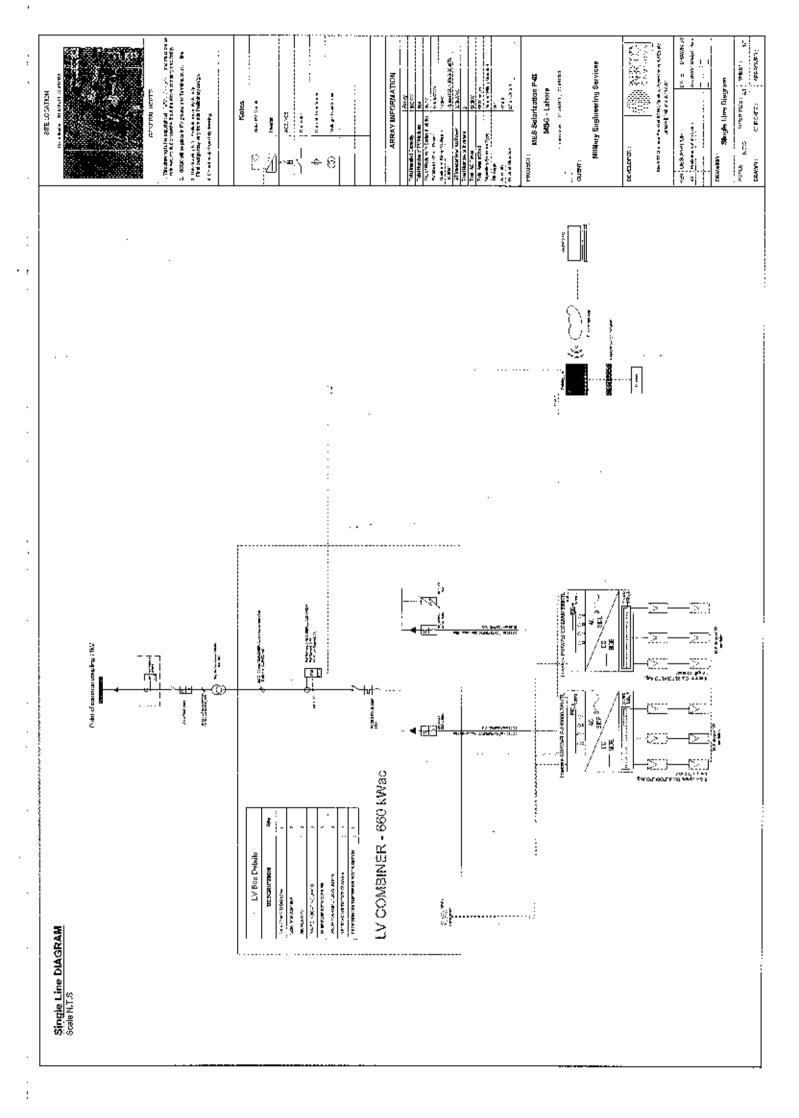
#### P50 - P90 evaluation

----

|              | Simulation and parameters uncer              | tainties  |
|--------------|--|-----------|
|              | PV module modelling/parameters               | 1.0 %     |
|              | Inverter efficiency uncortainty              | 0.5 %     |
|              | Soiling and mismatch uncertainties           | 1.0 %     |
|              | Degradation uncertainty                      | 1.0 %     |
|              | · · · · · · · · · · · · · · · · · · ·        |           |
|              | Annual production probability                |           |
|              | Veriability                                  | 37.5 MWh  |
|              | P50  | 589.8 MWh |
|              | P%0  | 541.7 MWh |
|              | ₽98  | 502.4 MWh |
| Probabi      | lity distribution                            |           |
| <u>;</u> ··· | <u>.                                    </u> | ···· 1    |









# **PVsyst - Simulation report**

Grid-Connected System

Project: Lahore Mes (CMH) Variant: New simulation variant No 3D scene defined, no shadings System power: 1001 kWp Lahore MES (CMH) - Pakistan



i

ı

.

# Project: Lahore Mes (CMH)

Variant: New simulation variant

....

#### PVsyst V7.3.1 VC0, Simulation date: 08/01/24 10:37 with v7.3.1

|   |                                       | Project s                                      | summary ——                    |   |             |
|---|---------------------------------------|--|-------------------------------|---|-------------|
| Geographical Site<br>Lahore MES (CMH)<br>Pakiatan |                                       | Situation<br>Latitude<br>Longitude<br>Attitude | 31.54 "N<br>74.37 °E<br>210 m | Project settings<br>Albedo              | 0.20        |
|   |                                       | Time zone                                      | UTC+5                         |   |             |
| <b>Meteo data</b><br>Lahore MES (CMH)             |                                       |  | •                             |   |             |
| Mateonorm 8.1 (1996-2                             | 015), Sat=100% - Syr                  |  |                               |   |             |
|   | · · · · · · · · · · · · · · · · · · · |  | summary                       |   |             |
| Grid-Connected Sys<br>Simulation for year no f    |                                       | No 3D sceno defir                              | -                             |   |             |
| PV Field Orientation                              | 1                                     | Near Shadings                                  |                               | User's needs                            |             |
| Fixed plane                                       |                                       | No Shadings                                    |                               | Unlimited load (grld                    | )           |
| TH/Azimuth  | 28/0^                                 |  | · · · ·                       |   |             |
| System information                                |                                       |  |                               |   |             |
| PV Array  |                                       |  | Invertors                     |   |             |
| Nb. of modules                                    |                                       | 1726 units                                     | Nb. of units                  |   | 3 units     |
| Pnom total  |                                       | 1001 kWp                                       | Pnom total                    |   | 900 kWac    |
|   |                                       |  | Pnom ratio                    |   | 1.112       |
| <b>_ u</b>  | - r                                   | Results a                                      | ummary                        |   |             |
| Produced Energy                                   | 1201970 kWh/year                      | Specific production                            | -                             | Perf. Ratio PR                          | 73.94 %     |
|   | ······                                | Table of e                                     | contents                      |   | · · · · · · |
| Project and results sum                           | marv                                  |  |                               |   |             |
| General parameters. PV                            | Arrey Characteristics                 | . System losses                                |                               | ~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~ | 2           |
| Main results                                      |                                       |  |                               |   | 3           |
| _oss diagram                                      |                                       |  |                               |   | b           |
| Predef. graphs                                    |                                       |  |                               |   | b           |
|   |                                       |  |                               |   | /           |



PVsyst V7.3.1 VC0. Simulation date: 08/01/24 10:37 with v7.3.1

# Project: Lahore Mes (CMH)

Variant: New simulation variant

\_...

|                             | General                   | parameters —             |                       |                |
|-----------------------------|---------------------------|--------------------------|-----------------------|----------------|
| Grid-Connected System       | No 3D scene de            | fined, no shadings       |                       |                |
| PV Field Orlentation        |                           |                          |                       |                |
| Örientation                 | Sheds configurati         | lon                      | beau aleboM           |                |
| Fixed plane                 | No 3D scene defin         | ed                       | Transposition         | Perez          |
| Tlit/Azimuth 26 / 0         | •                         |                          |                       | eleonom        |
|                             |                           |                          | Circumsolar           | separate       |
| Horizon                     | Near Shadings             |                          | User's needs          |                |
| Free Horizon                | No Shadings               |                          | Unlimited load (grld) |                |
|                             | PV Arcay C                | haracteristics –         |                       |                |
| PV module                   | T Y Anay C                |                          |                       |                |
| Manufacturer                | CSI Solar                 | Inverter<br>Manufasturer |                       | 177            |
| Modol                       |                           | Manufacturer             |                       | l Technologies |
|                             | CS7L-580MB-AG 1500V       | Model                    |                       | 00-330KTL-H2   |
| (Original PVsyst database)  | ED0 145-                  | (Custom paramete         |                       |                |
| Unit Nom, Power             | 580 Wp                    | Unit Nom, Power          | 3                     | l00 kWac       |
| Number of PV modules        | 1726 units                | Number of Inverters      |                       | 8 units        |
| Nominal (STC)               | . 1001 kWp                | Total power              | 0                     | 60 kWec        |
| Array #1 - PV Array         |                           |                          |                       |                |
| Number of PV modules        | 868 units                 | Number of Invertors      | 8 * MPPT 17%          | 6.3 ont        |
| Nominal (STC)               | 503 kWp                   | Total power              | 4                     | 00 kWaç        |
| Modules                     | 31 Strings x 28 In series |                          |                       |                |
| At operating cond. (50°C)   |                           | Operating voltage        | 500- <b>1</b> 5       | 00 V           |
| Pmpp                        | 463 kWp                   | Max. power (≏>30°C)      | 3                     | 30 kWac        |
| И трр                       | 854 V                     | Рлот ratio (DC:AC)       | 1.                    | 26             |
| Impp                        | 542 A                     | No Power sharing betw    | veen MPPTs            |                |
| Array #2 - Sub-array #2     |                           |                          |                       |                |
| Number of PV modules        | 858 units                 | Number of Invertera      | 10 * MPPT 17% 1       | .7 units       |
| Nominal (STC)               | 498 kWp                   | Total power              | 5                     | 00 kWac        |
| Modulea                     | 33 Strings x 26 In series |                          |                       |                |
| At operating cond. (50°C)   |                           | Operating voltage        | 500-15                | 00 V           |
| Իպեհ                        | 457 kWp                   | Max. power (=>30°C)      | 3                     | 30 ƙWao        |
| И трр                       | 793 V                     | Pnom ratio (DC:AC)       | 1.                    | aa             |
| գգո լ                       | 577 A                     | No Power sharing betw    |                       |                |
| Total PV power              |                           | Total Inverter powe      | ŧ٢                    |                |
| Nominal (STC)               | 1001 kWp                  | Total power              |                       | 00 kWac        |
| Total                       | 1726 modules              | Number of Invertere      |                       | 3 units        |
| Module area                 | 4885 m²                   | Phoin ratio              | 1.1                   | 11             |
|                             |                           | No Power shering         |                       |                |
|                             | Array                     | losses                   | ·····                 |                |
| Array Solling Losses        | Thermai Loss fa           |                          | Serie Diode Loss      |                |
| Loss Fraction 4.0           |                           | according to irradiance  | Voltage drop          | 0.7 V          |
|                             | Uc (const)                | 29.0 W/m²K               | Loss Fraction         | 0.1 % at STC   |
|                             | Uv (wind)                 | 0.0 W/m²K/m/s            |                       |                |
| LID - Light Induced Degrada | tion Module Quality L     | .055                     | Module mismatch io    | 5585           |
| Loss Fraction 2.0           |                           | -0.4 %                   | Loss Fraction         | 2.0 % at MPP   |

|  |                     | Project  | Lahore Mes (                           |                  |           |  |
|--|---------------------|--|--|------------------|-----------|--|
|  |                     |  |  | · ·              |           |  |
|  |                     | Variant:                                       | New simulation                         | varlant          |           |  |
| <b>PVsyst V7.3.1</b><br>VC0, Simulation date:<br>68/01/24 10:37<br>with v7.3.1 |                     |  |  |                  |           |  |
|  |                     |  | Array losses                           |                  |           |  |
| Strings Mismatch loss  | 0.1 %               | Module av<br>Yearno                            | rage degradatio<br>10                  |                  |           |  |
|  |                     | Loss factor                                    |  | %/year           |           |  |
|  |                     | <b>Mis</b> match g<br>Imp RMS dis<br>Vmp RMS d | e <b>to dogradation</b><br>Deraion 0.4 | %/year<br>%/year | ·         |  |
| I <b>AM loss factor</b><br>Incidence effect (IAM): Use                         | r defined profile   |  |  |                  |           |  |
| 10" 20"  | <br>                |  | · ·                                    |                  |           |  |
| i  | · ·                 | 40° .  | 50°                                    | 60°              |           | 80° 80″                                |
| !0.998  0.998  | 0.995               | 0.992  | . 0.986                                | <u>0.976</u>     | ··· 0.947 | 0.763 0,000                            |
| <u></u>  |                     |  |  |                  |           |  |
|  |                     | D(   | wiring losses                          |                  |           |  |
| Global wiring resistance   | 10 mΩ               | -  | ming losses                            |                  |           |  |
| Loss Fraction  | 1.5 % at STC        |  |  |                  |           |  |
| Array #1 - PV Array  |                     |  | Array #                                | #2 - Sub-ar      | тау #2    |  |
| Global array res.  |                     | 26 mΩ  |  | may res,         | 2         | 23 mQ                                  |
| Loss Fraction  |                     | 1.5 % at STC                                   | Loss Fra                               | action           |           | 1.5 % et STC                           |
| ···  |                     | _  | -·                                     | ·                | ·         | ··                                     |
|  |                     |  | stem losses                            |                  |           |  |
| Unavailability of the sy<br>Time fraction                                      |                     | Auxiliarles                                    |  |                  |           |  |
| Time traction  | 3.4 %<br>12.4 days, | Proportionna                                   |  | WAW              |           |  |
|  | 3 periods           | 0.0 kW from<br>Night aux. co                   |  | 50               |           |  |
|  |                     | Hight dax. ed                                  | a. 500                                 |                  |           |  |
|  |                     | A0   | wiring losses                          |                  |           |  |
| Inv. output line up to M   | V transfo           |  | 3                                      |                  |           |  |
| Invertor voltage   | i dansio            | 800 Vac tri                                    |  |                  |           |  |
| Loss Fraction  |                     | 0.08 % at STC                                  |  |                  |           |  |
| Inverter: SUN2000-330KTI   | L-H2                |  | Inverter                               | : SUN2000-3      | 330KTL-H2 |  |
| Wire section (1 lav.)  | Alu 1 x 3 x         | 240 mm²  |  | tion (2 Inv.)    |           | lu 2 x 3 x 150 mm²                     |
| Wires length   |                     | 20 m   | Average                                | witee length     |           | Dm                                     |
| MV line up to Injection  |                     |  |  |                  |           |  |
| MV Voltage   |                     | 11 kV  |  |                  |           |  |
| Wires  | . Alu 3 x           | 120 mm²  |  |                  |           |  |
| Length   |                     | 100 m  |  |                  |           |  |
| Loss Fraction  |                     | 0.02 % at STC                                  |  |                  |           |  |
|  |                     |  | n                                      |                  |           | · ·                                    |
|  |                     | AC loss  | es in transform                        | ers              |           | ······································ |
| MV transfo   |                     |  |  |                  |           |  |
| Medium voltage   |                     | 11 kV  |  |                  |           |  |
| Transformer from Datashe   |                     |  |  |                  |           |  |
| Nominal power  |                     | 250 kVA  |  |                  |           |  |
| Iron Loss (24/24 Connexion   |                     | 1.00 kVA                                       |  |                  |           |  |
| fron loss fraction   |                     | 0.08 % of PNcm                                 |  |                  |           |  |
| Copper loss  |                     | 0.00 kVA                                       |  |                  |           |  |
| Copper loss fraction<br>Coils equivalent resistence                            |                     | 1.60 % at PNom<br>8.19 mΩ                      |  |                  |           |  |
|  |                     |  |  |                  |           |  |

ł

.

.

:

: .



#### Variant: New simulation variant

PVsyst V7.3.1 VC0, Simulation date: 08/01/24 10:97 with v7.3.1

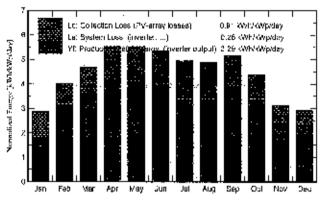
#### Main results

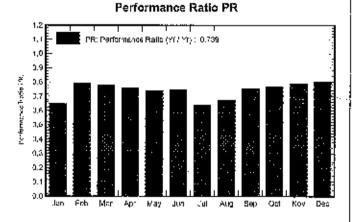
#### System Production

Produced Energy (P50) 1201970 kWh/yeer Produced Energy (P90) 1103932 kWh/yeer Produced Energy (P99) 1024030 kWh/yeer Specific production (P50) Produced Energy (P90) Produced Energy (P99)

1201 kWh/kWp/year Performance Ratio PR 73.94 % 1103 kWh/kWp/year 1023 kWh/kWp/year

#### Normalized productions (per installed kWp)





#### Balances and main results

|           | GlobHor                         | DiffHor       | T_Amb | Globine    | GlobEff             | EArray              | PR    |
|-----------|---------------------------------|---------------|-------|------------|---------------------|---------------------|-------|
|           |                                 | kWh/m²        | °C    | kWh/m²     | kWh/m²              | kWh                 | ratio |
| January   | 69.8                            | 43.B          | 11.97 | 89.2       | 84.1                | 75051               | 0.648 |
| February  | 91.5                            | 47.0          | 16.DB | 112.8      | 106.6               | 93022               | 0.793 |
| March     | \$30.8                          | 77.5          | 22.10 | 145.7      | 137.2               | 117704              | 0.779 |
| April     | 160.2                           | 87.6          | 27.05 | 165.9      | 156.2               | 130724              | 0.760 |
| Мөу       | 176.0                           | 99.4          | 33.10 | 171.5      | 161.5               | 132088              | 0.742 |
| June      | 169.5                           | 102.6         | 33.05 | 160.2      | 150.7               | f24093              | 0,747 |
| July      | 160.6                           | 102,3         | 31.57 | 153.2      | 144.1               | 119855              | 0.641 |
| August    | 151.4                           | 95.3          | 30.78 | 151.6      | 142.7               | 118810              | 0.675 |
| September | 141.5                           | 71.5          | 29.07 | 154.5      | 145.6               | 121017              | 0.755 |
| October   | 115,7                           | 69.5          | 26.00 | 135.2      | 127.6               | 107744              | 0.768 |
| November  | 76,5                            | 52.0          | 19.07 | 93.4       | 88.0                | 78644               | 0.788 |
| December  | 68,5                            | 41.8          | 13.92 | 90.7       | 85.6                | 75726               | 0.801 |
| Year      | 1511. <del>9</del>              | 890.5         | 24.52 | 1623.8     | 1529.9              | 1292479             | 0.739 |
| Legends   |                                 |               |       |            |                     |                     |       |
| GlobHor   | Global horizontal irradiation   |               |       | EArray Eff | ective energy at th | e output of the arm | ay    |
| DiffHor   | Horizontal diffuse irradiation  |               |       | PR Pe      | dormance Ratio      | -                   | -     |
| T_Amb     | Ambient Temperature             |               |       |            |                     |                     |       |
| Globino   | Global incident in coll, plane  |               |       |            |                     |                     |       |
| GlobEff   | Effective Global, corr. for IAN | and shadlings |       |            |                     |                     |       |

ï



Variant: New simulation variant

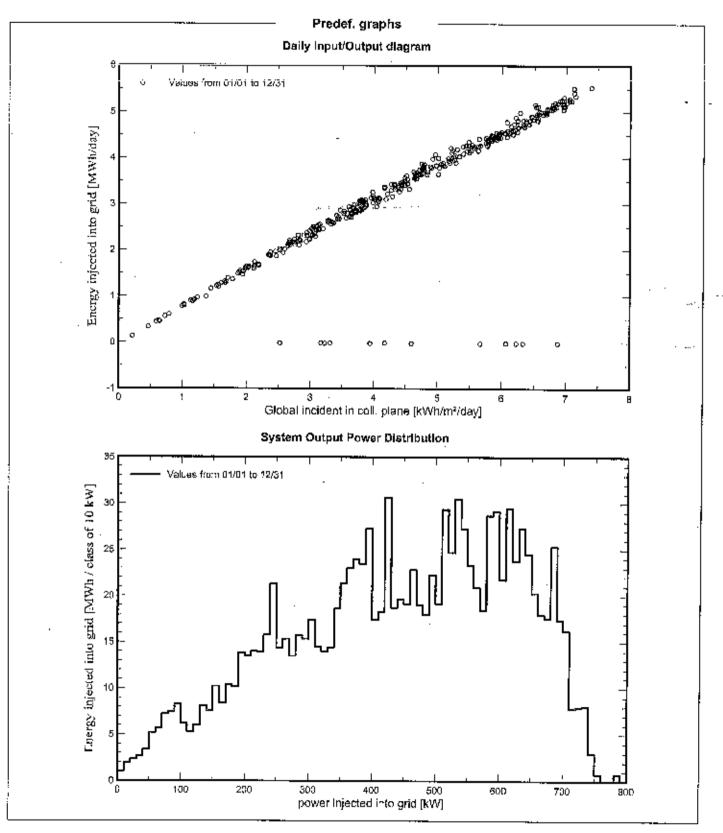
PVsyst V7.3.1 VC0, Simulation date; 08/01/24 10:37 with v7.3.1

> Loss diagram 1512 kWh/m\* **Global horizontal imadiation** +7.4% Global incident in coll. plane ⇒-1.86% IAM factor on global 4.00% Soiling loss factor 1530 kWh/m² \* 4885 m² coll. Effective irradiation on collectors efficiency at STC = 20.58% PV conversion 1538279 kWh Array nominal energy (at STC effic.) <u> - -</u> -3.80% Module Degradation Loss ( for year #10) -0.27% PV loss due to irradiance level -6.53% PV loss due to temperature { +0.43% Module quality loss -2.00% LID - Light induced degradation -3.91% Mismatch loss, modules and strings (including 1.8% for degradation dispersion 9-0.93% Ohmic wiring loss 1292479 kWh Array virtual energy at MPP 9-1.66% Inverter Loss during operation (efficiency) 90.00% Inverter Loss over nominal inv, power ₩0.00% Inverter Loss due to max, input current 90.00% Inverter Loss over nominal inv. voltage ን -0.01% Inverter Loss due to power threshold 90.00% Inverter Loss due to voltage threshold N-0.01% Night consumption 1270876 kWh Available Energy at Invertor Output 9-0.66% Auxiliarles (fans, other) 4-0.03% AC ohmic loss -1.24% Medium voltage transfolioss +-0.01% MV line ohmid Joes \$-3.55% System unavailability 1201970 kWh Energy injected into grid



Variant: New simulation variant

PVsyst V7.3.1 VC0, Simulation date: 08/01/24 10:37 with v7.3.1





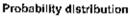
#### Variant: New simulation variant

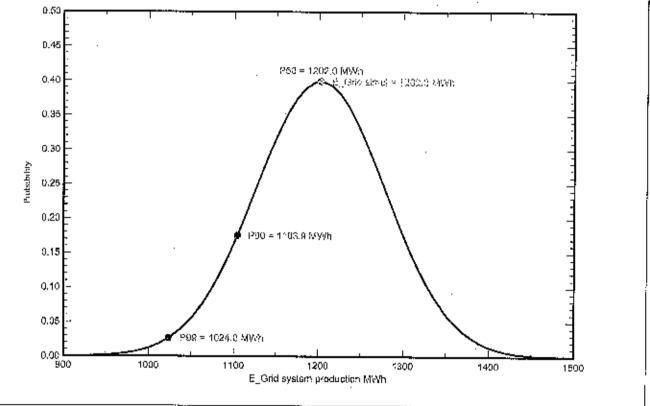
**PVsyst V7.3.1** VC0, Simulation date: 08/01/24 10:37 with v7.3.1

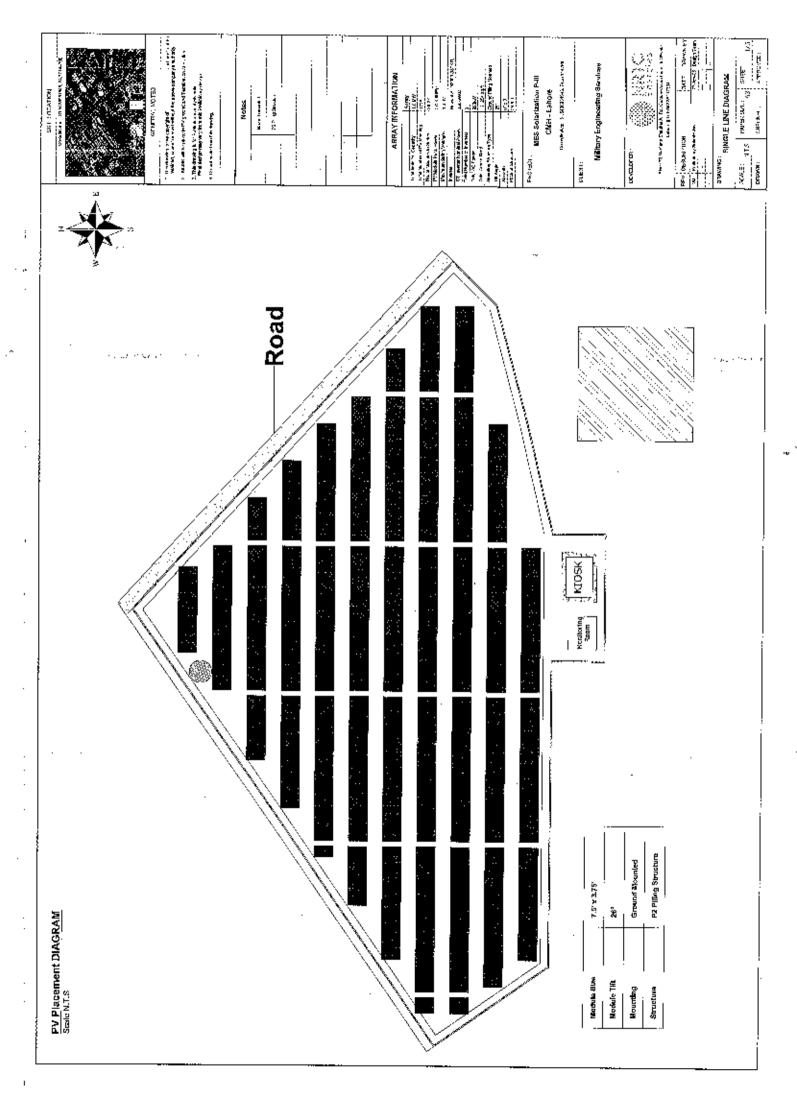
#### P50 - P90 evaluation

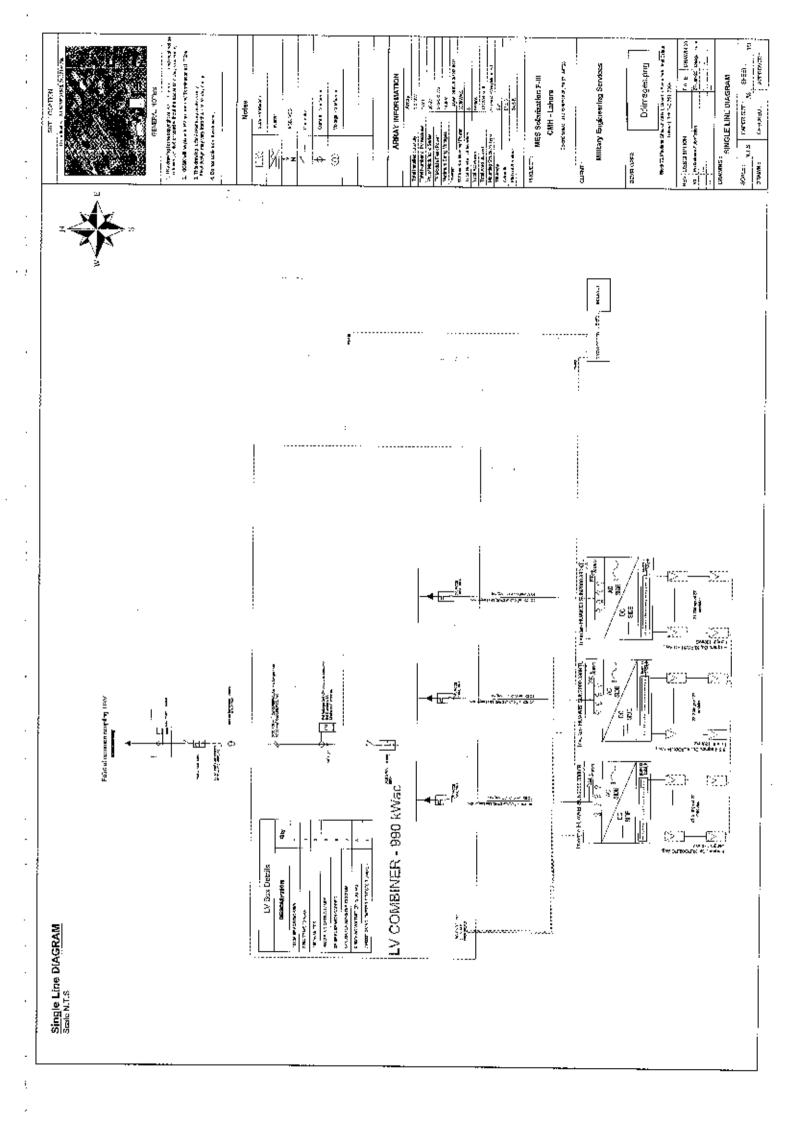
| Source Meteor        | onn 8.1 (1996-2015), | Saf∺100%   |
|----------------------|----------------------|------------|
| Kind                 | Monthly              | v averages |
| Synthetic - Multi-ye | er everage           |            |
| Year-to-year variab  | ility(Variance)      | B.1 %      |
| Specified Deviatio   | n                    |            |
| Climate change       |                      | 0.0 %      |
|                      | v (meteo + system    |            |
| Variability (Quadrat | • • •                | "<br>6.4 % |

| Simulation and parameters unce                             | rtaintles              |
|--|------------------------|
| PV module modelling/paramotern                             | 1.0 %                  |
| Inverter efficiency uncertainty                            | 0.5 %                  |
| Soiling and mismatch uncertainties                         | · 1.0 %                |
| Degredation uncertainty                                    | . 1.0 %                |
|  |                        |
|  |                        |
| · · ·  |                        |
| · · ·  | 76.5 MWh               |
| <b>Annual production probability</b><br>Variability<br>P60 | 76.5 MWh<br>1202.0 MWh |
| Variability  |                        |













6-19-

# **PVsyst - Simulation report**

Grid-Connected System

Project: Lahore MES (Akram Line)

Variant: New simulation variant No 3D scene defined, no shadings System power: 501 kWp Lahore Mes (Akram Line) - Pakistan

Author



. ...

:

:

ļ

# Project: Lahore MES (Akram Line)

Variant: New simulation variant

#### **PVsyst V7.3.1** VC0, Simulation date: 08/01/24 10:40 with v7.3.1

|  |                       |                 | Project su  | ummary —        |                      |          |              |
|--|-----------------------|-----------------|-------------|-----------------|----------------------|----------|--------------|
| Geographical Site                              |                       | Situatio        | n           |                 | Project settings     |          |              |
| Lahore Mes (Akram Li                           | ne)                   | a butite. I     |             | 31.53 FN        | Albedo               | 0.20     |              |
| Pakistan                                       |                       | Longitude       | )           | 74.38 °E        |                      |          |              |
|  |                       | Altitude        |             | 217 m           |                      |          |              |
|  |                       | Time zon        | э           | UTC+5           |                      |          |              |
| <b>Meteo data</b><br>Lahore Mes (Akram Lini    | 0)                    |                 |             |                 |                      |          |              |
| Meteonorm 8.1 (1996-2)                         | 015), Sal=100% - Syr  | nthetic         |             |                 |                      |          |              |
| ·  |                       |                 | System si   |                 |                      |          |              |
| <b></b>  |                       |                 | F           | -               | ·                    |          |              |
| Grid-Connected Sys<br>Simulation for year no 1 |                       | No 3D s         | cene define | ed, no shadings | ·                    | ·        |              |
| <b>PV Field Orlentation</b>                    | 1                     | Near Sh         | adings      |                 | User's needs         |          |              |
| Fixed plane                                    |                       | No Shadii       | าฏร -       |                 | Unlimited foad (grid | )        |              |
| Till/Azimuth                                   | 28/0°                 |                 |             |                 |                      |          |              |
| System Information                             |                       |                 |             |                 |                      |          |              |
| PV Array                                       |                       |                 |             | Invorters       |                      |          |              |
| Nb. of modules                                 |                       | 864 units       |             | Nb. of units    |                      | 2 unite  |              |
| Pnom total                                     |                       | 501 kWp         |             | Priom total     |                      | 600 kWaq |              |
|  |                       | · ·             |             | Prom ratio      |                      | 0.835    |              |
|  | "- <b>`- ±</b>        |                 | Results su  | ummary          |                      |          | <del>.</del> |
| Produced Energy                                | 595529 kWh/yeer       |                 | roduction   | -               | Perf. Ratio PR       | 72.86 %  |              |
|  |                       |                 | Table of c  | ontents         |                      |          |              |
| Project and results sum                        | mary                  |                 |             |                 |                      |          | 2            |
| General parameters, PV                         | Array Characteristics | s, System lossa | s           | ·······         |                      |          | 2<br>9       |
| Main results                                   | ,                     |                 |             | ·····           | ~~~~                 |          | 5            |
| Loss diagram                                   |                       |                 |             | ······          |                      |          | 6            |
| Predef. graphs                                 |                       |                 |             |                 |                      |          | 7            |
| P50 - P98 evaluation                           |                       |                 |             | ······          | ~                    |          | é.           |
| -  |                       |                 |             |                 |                      |          |              |



Variant: New simulation variant

PVsyst V7.3.1 VC0. Simulation date: 08/01/24 10:40 with v7.3.1

**Grid-Connected System** 

26/0 \*

**PV Field Orientation** 

# General parameters Second defined, no shadings

No 3D scene defined

Near Shadings No Shadings

# Models used Transposition Parez Diffuse Parez, Mateonorm Circumsolar separate

User's neods Unlimited load (grid)

Horizon Free Horizon

Orientation

Fixed plane

Tllt/Azlmuth

:

| PV module                  |                           | Inverter                           |                     |
|----------------------------|---------------------------|------------------------------------|---------------------|
| Manufacturer               | CSI Solar                 | Manufacturer                       | Huawei Technologies |
| Model                      | CS7L-580MB-AG 1500V       | Madel                              | SUN2000-330KTL-62   |
| (Original PVsyst detabase) |                           | (Custom parameters definition      | n)                  |
| Unit Nom, Pawer            | 580 Wp                    | Unit Norn, Power                   | 300 kWac            |
| Number of PV modules       | 864 unite                 | Number of inverters                | 2 units             |
| Nominal (STC)              | 501 kWp                   | Tatai power                        | 600 kWao            |
| Modules                    | 27.Strings x 32 in series | Operating voltage                  | 500-1500 V          |
| At operating cond. (50°C)  |                           | Max. power (=>30°C)                | 330 kWac            |
| Pmpp                       | 480 kWp                   | Phom ratio (DC:AC)                 | 0.84                |
| U impp                     | 978 V                     | Power sharing within this laverter |                     |
| f mpp                      | 472 A                     | -                                  |                     |
| Total PV power             |                           | Total inverter power               |                     |
| Nominal (STC)              | 501 kWp                   | Total power                        | 600 kWad            |
| Total                      | 864 modules               | Number of inverters                | 2 unita             |
| Module erea                | 2445 m²                   | Phom ratio                         | 0.84                |

| Array 8 | osses |
|---------|-------|
|---------|-------|

| <b>Array Soiling Losses</b><br>osa Fraction             | 4.0 %                 | Thermal Loss fact<br>Module temperature e<br>Uc (const)<br>Uv (wind) | or<br>icco/ding to irradiance<br>29.0 W/m²K<br>0.0 W/m²K/m/s | DC wiring losses<br>Global array res.<br>Loss Fraction | 34 mΩ<br>1.5 % at STC     |
|---|-----------------------|--|--|--|---------------------------|
| <b>ierie Diode Lass</b><br>fallage drop<br>oss Fractian | 0.7 V<br>0.1 % at STC | LID - Light Induced<br>Loss Fraction                                 | d Degradation<br>2.0 %                                       | Module Quality Loss                                    | -0.4 %                    |
| lodule mismatch los                                     |                       | Strings Mismatch   | loss   | Module average degr                                    | adation                   |
| loss Fraction   | 2.0 % at MPP          | Loss Fraction  | 0.1 %  | Year no  | 10                        |
|   |                       |  |  | Loss factor  | 0.4 %/year                |
|   |                       |  |  | Mismatch due to degrad                                 | lation                    |
| -   |                       |  |  | tmp RMS dispersion                                     | 0.4 %/year                |
|   |                       |  |  | Vmp RMS dispersion                                     | 0.4 %/year                |
| AM loss factor<br>Icidence e″ect (JAM): Us<br>10° 20°   | er defined profile    | <u></u> .<br>40° 50  | • <del>- <u>60</u>~.</del>                                   | . <u></u>  |                           |
| 0.998 0.998   |                       | 0.992 0.98   |  |  | 1 90°                     |
|   |                       |  | 36 D,970   | 0.917 0.763  | <ul> <li>0.000</li> </ul> |



i

: i

.

# Project: Lahore MES (Akram Line)

#### Variant: New simulation variant

.

-- .\_\_

#### PVsyst V7.3.1 VC0. Simulation dete: 08/01/24 10:40 with v7.3.1

|                             |           | System los               | 58S      |  |
|-----------------------------|-----------|--------------------------|----------|--|
| Unavailability of the sys   | stem      | Auxillarles loss         |          |  |
| Time fraction               | 3.4 %     | Proportionnal to Power   | 5.0 W/RW |  |
|                             | 12.4 days | 3.6 kW from Power threet |          |  |
|                             | 3 periods | Night aux. cons.         | 500 W    |  |
|                             |           | AC wiring lo             |          |  |
| Inv. output line up to M    | V transfo |                          |          |  |
| Invertor voltage            |           | 800 Vac tri              |          |  |
| Loss Fraction               |           | 0.10 % at STC            |          |  |
| Inverter: SUN2000-330KTL    | -H2       |                          |          |  |
| Wire section (2 Inv.)       | Alu 2 x 3 | x 240 mm²                |          |  |
| Average wires length        |           | 20 m                     |          |  |
| MV line up to injection     |           |                          |          |  |
| MV Voltage                  |           | 11 kV                    |          |  |
| Wiros                       | Alu (     | 4 x 95 mm²               |          |  |
| Longth                      |           | 100 m                    |          |  |
| Loss Fraction               |           | 0.01 % at STC            |          |  |
|                             |           | AC losses in tran        | sformers |  |
| MV transfo                  |           |                          |          |  |
| Medium voltage              |           | 11 kV                    |          |  |
| Transformer from Datashe    | ets       |                          |          |  |
| Nominal power               |           | 630 kVA                  |          |  |
| Iron Loss (24/24 Connexion  | ) .       | 1.00 kVA                 | · ·      |  |
| iron loss fraction          | -         | 0.16 % of PNom           |          |  |
| Copper loss                 |           | 20.00 KVA                |          |  |
| Copper loss fraction        |           | 3.17 % at PNom           |          |  |
| Colls equivalent resistance | 3 x 3     | 32.25 mΩ                 |          |  |

.

·-.



i

;

:

## Project: Lahore MES (Akram Line)

#### Variant: New simulation variant

#### PVsyst V7.3.1 VC0, Simulation date: 08/01/24 10:40 with v7.3.1

#### Main results

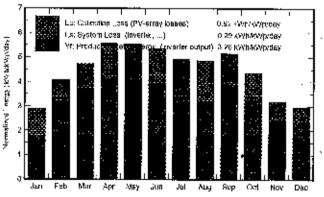
#### System Production

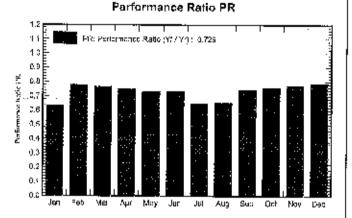
Produced Energy (P50) 595529 kWh/yeer Produced Energy (P90) 546955 kWh/year Produced Energy (P99) 507367 kWh/year

Produced Energy (P90) Produced Energy (P99)

Specific production (P50) 1188 kWh/kWp/year Porformance Ratio PR 72.86 % 1091 kWh/kWp/year 1012 kWh/kWp/year

#### Normalized productions (per installed kWp)





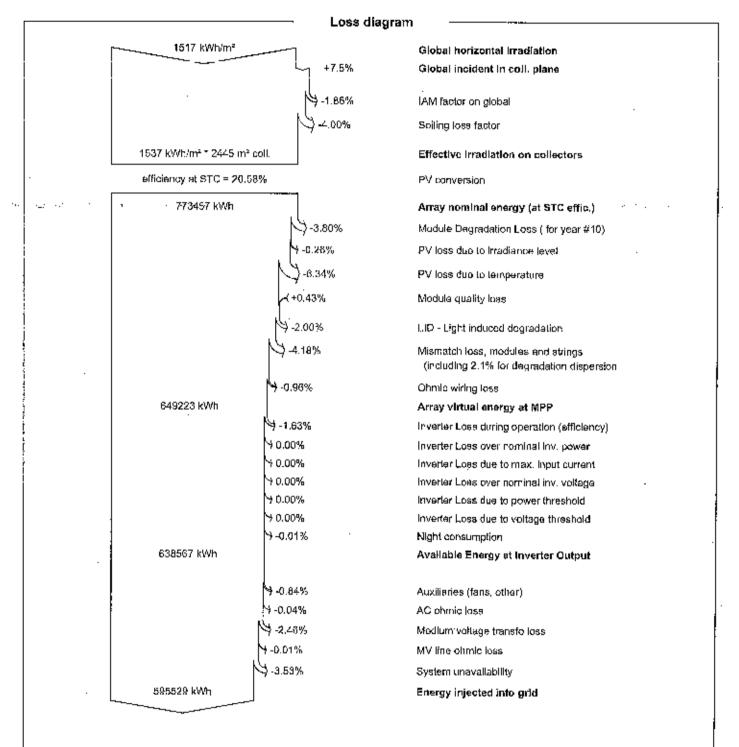
#### Balances and main results

|           | GlobHor                    | DiffHor        | T_Amb | Globinc | GlobEff     | EArray           | E_Grid            | PR    |
|-----------|----------------------------|----------------|-------|---------|-------------|------------------|-------------------|-------|
|           | kWin/m²                    | kWh/m²         | °C    | kWh/m²  | kWh/m²      | kWh              | , kWh ,           | ≠atio |
| January   | 69.8                       | 43.8           | 11.37 | 89.2    | 84.1        | 37528            | 28371             | 0.635 |
| February  | 92.5                       | 46.5           | 15.69 | 114.4   | 108.1       | 47087            | 44653             | 0.779 |
| March     | 131.6                      | 77.3           | 21.71 | 146.B   | 138.3       | 59241            | 56368             | 0.766 |
| April     | 161.0                      | B7.2           | 26.85 | †66,B   | 157.1       | 65640            | 62526             | 6.748 |
| May       | 176.7                      | 99.C           | 32.94 | 172.2   | 162.2       | 66243            | 63090             | 0.731 |
| June      | 169.5                      | 105,7          | 32.79 | 160.3   | 150.8       | 62C1B            | 59076             | 0.736 |
| July      | 160.5                      | 105.1          | 31.24 | 153.2   | 144.0       | 59925            | 49693             | 0.647 |
| August    | 151.1                      | 95,5           | 30.47 | 150.9   | 142.0       | 59213            | 49407             | 0.653 |
| September | • 141.8                    | 74.6           | 28.75 | 154.3   | 145.4       | 60574            | 57618             | 0.745 |
| October   | 116. <b>2</b>              | 71.3           | 25.59 | 135.5   | 127.9       | 54007            | 51303             | 0.756 |
| Novembar  | 77.2                       | 50.6           | 18.59 | 95.9    | 90.4        | 39371            | 37208             | 0.774 |
| Decembor  |                            | 42.5           | 13.44 | 91.7    | 86.5        | 38375            | 36218             | 0.788 |
| Year      | 1517.3                     | 899.2          | 24.18 | 1631.1  | 1536,7      | 649223           | 595529            | 0.729 |
| Legends   |                            |                |       |         |             |                  |                   |       |
| GlobHor   | Global horizontal irradia  | rtion          |       | EArray  | Elfective ( | energy at the ou | #put of the array |       |
| DiffHor   | Horizontal diffuse irradi  | ation          |       | E_Grid  |             | jected Into grid |                   |       |
| T_Amb     | Amblent Temperature        |                |       | PR      | Performat   | nce Ratio        |                   |       |
| Globine   | Global incident in coll. p | lane           |       |         |             |                  |                   |       |
| GlobEff   | Effective Globel, corr. fo | x JAM and shad | lings |         |             |                  |                   |       |



Variant: Now simulation variant

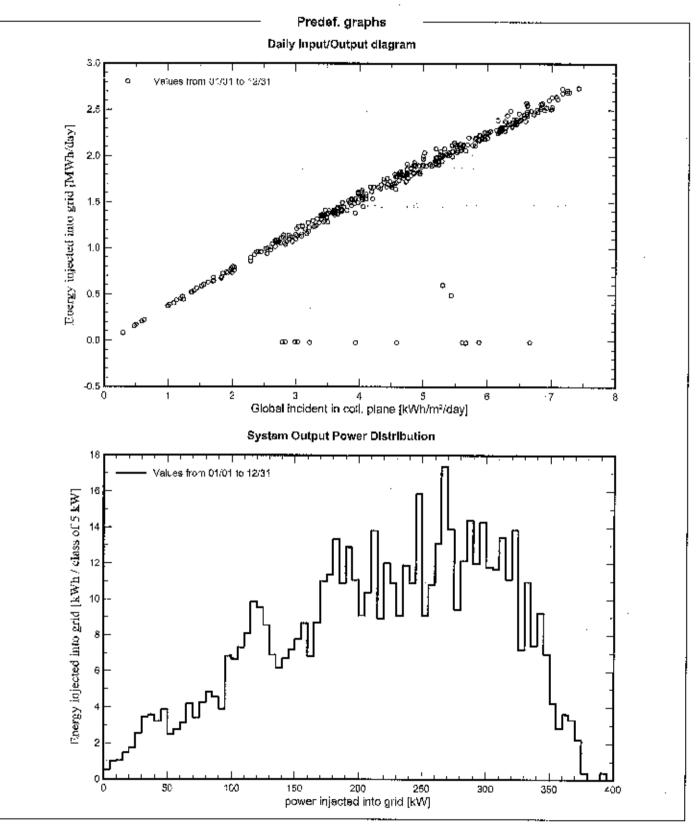
PVsyst V7.3.1 VC0, Simulation dato: 08/01/24 10:40 with v7.3.1





Variant: New simulation variant

PVsyst V7.3.1 VC0, Simulation date: 08/01/24 10:40 with v7.3.1



ć



#### Variant: New simulation variant

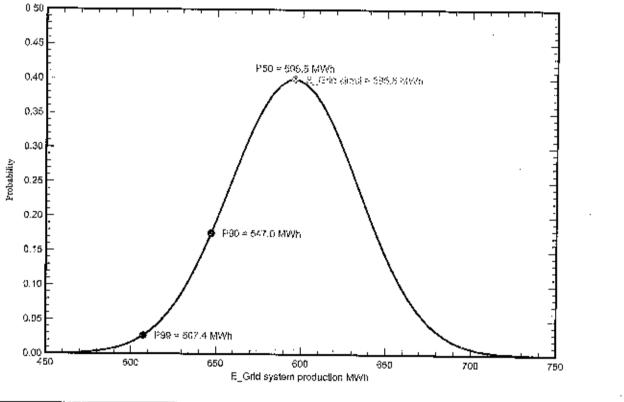
#### PVsyst V7.3.1 VC0, Simulation date; 08/01/24 10:40 with v7.3.1

| <b>Meteo d</b><br>Sourca |                             |             |
|--------------------------|-----------------------------|-------------|
|                          | Meteonorm 8.1 (1996-2015),  | Sat=100%    |
| Kind                     | Manthi                      | à avei.aõee |
| Synthetic                | - Multi-year avorage        |             |
| Year-to-y                | eer variability(Varlance)   | 0.1 %       |
| Specified                | i Deviation                 |             |
| Climate c                | hanga                       | 0.0 %       |
| Giobal v                 | /ariability (meteo + system | à           |
|                          | / (Quedratic sum)           | ")<br>6.4 % |

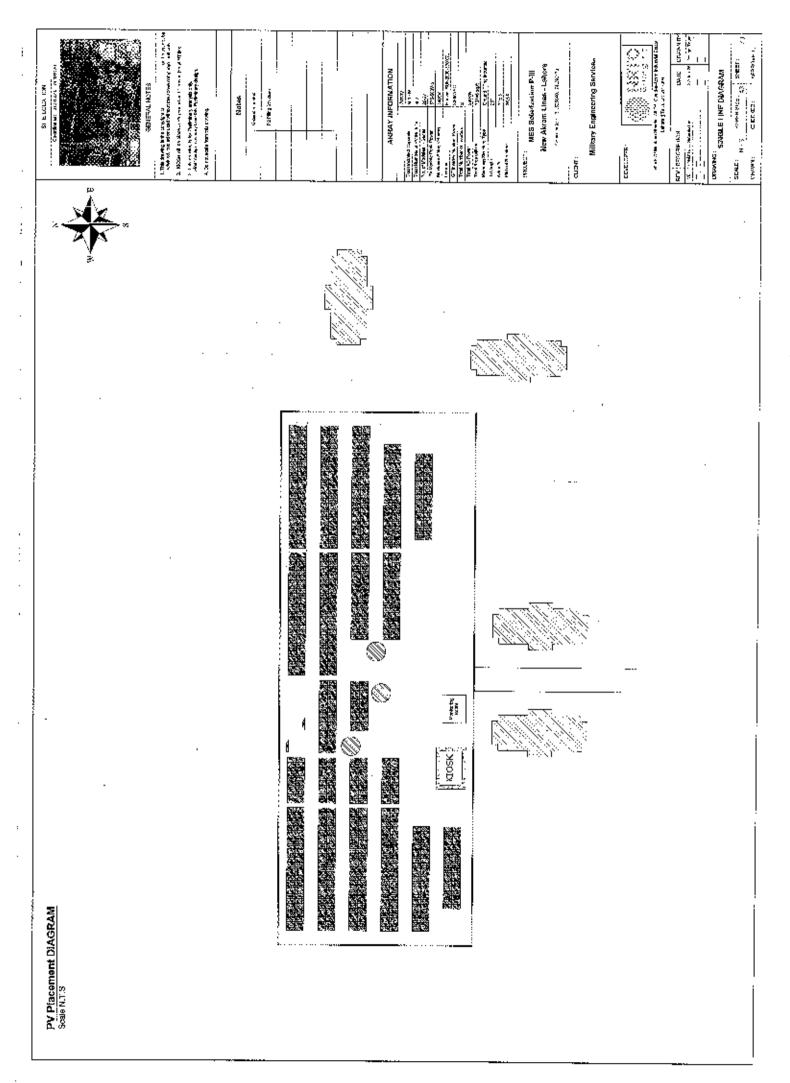
#### P50 - P90 evaluation

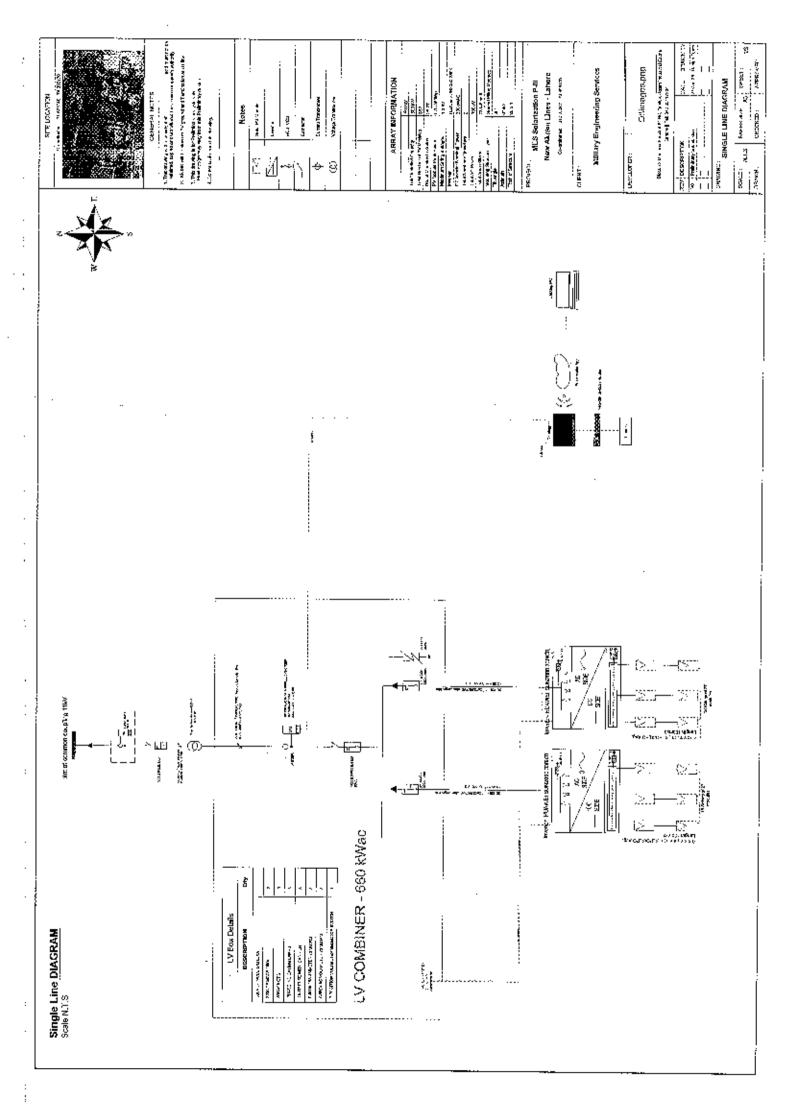
·

|               | Simulation and parameters uncer    | tainties  |  |
|---------------|------------------------------------|-----------|--|
|               | PV module modelling/parameters     | 1.0 %     |  |
|               | Invorter efficiency uncertainty    | 0.5 %     |  |
|               | Soiling and mismatch uncertainties | f.0 %     |  |
|               | Degradation uncertainty            | 1.0 %     |  |
|               | Annual production probability      |           |  |
|               | Veriebility                        | 37.9 MWh  |  |
|               | P50                                | 595.5 MWh |  |
|               | PSD                                | 547.0 MWh |  |
|               | P39                                | 507.4 MWh |  |
| Probability d | Istribution                        |           |  |



•







# PVsyst - Simulation report

Grid-Connected System

# Project: Okara MES

Variant: New simulation variant No 3D scene defined, no shadings System power: 1001 kWp Okara MES - Pakistan

Author



•

. .

.

:

:

# Project: Okara MES

#### Variant: New simulation variant

#### PVsyst V7.3.1 VC0, Simulation date: P1/08/24 17:58 with v7.3.1

|  | <b>.</b>                        | Project a             | summary ——                            |                            |             |        |
|--|---------------------------------|-----------------------|---------------------------------------|----------------------------|-------------|--------|
| Geographical Site<br>Okara MES               | 0                               | Situation<br>Latitude | 30.75 °N                              | Project settings<br>Albedo | 0.20        |        |
| Pakistan                                     |                                 | Longliude             | 73.35 °E                              | Albedo                     | 0.20        |        |
|  |                                 | Allitude              | 170 m                                 |                            |             |        |
|  |                                 | Time zone             | UTC+5                                 |                            |             |        |
| Meteo data                                   |                                 |                       |                                       |                            |             |        |
| Okara MES                                    |                                 |                       |                                       |                            |             |        |
| Meteonorm 8.1 (1996                          | 5-2015), Sat≃100% - Sj          | rthetic               |                                       |                            |             |        |
| ·  | ·                               | System s              | summary                               | 、,                         |             |        |
| Grid-Connected S<br>Simulation for year n    |                                 | No 3D scene defit     | ied, no shadings                      |                            |             |        |
| PV Fleid Orientati                           | ion                             | Near Shadings         |                                       | User's needs               |             |        |
| Fixed plane                                  |                                 | No Shadings           |                                       | Unitmited load (grid       | )           |        |
| Tilt/AzImuth                                 | 26/0 *                          |                       |                                       |                            |             |        |
| System Informatio<br>PV Array                | on                              |                       | Invertors                             |                            |             |        |
| Nb. of modules                               |                                 | 1726 units            | Nb. of units                          |                            | 3 units     |        |
| Phom. total                                  |                                 | 1001 kWp              | Phom total                            |                            | 900 kWae    |        |
|  |                                 | ·                     | Pnom ratio                            |                            | 1.112       |        |
|  |                                 | Results a             | ummary                                |                            | , <b></b> , |        |
| Produced Energy                              | 1353019 kWb/year                |                       | 1352 kWh/kWp/year                     | Perf. Ratio PR             | 78.68 %     |        |
| · · ·  | <del></del> .                   | Table of e            |                                       | -                          |             | _      |
| Project and results su<br>General parameters | mmary<br>RV Arroy Chamotovistic | e Rusion Interes      |                                       |                            |             | 2      |
| Comprar parentierers                         | F V Analy Gharacteristic        | s, aysiani ibeeas     |                                       |                            |             | 3      |
| coss disgraph                                |                                 |                       |                                       |                            |             | Б<br>Б |
| ствові, ўгазлів "                            |                                 |                       |                                       |                            |             | 7      |
|  |                                 |                       | · · · · · · · · · · · · · · · · · · · |                            |             | •      |

.



:

· . . ..

•

;

.

#### PVsyst V7.3.1 VC0, Simulation date: 01/08/24 17:58 with v7.3.1

## Project: Okara MES

## Variant: New simulation variant

|   | General                  | l parameters – – –         |                       |                  |
|---|--------------------------|----------------------------|-----------------------|------------------|
| Grid-Connected System                         |                          | efined, no shadings        |                       |                  |
| PV Field Orientation                          |                          | -                          |                       |                  |
| Orientation                                   | Sheds configurat         | tion                       | Models used           |                  |
| Fixed plane                                   | No 3D scene defin        |                            | Trensposition         | Peraz            |
| TllVAzimuth 26/0°                             |                          | 1000                       |                       | Meteonorm        |
| 2010  |                          |                            | Circumsolar           | separate         |
| Horizon                                       | Near Shadings            |                            | User's needs          |                  |
| Frae Horizan                                  | No Shadings              |                            | Unfimited load (grid) |                  |
|   | PV Array (               | Characteristics –          |                       | <u></u>          |
| PV module                                     |                          | Inverter                   |                       |                  |
| Manufacturer                                  | CSI Solar                | Manufacturer               | Hugu                  | voi Technologiae |
| Model   | CS7L-580MB-AG 1500V      | Model                      |                       | vei Technologias |
|   | 037 E-300 M B-AG (300 V  |                            |                       | 2000-330KTL-H2   |
| (Original PVsyst database)<br>Unit Nom, Power | C00 141-                 | (Custom paramete           | rs celinition)        |                  |
|   | 580 Wp                   | Unit Nom, Power            |                       | 300 kWac         |
| Number of PV modules                          | 1726 units               | Number of inverters        |                       | 3 units          |
| Nominal (STC)                                 | 1001 kWp                 | Total power                |                       | 900 kWac         |
| Array #1 - PV Array                           |                          |                            |                       |                  |
| Number of PV modules                          | 868 units                | Number of inverters        | 9 / MPPT 17%          | 1.5 units        |
| Nominal (STC)                                 | 503 kWp                  | Total power                |                       | 450 kWac         |
| Modules 3                                     | 1 Strings x 28 In series |                            | •· ·                  |                  |
| At operating cond. (50°C)                     |                          | Operating voltage          | 500-1                 | 1500 V           |
| Ртрр  | 463 kWp                  | Max. power (=>30°C)        |                       | 330 kWac         |
| U трр   | 854 V                    | Priominatio (DC:AC)        |                       | 1.12             |
| լ աեն   | 542 A                    | No Power sharing bat       |                       |                  |
| Array #2 - Sub-array #2                       |                          |                            |                       |                  |
| Number of PV modules                          | 858 units                | Number of Invartors        | 9 * MPPT 17%          | 1.5 units        |
| Nominal (STC)                                 | 498 kWp                  | Total power                |                       | 450 kWac         |
| 1 1   | 3 Strings x 26 In series |                            |                       |                  |
| At operating cond. (50°C)                     |                          | Operating voltage          | 500 -                 | 500 V            |
| Pmpp  | 457 kWp                  | Max. power (=>30°C)        | 200-1                 | 330 kWec         |
| и търр  | 497 KMP<br>793 V         | ,                          |                       |                  |
|   |                          | Pnom ratio (DC:AC)         |                       | 1.11             |
| փրթ   | 577 A .                  | No Power shading betw      | veen MPP1S            |                  |
| Total PV power                                |                          | Total Inverter powe        | ÷٢                    |                  |
| Nominal (STC)                                 | 1001 kWp                 | Total power                |                       | 900 kWac         |
| Total   | 1726 modules             | Number of Invarters        |                       | 3 unite          |
| Module area                                   | 4885 m²                  | Pnom ratio                 | · .                   | 1.11             |
|   |                          | No Power sharing           |                       |                  |
|   | Arra                     | y losses ———               | - <u>-</u>            | <i>.</i>         |
| Array Solfing Losses                          | Thermal Loss fa          | actor                      | Serie Diode Loss      |                  |
| Loss Fraction 2.0 %                           | Module temperatu         | re according to irradiance | Voltage drop          | 0.7 V            |
|   | Uc (const)               | 29.0 W/m²K                 | Loss Fraction         | 0.1 % at STC     |
|   | Uv (wind)                | 0.0 W/m²K/m/s              |                       |                  |
| LID - Light Induced Degradation               | Module Quality           | Loss                       | Module mismatch       | losses           |
| Loss Fraction 2.0 %                           | Loss Fraction            | -0.4 %                     | Loss Frection         | 2.0 % at MPP     |

| : | • |   | ć | ŝ      | 2      | 3 | 3     |
|---|---|---|---|--------|--------|---|-------|
|   | ş | Ĵ | į | )<br>N | 10.000 |   | 10044 |
|   |   |   |   |        |        |   |       |

1

÷

· · •

:

.

:

.

÷

## Project: Okara MES

## Variant: New simulation variant

-- .

---- ....

#### PVsyst V7.3.1 VC6, Simulation dote: 01/08/24 17:58 with v7.3.1

|   | A                            | rray losses  | ·                   |
|---|------------------------------|--|---------------------|
| Strings Mismatch loss   | Module avera                 | age degradation  |                     |
| Loss Fraction 0.1 %   | Year no                      | 10   |                     |
|   | Loss factor                  | 0.4 %/year   |                     |
|   |                              | to degradation   |                     |
|   | Imp RMS dispe                | rsion 0.4 %/year   |                     |
|   | Vmp RMS disp                 | ersion 0.4 %/year  |                     |
| IAM loss factor<br>Incidence effect (IAM). User defined profile |                              |  |                     |
| 10° 20° 30°   | 40°                          | 50° 60° 70°  |                     |
| 0.998   | 0.992                        |  | ·                   |
| produkt (110 molekov v 110 molekov                              | 0.002                        | 0.970 0.917  | 0.000               |
| · · · · · · · · · · · · · · · · · · ·                           |                              |  |                     |
| ·······   |                              | wiring losses  |                     |
| Global wiring resistance 10 mΩ                                  |                              | -  |                     |
| Loss Fraction 1.5 % at STC                                      |                              |  |                     |
| Array #1 - PV Array   |                              |  |                     |
| Global array res.   | 26 mΩ                        | Array #2 - Sub-array #2  |                     |
| Loss Fraction   | 1.5 % at STC                 | Global array res.<br>Loss F <i>r</i> action  | 23 mΩ               |
|   |                              |  | 1.5 % at STC        |
| · · · · · · · · · · · · · · · · · · ·                           | AC v                         | wiring losses  | ··· ·               |
|   |                              | in the topological sector of topologic |                     |
| Inv. output line up to MV transfo<br>Inverter voltage           | 900 Mar 44                   | and a second second  |                     |
| Loss Fraction   | 800 Vac tri<br>0.03 % at STC |  |                     |
| Inverter: SUN2000-330KTL-H2                                     | 0.03 % at STC                |  |                     |
|   | 3 x 240 nim²                 | Inverter: SUN2000-330KTL-H:  |                     |
| Average wires length  | 10 m                         | Wire section (2 Inv.)  | Alu 2 x 3 x 150 mm² |
| Avarage withs length  | 19 (1)                       | Average wires length   | 0 m                 |
| MV line up to injection   |                              |  |                     |
| MV Voltage  | 11 kV                        |  |                     |
|   | 3 x 120 mm²                  |  |                     |
| Length  | 392 m                        |  |                     |
| Loss Fraction   | 0.08 % at STC                |  |                     |
|   | – AC losse                   | s in transformers  |                     |
| MV transfo  |                              |  |                     |
| Medium voltage  | . 11 kV                      |  |                     |
| Transformer from Datasheets                                     |                              |  |                     |
| Nominal power   | 1250 KVA                     |  |                     |
| Iron Loss (24/24 Connexion)                                     | 1.00 kVA                     |  |                     |
| Iron loss fraction  | 0.08 % of PNom               |  |                     |
| Copper loss   | 2.00 kVA                     |  |                     |
| Copper loss fraction  | 0.16 % at PNom               |  |                     |
|   | x 0.82 mΩ                    |  | i                   |
|   |                              |  |                     |



## Project: Okara MES

#### Variant: New simulation variant

PVsyst V7.3.1 VC0, Simulation date: 01/08/24 17:58 with v7.3.1

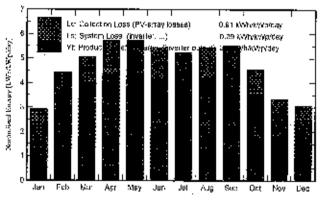
#### Main results

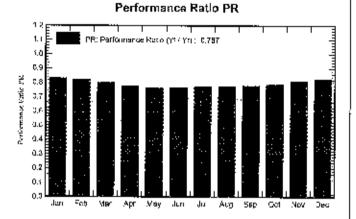
#### System Production

Produced Energy (P50) 1353019 kWh/year Produced Energy (P90) 1267301 kWh/year Produced Energy (P99) 1197439 kWh/year Specific production (P50) Produced Energy (P90) Produced Energy (P99)

1352 kWh/kWp/year Performance Ratio PR 78.68 % 1266 kWh/kWp/year 1196 kWh/kWp/year

## Normalized productions (per installed kWp)





# Balances and main results

|           | GlobHor                    | DiffHor | T_Amb   | Globinc | GlobEff            | ЕАгтау           | E_Grid              | PR    |
|-----------|----------------------------|---------|---------|---------|--------------------|------------------|---------------------|-------|
|           | kWn/m²                     | kWh/m²  | °C      | kWh/m²  | kWh/m <del>*</del> | kWh              | kWh                 | ratio |
| January   | 72.0                       | 44,1    | 12.67   | 90.8    | 87.4               | 77537            | 75382               | 0,830 |
| February  | 100.5                      | 52.8    | 16.58   | 123.9   | 119.5              | :<br>104112      | 101593              | 0.819 |
| March     | 139.6                      | 78.4    | 22.74   | , 156.9 | 151.2              | 128386           | , 125384            | 0,798 |
| April     | 166.7                      | 89.5    | 28.19   | 172.4   | 165.8              | 137437           | 134293              | 0.778 |
| Мау       | 183.4                      | 101,2   | 33.85   | 177.8   | 170.9              | 138844           | 135639              | 0.762 |
| June      | 173.7                      | 107.9   | i 34.21 | 163.3   | 156.8              | 128068           | 125087              | 0.765 |
| July      | 170.9                      | 104.8   | 33.08   | 162,4   | 156.0              | 1 <b>2</b> 8382  | 125359              | 0.771 |
| August    | 168.5                      | 99.0    | 31.92   | 168.6   | 162.1              | 133754           | 130648              | 0.774 |
| September | r 152.3                    | 78.4    | 29.90   | 168.1   | 159.8              | 132403           | 129346              | 0.778 |
| October   | 120.0                      | 68.2    | 26.94   | 141.0   | 135.9              | 113872           | 111127              | 0.788 |
| November  | . 80.9                     | 52,4    | 20.30   | 100.1   | 96.3               | 83176            | 80993               | 0.809 |
| December  | 71.7                       | 44.1    | 14.94   | 94,6    | 9f.1               | 80339            | 78167 j             | 0.825 |
| Year      | 1600.1                     | 919.0   | 25.49   | 1717.7  | 1652.6             | 1386311          | 1353019             | 0.787 |
| Legends   |                            |         |         |         |                    |                  |                     |       |
| GlobHor   | Global horizontal imertia  | alion   |         | EArray  | Effective (        | energy at the or | uppet of the array  |       |
| DiffHor   | Horizontal diffuse irradi  | ation   |         | E_Grid  |                    | iected into grid | apper of the citaly |       |
| T_Amb     | Ambient Temperature        |         |         | PR      | Períoma            |                  |                     |       |
| Glabina   | Globel incident in coll. p | lane    |         |         |                    |                  |                     |       |
| GlobEll   | Effective Global, corr. fo |         | ands    |         |                    |                  |                     |       |



#### PVsyst V7.3.1 VC0, Simulation date: 01/09/24 17:58 with v7.3.1

## Project: Okara MES

#### Variant: New simulation variant

Loss diagram

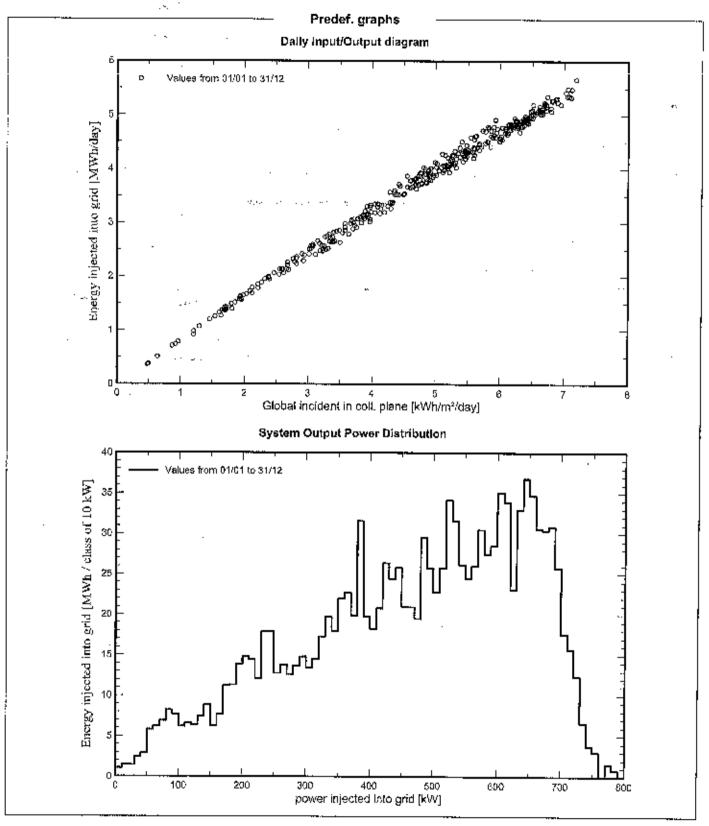
1600 kWh/mª **Global horizontal irradiation** +7.4% Global incident in coll. plane -1.83% IAM factor on global -2.00% Soiling loss factor 1653 kWh/m² \* 4885 m² coll. Effective Irradiation on collectors efficiency at STC = 20.58% PV conversion Array nominal energy (at STC offic.) . . . . . Module Degradation Loss ( for year #10) -3.80% 9-0.10% PV loss due to irradiance level -7.00% PV loss due to temperature (+0.43%) Module quality loss \$ -2.00% LID - Light induced degradation -1.14% Mismatch loss, modules and strings (including 2% for degradation disporsion 9-0.97% Ohmic wining loas 1386311 kWh Array virtual energy at MPP ¥)-1.65% Inverter Loss during operation (efficiency) 90.00% Inverter Loss over nominal inv. power 90.00% Inverter Loss due to max. Input current N 0.00% Inverter Loss over nominal inv, voltage N 0.00% Inverter Loss due to power threshold 9 0.00% Inverter Loss due to voltage threshold 90.00% Night consumption 1363346 KWh Available Energy at Inverter Output 9-0.02% AC ohmic loss 9-0.70% Medium voltage transfolioss 9-0.04% MV line atmic lass 1353019 kWh Energy injected into grid



## Project: Okara MES

## Variant: New simulation variant

# PVsyst V7.3.1 VC0, Simulation date: 01/08/24 17:58 with v7.3.1





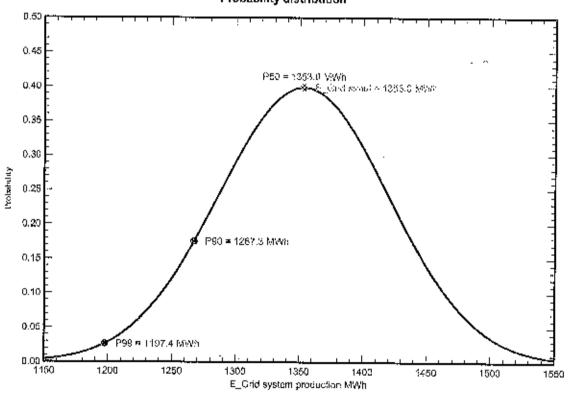
:

# Project: Okara MES

## Variant: New simulation variant

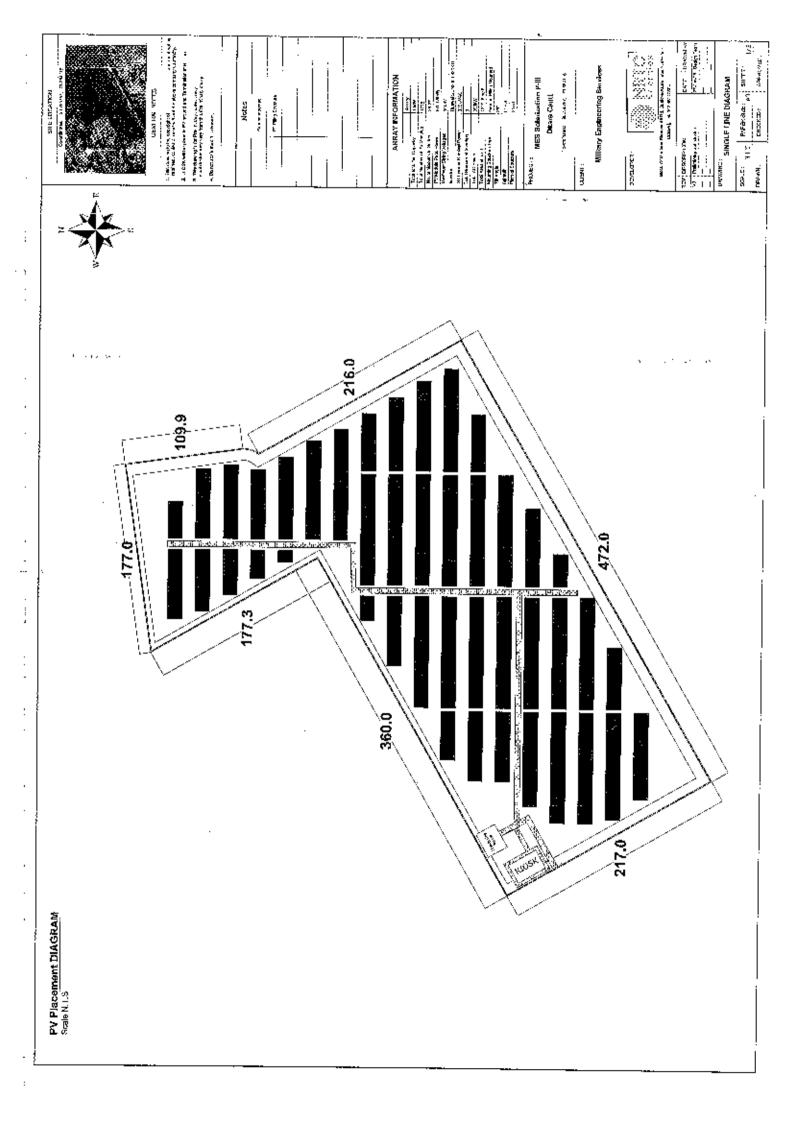
#### PVsyst V7.3.1 VC0, Simulation date: 01/08/24 17:58 with v7.3.1

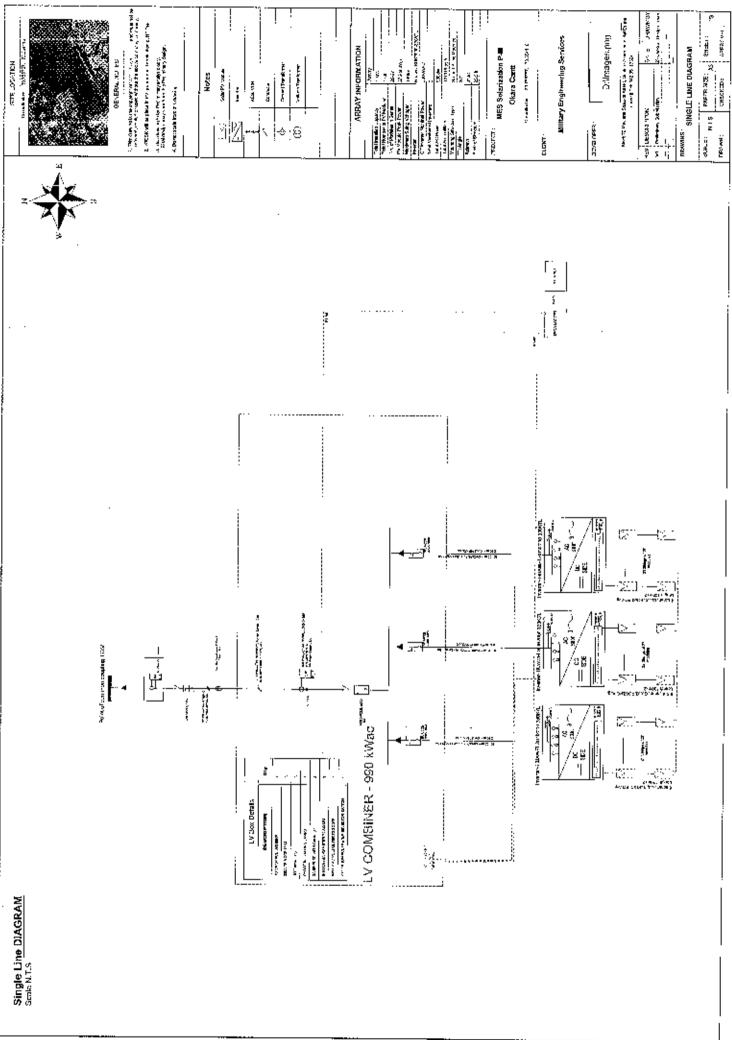
|                                     |              | P50 - P90 e | valuation                          |            |
|-------------------------------------|--------------|-------------|------------------------------------|------------|
| Meteo data                          |              |             | Simulation and parameters unce     | rtainties  |
| Source Meteonom 8-1 (1996-2015),    | 5at=100%     |             | PV module modelling/parameters     | 1.0 %      |
| Kind Monfhly                        | / averages   |             | Inverter efficiency uncortainty    | 0.5 %      |
| SyntheticMulti-year average         |              |             | Solling and mismatch uncertainties | 1.0 %      |
| Year-to-year variability(Varience)  | 4.6 %        |             | Degradation uncertainty            | 1.0 %      |
| Specified Deviation                 |              |             | ÷ •                                |            |
| Climate change                      | 0.9 %        |             |                                    |            |
| Global variability (meteo + system) | )            |             | Annual production probability      |            |
| Variability (Quadratic sum)         | 4.9 %        |             | Variability                        | 66.8 MWh   |
|                                     |              |             | P50                                | 1353.0 MWh |
|                                     | <del>.</del> | 56 mil 140  | P90                                | 1267.3 MWb |
|                                     |              |             | P99                                | 1197.4 MWh |



## Probability distribution

## 01/08/24





i

.

•

ł

:

1

i ļ

:

:

:

;

Annex - K (Project Cost)

.

÷

| Regulatory Complaince  |   |   |   |   |   |  |                        |               |
|--|---|---|---|---|---|--|------------------------|---------------|
|  |   |   |   |   |   |  |                        |               |
| <ul> <li>Generalian Lisconsinu</li> </ul>  | NEPRO.                                    | 2 1 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2                                   |   | 070000000000000000000000000000000000000 | 100720002000000000000000000000000000000   |  | 122032222222222222     | 1.<br>        |
| 2 Disgriščigenery<br>3 Eviceratal Second   | EN NE                                     | Cate Mark - (Pistors / Sictions)<br>                                      | -   | ∩ri⊓                                    | 1CF/32/F  | 4601,428                                       | 672°90)                | 690/201V      |
| 18233334   |   |   |   |   |   |  | Ř                      |               |
| Civil Works  |   |   |   |   |   |  |                        |               |
| 🔶 😤 🖓 et n sel atuellas  |   | Unit and considered in reach site medianed in the zone.                   | - <u>.</u>  | 3                                       | 1,556,000 (APR)   | 8,425 (2003)                                   | (3)(2)(2)(1)           | CUCDO E77.3   |
| 2 Land preparation   | P   | 1914 35 BW  | 5   | 11.                                     | 2215 803.09   | 1: 271(54540                                   | 17727,2771             | 12 HEADON 13  |
| X Red CV1 Works  | NE  | 1440 UNA  | .<br>  .  | !<br>ę                                  | 2,260,0000  | !  | '<br>                  |               |
| 1  | <u>נ</u> ר                                | Unit cost considerant la machanadia the zame                              | !   | \$.<br>                                 | 2,4000.0F   | 13 605,056 06 1                                | (0.960 HML)            | 15,082,030,00 |
| _ I  | ž   | l Comulative 10.90 metros destructed (engilit is considered for several e | !<br>   | 4                                       | 2 PONIDE DE   | 13,125,000.00                                  | 0.00000000             | 15 225,000 00 |
|  | *   | Acres Portform & Maribaling russing hearth ang                            | <del>_ </del>   | ţţ                                      | 3 dount   | 13(00)20                                       |                        | 10,000,000    |
| International Contraction  | 2   |   | ~   | 93                                      | 2.000,000.5   | 000'005'2-                                     | 20000/2                | 20-'30%'M     |
| - ×  | 1<br>100000000000000000000000000000000000 | Unit call curvationed in vector site monthanced in the come               | 2<br>2<br>2<br>2<br>2<br>2<br>2<br>2<br>2<br>2<br>2<br>2<br>2<br>2<br>2<br>2<br>2<br>2<br>2 | LA<br>SETERACIONES                      | 1,420,000<br>395,509,600,650,550  | 7, 141,000 600 600 600 600 600 600 600 600 600 | 1228,000 (1228,000)    | 02 822 8      |
| PV Plant   |   |   |   |   |   |  | 9<br>9                 |               |
| t in version   | UNICINOUNTRY HAVE THE                     | jeer 1  | 202   | Kiter -                                 | 23,426.26   | a3.02478/5720                                  |                        | 30,026,975    |
| <ul> <li><sup>10</sup> Intertors</li> <li><sup>10</sup> Division entremiser</li> </ul> | Hiterati Surgitas<br>Mi                   | Smart String June 14: 14V Genes   | COEE  | Weild                                   | 00000°-   | 07000'001%2                                    | 6,300 000,0            | 41,800,       |
|  | NE .                                      |   | 20X   | IFAX                                    | 22,500.00   | 75, 250,000,000                                | 14 175,050.50          | 92,926,200    |
| a unatime<br>b Lu Switchgoor   | ICCANNERS.                                | DOXEND (AA MURENAE)<br>Dif contains an an an an an an                     | ÷,  | FL                                      | 2250.0000   | Callabard'ss                                   | 2205(020-00            | 14,633,000    |
|  |   | LVNV Selfchuse in transmissions   | ÷ ن   | <br>[]<br>                              | 1,200,000,000,000,000,000,000,000,000,00  | // Winterior                                   | - 3, <u>029,00</u> 0 - | 91273.00      |
|  |   |   |   |   | A SOLUTION OF A CONTRACT OF A | 2 X100 X                                       | AND TAKES              |               |
|  |   |   |   | STOCKING STOCK                          |   |  |                        |               |

.

•

:

# Annex - L (Health and Safety Plan)

and the second second

.

| Conte | nts |
|-------|-----|

i

. .

•

.

.

•

. .

• .

;

:

i

:

:

:

. .

.

. .

.

.

| 1.0.           | PURPOSE:                                    | 4          |
|----------------|---|------------|
| 2.0.           | SCOPE:                                      | 4          |
| 3.0.           | HSE POLICY:                                 | 4          |
| 4.0.           | OBJECTIVES:                                 | 5          |
| 5.0.           | SITE HSE RULES:                             | 5          |
| 6.0.           | MANAGEMENT SYSTEM AND RESPONSIBILITY:       | 6          |
| 6.1.           | Common Requirement:                         | 7          |
| 6.1.1.         | Legal and Other Requirements:               | 7          |
| 6.2.           | ORIENTATION AND TRAINING:                   | 8          |
| <b>6.2</b> .1. | HSE orientation:                            | 8          |
| 6.2.2.         | HSE Training:                               | 8          |
| 6.2.3.         | HSE Induction Training for New Personal:    | 8          |
| 6.2.4.         | Tool Box Talk:                              | 9          |
| 6.2.5.         | First Ald Training:                         | 9          |
| 7.0.           | HSE INSPECTION:                             | 9          |
| 7.1.           | Check List;                                 | 9.         |
| 7.2.           | Periodic Inspection:                        | 10         |
| 8.0.           | HSE MEETING:                                | 10         |
| 8.1.           | Weekly HSE Meeting:                         | 10         |
| 9.0.           | Risk Management:                            | 10         |
| 9.1.           | Risk Identification:                        | 10         |
| 9.2.           | Hazards Type:                               | 10         |
| 9.3.           | Interface Potential Hazards:                | 11         |
| 9.4.           | Risk Assessment:                            | 11         |
| 9.5.           | Risk Controls:                              | 12         |
| 10.0,          | Incident Accident Report and Investigation: | 13         |
| 10.1.          | Incident Report:                            | 13         |
| 10.2.          | Incident Investigation:                     | 13         |
| 10.3.          | Accident Report:                            | 14         |
| 10.4.          | Accident Investigation:                     | 14         |
| 11.0.          | Permit To Work:                             | 14         |
| 12.0.          | Emergency Response:                         | <b>1</b> 4 |
| 12.1.          | Emergency Communication:                    | 14         |
|                |   |            |

.

.

|     | 12.2.   | Emergency Response Plan:                          | 14   |
|-----|---------|---|------|
|     | 13.0.   | Emergency response drill:                         | 15   |
|     | 13.1,   | Plan of Emergency Procedure:                      | 15   |
| ·   | 13,2,   | Emergency Layout Plan:                            | . 15 |
|     | 14,0,   | Safety Work Practices                             | 15   |
| :   | 14,1,   | Electrical:                                       | 15   |
| • , | 14.2.   | Hand & Power Tools:                               | 15   |
|     | 14.3,   | Work At Height:                                   | 16   |
|     | 14.4.   | Ladders:  | 16   |
|     | 15.0.   | Hazardous Material:                               | 17   |
|     | 15.1,   | Guidelines:                                       | 17   |
|     | 15.2,   | Emission Control:                                 | 17   |
|     | 15.3,   | Noise Control:                                    | 17   |
|     | 15.3.1. | Hazard Identification:                            | 17   |
|     | 15.3.2. | Control Measure:                                  | 17   |
|     | 16.0.   | Housekeeping:                                     | 18   |
|     | 17.0.   | Site Security:                                    | 18   |
|     | 17.1,   | Control Measure:                                  | 18   |
| 1   | 17.2,   | Identification Control:                           | 18   |
|     | 17,3.   | Material Control:                                 | 19   |
| :   | 17.4,   | Incoming Material:                                | 19   |
|     | 17.5.   | Outgoing Material:                                | . 19 |
| :   | 18.0.   | Fire Prevention:                                  | 19   |
| ·   | 18.1.   | General:  | 19   |
|     | 18.2.   | Fire Prevention Guide:                            | 19   |
|     | 18.3.   | Requirements:                                     | 19   |
|     | 19.0.   | Engagement of Staff and Labour:                   | 20   |
|     | 19.1.   | General:  | 20   |
|     | 19.2.   | Labour Law:                                       | 20   |
| :   | Sub H:  | SES Plans/Policies                                | 21   |
|     | Securi  | ity Management Plan                               | 21   |
|     | Health  | h and Safety Policy                               | 21   |
|     | Health  | h and safety handbook                             | 21   |
| :   | Emerg   | gency Response Plan                               | 21   |
|     | Safety  | Practices and Procedures                          | 21   |
|     | Code «  | of Practice for hazardous equipment and materials | 21   |

.

. ·

:

:

.

. 🕶

.

| Traffic Management Plan              | 21 |
|--------------------------------------|----|
| Environmental Policy                 | 21 |
| Environmental Procedures Manual      | 21 |
| Hazardous waste management procedure | 21 |
| Emission and dust control procedure  | 21 |
| Noise emission and control procedure | 21 |
| Water conservation procedure         | 21 |
| Policy on sexual harassment          | 21 |
|                                      |    |

#### 1.0. PURPOSE:

The purpose of this HSE Plan for Project of **Procurement of Grid Connected Solar PV Plants Aggregate up to 33MW at Various locations in Pakistan** is to identify the strategy and devise mechanism which is directed towards the better management of occupational Health, Safety, Environment (hereinafter referred to as HSE) for the Solar power project and demonstrates the NRTC Energies' overall approach in relation to health and safety to meet its health and safety obligations under both the Contract and Health and Safety Legislation

#### 2.0.<u>SCOPE:</u>

The MSE Plan details the procedures and Standard Operating Procedures that shall apply to all activities coming under project scope of work at the project including the subcontractors employed by the contractor under the EPC contract. The scope of work shall be executed by supplying the designated materials, baseline manpower, temporary facilities, baseline equipment / tools, consumables, testing and inspection facilities and other services necessary to complete the scope of work.

## 3.0. NRTC's HSE POLICY:

Every employee, no matter from or sub-contractors shall recognize that health, safety, environment and community responsibilities are an integral part of his work. We shall prevent harm to people, environment and community around us by:

- Developing management structure and procedures for implementations at all our workplaces and continuous improvement through regular monitoring.
- Fully abiding by applicable government legislation and regulations.
- Creating awareness amongst all the employees, through a comprehensive program, facilitated by HSE department and implemented by respective site and office management.
- Ensuring that every leader of an operation, whether in the field or office, is directly
  responsible for the judicious enforcement of an organized program upholding this HSE
  Policy.
- Making line managers, all personnel accountable for HSE management effort towards elimination of causes that might lead to harm people, environment and community.
- Ensuring that the management systems of our subcontractor and vendors are compatible with our own commitment to HSE.
- Participating in hazard identification, risk assessment and eliminating potential threats to HSE.
- Providing training and encourages behavior that upholds this policy.

- Every employee and subcontractors work shall endeavor to conserve the environmental resources and work in an environment friendly atmosphere.
- Developing environmental management standards in compliance with EPA & SEPA and their maintenance through application of inspection and audit system.
- Fully abiding by government legislations and regulations related to environmental preservation and pollution control.
- Communicating environmental issues all across the company and investigation of incidents and violations thereof, to prevent recurrence.
- Ensuring commitment from our subcontractors and vendors to comply with environmental standards.
- Striving for continuous improvement in environmental matters.

#### 4.0. OBJECTIVES:

Pursuant to the Policy Statement above, the following objectives are identified in order to create a positive approach to health, safety, and protection of the environment during all activities for project:

- To avoid all personal injuries during the execution of the Project, 'Target Zero LTI (lost time injury)'. ('Target Zero LTI' can be achieved by conducting risk assessments, safety trainings to employees and employers of the project, permit to work (PTW) system and implementation of HSE plan at site.)
- To ensure that all personnel employed on the project either employee or subcontractor employee are competent to carry out their designated tasks safely.
- To create positive health, safety and environment attitudes and perceptions at all levels of the project organization, and to raise health safety and environmental awareness in general.
- To implement a training program that supports the achievement of personnel competency in relation to Health, Safety, and the Environment.
- To complete the Project without Incurring any significant property damage to permanent equipment, or temporary facilities.
- To complete the Project with minimum avoidable impact upon the surrounding environment.
- To implement a hierarchy of communication forums that ensure that HSE concerns can be raised and addressed at all levels of the organization.
- To introduce a method of motivating good safety and environmental performance, which shall include the usage of commendation, as well as corrective techniques.
- To continually monitor and improve HSE performance.
- Ensure availability of resources to fully implement health and safety policy of the company.

#### 5.0. SITE HSE RULES:

- All new workers of the contractor and subcontractors must go through the HSE Orientation before starting work, understand HSE Policy of NRTC ENERGIES and adhere to HSE rules.
- Personal Protective Equipment will be provided and must be worn when required. Safety shoes, overalls and hard hats in all site areas, masks, gloves and earplugs as required, etc.
- Follow the messages and instructions displayed on HSE boards installed on site. Be aware of emergency assembly points and escape routes. In the event of an emergency do not panic, follow the site emergency response procedures.

- Report promptly all accidents to your supervisor and HSE officer at site. Immediately provide first aid for the injured and call for the medic.
- While working in a confined space make sure that your nearby colleague and supervisor are well informed.
- Ensure adequate lighting is in place for work on night shifts or for emergency response.
- All scraps, waste materials and garbage must be disposed of in accordance with the construction waste management plan.
- Always clean work site after completing the job or shift. Maintain appropriate barricades as required. Never tamper with electric cables and appliances. Never insert direct cables into sockets, rather use proper plugs.
- Work at height is strictly prohibited without appropriate fall arrest systems in place. Ensure
  presence of strong side railings; there should be no gaps and ensure that all planks are
  secured appropriately.
- Do not enter scaffold that is not tagged safe for access.
- Tools or materials must not be carried while climbing up or down scaffolding or ladders. Use pouches or ropes for this purpose.
- Do not smoke or produce naked flame in NO SMOKING area. Use of open fire is prohibited.
- Keep all gangways and aisles clear and clean at work sites.
- Vehicles must be driven at a safe speed, observing speed limits. Drivers must have a valid driving license. Vehicles shall only be parked in designated parking areas.

## 6.0. MANAGEIMENT SYSTEM AND RESPONSIBILITY:

Project Management is committed to a HSE Plan requiring that accountability will begin at the highest level of management. Each level of Project Management, Subcontractor Management, supervision and employees will claim ownership in, and take personal responsibility for their roles In the safety program and will act as a change agent to modify each employee's behavior positively towards working safely. Each level of management shall take on the responsibility for the safety of employees and comply with the project safety standards and requirements. Contractor and The Project Company will perform inspections and audits and continuous field monitoring jointly and/or separately to determine compliance to safety. Accountability is a critical part of the HSE Plan and will be implemented with positive reinforcement that will challenge everyone involved, irrespective of his level of responsibility, to achieve our mutual goal of "No Accidents." All activities will be governed by the assumption that, "all accidents can be prevented" and that the "behavior of all employees can be modified to work safely". In order to achieve a No Accident and No Injury culture all levels of management are required to subscribe to the following:

- A bold aligned commitment to the elimination of worker injury.
- Establishing a sense of urgency for the elimination of incidents and injury.
- Forming a powerful coalition with parties that can make a difference to lead the initiative.
- Creating a vision of No Accident that emphasizes the impact on people and the possibilities it creates.
- Communicating the vision to everyone many times and in many ways.
- Focusing on leadership, behavior and the environment for safety.
- Empowering everyone to act on the vision.
- Institutionalizing new approaches by articulating the connection between incident and No Accident and the project's business objectives.

## 6.1. Common Requirement:

The management of HSE issues for contractor and subcontractors shall be based on the following:

- Performance Standards on Social and Environmental Sustainability
- Environmental, Health, and Safety General Guidelines.
- Ensuring the requirements of the contract.
- Contractor's HSE Policy.
- HSE issues must be integrated in all business areas and every subcontractor.
- All incidents can be prevented. Everyone responsible for safety, if anyone witness unsafe acts or conditions must act. Safe behavior must be promoted & rewarded in order to continuously improve working conditions.
- Establishing performance standards to eliminate or minimize risks to the HSE resulting from the work to be done.
- Establishing means for management of subcontractors and coordination of subcontractor's activities.
- The Project's HSE Policy, Objectives and Plan must be communicated to everyone.
- HSE risks associated to construction and commissioning activities must be understood and managed effectively.
- Workers must be competent to carry out their designated work.
- Corrective and preventive actions must be implemented.
- HSE shall not be compromised in order to achieve any objective.
- HSE Management Plan update as necessary.
- Performance must be openly reported.
- Consequences for non-compliance:
- HSE violations are not condoned, tolerated and accepted as the norm, but strict disciplinary action shall be taken against violators as per the disciplinary procedures.

## 6.1.1. Legal and Other Requirements:

The EPC Contractor shall comply with its obligations (with respect to the EPC Contractor, its subcontractors and otherwise) under and in accordance with the HSE Audit Requirements. The EPC Contractor shall additionally grant or ensure the grant to the Project Company and the Client of all the rights accorded to the Project Company and the Client under and in accordance with the HSE Audit Requirements.

HSE-related laws and regulations of Pakistan.

- Environment Protection Rules of Pakistan, 2054(1997)
- Environment Protection Act of Pakistan, 2053 (1997)
- National Ambient Air Quality Standard (NAAQS; issued in 2003)
- Environmental Impact Assessment (EIA; issued in 1993)
- Labor Protection Act of Pakistan (2010)

### 6.2. ORIENTATION AND TRAINING:

#### 6.2.1. Het orientation:

Every person will undergo an HSE orientation program. On completion of orientation he/she will be issued an ID card and permitted to enter the site. HSE orientation shall be performed by Safety Manager, based on but not limited to the following:

- Introduce and explain HSE Policy and Project organization.
- General HSE rules and regulations for working at the project, including use of PPE, electrical equipment, Working at the height, accident Reporting, First Aid, Emergency Response, HSE Inspection, Housekeeping, etc.
- Risk Identification, Risk Assessment and Control at construction site, works, offices, etc. Specific hazards like work at height, electrical, fire, crane, scaffold and vehicle safety etc. Environmental hazard.

#### 6.2.2. HSE Training:

This training Is to improve all kinds of engineers as civil engineers, electrical engineers, quality engineers, especially HSE engineers, for the safety management level and quality to better reflect pairs of responsibilities system, people-oriented principle, and be conducted by the Safety Manager and HSE engineers.

- HSE rules and regulations
- HSE theoretical knowledge
- Risk Identification, Risk Assessment, Risk Controls.
- Typical accident case.
- HSE induction training for new personal
- HSE training for management and supervision
- Emergency evacuation training
- HSE Training Weekly
- Occupational Health and safety
- Fire Safety & prevention
- Emergency Response Preparation
- Onsite Waste Management
- PPE Training
- Driver Safety
- Implementation of environmental and social management plan.

#### 6.2.3. HSE Induction Training for New Personal:

All employees must attend a site-specific orientation presented by Contractor/Subcontractor prior to the start of work or as required when site conditions change such as when there is a change in the construction phase and/or during recommissioning and start-up. The goals set for the project, the project safety rules and regulations and the No Accident philosophy will be communicated to all employees, supervisors and managers. The course will also emphasize the importance of human life and promote employee ownership and accountability by utilizing behavior based safety techniques. The subcontractor should give the new hire internal orientation and submit the copy of attendance list to HSE department before the start of the site work. The orientation should include but not limited to following:

- Safety and environment policy,
- Basic PPE,
- Emergency preparedness and response plan,
- evacuation plan,
- Disciplinary procedure,
- Site safety and environment rules,
- Security procedure,
- Applicable HSE legalization and regulations.

#### 6.2.4. Tool Box Talle

- All supervisors will be trained to deliver daily tool box talk in their respective areas.
- Subjects for "tool box talks" would be selected to reflect the specific hazards of a particular site, feedback from first line supervisors/ HSE inspectors and observation / input from any other employee.
- Incidents, which may occur in the site, shall also be discussed in "tool box talks". Annexure:018

#### 6.2.5. First Aid Training:

- First AID training will be conducted by safety Manager.
- Although all employees will be trained in basic first aid, having got training in advance first aid will be posted at selected points to impart first aid, when required.

## 7.0. HSE INSPECTION:

#### 7.1. Check List:

Safety Check List is an effective management procedure for the discovery of potential hazards and the implementation of various laws and regulations. Safety Check Lists comprise of and will be used as per site requirements:

| Annexures    | Description                |
|--------------|----------------------------|
| Annexure:001 | Minutes OF Meeting         |
| Annexure:002 | Safety Signs               |
| Annexure:003 | Environmental Inspection   |
| Annexure:004 | Hazardous Waste inspection |
| Annexure:005 | Ladder Inspection          |
| Annexure:006 | Permit to Work             |
| Annexure:007 | Confined Space             |
| Annexure:008 | Chemical Inventory         |
| Annexure:009 | Fall Protection            |
| Annexure:010 | Job Safety Analysis        |
| Annexure:011 | DG Inspection              |
| Annexure:012 | Electrical Safety          |
| Annexure:013 | Monthly Fire ExtInguisher  |
| Annexure:014 | Hazard Identification      |
| Annexure:015 | Scaffold Inspection        |

| Annexure:016 | Housekeeping           |
|--------------|------------------------|
| Annexure:017 | Daily TBT              |
| Annexure:018 | HSE Rules              |
| Annexure:019 | Daily EHS Report       |
| Annexure:020 | Lifting Activities     |
| Annexure:021 | Accident Report        |
| Annexure:022 | Risk Assessment Format |
| Annexure:023 | EHS Orientation        |
| Annexure:24  | Training plan/Record   |

• Others, if necessary

#### 7.2. Periodic Inspection:

HSE periodic inspection include weekly, monthly, quarterly HSE inspection that will be respectively conducted by engineers, Safety. After completion, HSE inspection reports must be delivered to relevant company, department, personnel, so that they can correct unsafe behaviors, conditions and circumstances. HSE monitoring will be conducted all time until unsafe behaviors, conditions and circumstances are corrected thoroughly.

## 8.0. HSE MEETING:

#### 8.1. Weekly HSE Meeting:

Weekly HSE Meetings chaired by the Safety Head, will be held each week with all sub-contractors and nominated Engineers, Supervisors etc. All-important HSE matters of the site as well as the results of the HSE inspect and corrective action will be discussed in weekly HSE meeting. The meeting will promote the Implementation of the HSE management and rectification.

#### 9.0. Risk Management:

Hazard Analysis and Risk management techniques shall be carried out on all life critical and asset damaging activities, so that all the potential hazards are identified and evaluated prior to execution, thereby enabling either substitution or adoption of control techniques. All method statements, hazard analysis & control sheets will be reviewed.

#### 9.1. Risk Identification:

Hazard Analysis and Risk management techniques shall be carried out on all life critical and asset damaging activities, so that all the potential hazards are identified and evaluated prior to execution, thereby enabling either substitution or adoption of control techniques. All method statements, hazard analysis & control sheets will be reviewed.

#### 9.2. Hazards Type:

Following are examples of typical hazards that can be encountered:

- Fire (Fire extinguishers will be set on any location based on the risk assessment)
- Falling objects

- Falls from heights
- Grinding
- Erection of steel work
- Installation of equipment
- Electric shock.

#### 9.3. Interface Potential Hezards:

- Existing emergency evacuation procedures
- Emergency communication system
- Protective equipment requirements
- Waste disposal

#### C.4. Risk Assessment:

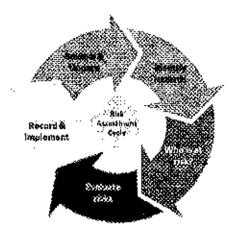
The responsibility for ensuring that risk assessments are carried out lies with Health & Safety Head.

The Head of HSE must ensure that all operations likely to give rise to risk are fully assessed and that control measures are put in place to reduce any significant risks.

#### Basic Five Steps for a Risk Assessment:

Five steps to risk assessment can be followed to ensure that your risk assessment is carried out correctly, these five steps are:

- Identify the hazards
- Decide who might be harmed and how
- Evaluate the risks and decide on control measures
- Record your findings and implement them
- Review your assessment and update if necessary.



#### Procedure to calculate risk level by matrix method

The matrix works by selecting the appropriate consequences from across the top, and then cross referencing against the row containing the likelihood, to read off the estimated risk rating.

The following is a guide to the matrix's risk rating clarification.

Insignificant Risk. No action is required.

**Medium Risk.** Efforts should be made to mitigate the risk. Risk should only be tolerated for the short term, and then only whilst further control measures to mitigate the risk are being planned and introduced, and these within a pre-defined time period. However, the costs of prevention should be carefully measured. Where the moderate risk is associated with extremely harmful consequences, further assessment maybe necessary to establish more precisely the likelihood of harm, this as a basis for determining the need for improved control measures.

**High Risk.** Work activities should not be started until the risk has been mitigated. Significant resources may have to be allocated to mitigate the risk. Where the risk involves work in progress, urgent action should be taken.

**Extreme Risk.** Work should not be started or continued until the risk has been mitigated. If it is not possible to mitigate risk even with unlimited resources, the work should remain prohibited.

- The Safety Manager will assign duties for the preparation, review communication, coordination and implementation, of the work method statement and risk assessment process, to the concerned individuals of execution team.
- Details on who is doing the work and the respective disciplines, numbers involved, date
  of preparation and reference number to be supplied by the individual responsible for
  managing and controlling the work an outline definition of the work scope to be
  provided, and then any risks identified in terms of high potential, should be highlighted
  and addressed as part of the stage two procedure on risk assessment.
- It is essential for the purpose of this procedure that all tools and equipment are listed and a Performa providing a list of considerations should be reviewed against the previous sections and after undergoing the approval route of this procedure, an assurance regarding communication should be made that parties involved with the task are fully aware of the steps, procedures and considerations necessary to undertake the task.
- Following the completion of the work method statement Performa, an evaluation will be made as to any identified hazards which shall be ranked in order of magnitude against the list of hazards.
- The rankings are given as low, medium and high in terms of probability and severity, the assessment should therefore be based on what the hazards are and what potential exists for injury or property damage. In other words, risk rating i.e. low, medium and high = severity x probability.

#### 9.5. Risk Controls:

- The hierarchy of Risk/Hazard Control is used to determine risk reduction measure in order of their effectiveness, as follows:
- Elimination or substitution of the task / job step or substance.
- Engineering Control
- Including guarding and mechanical aids such as scaffolding, extraction ventilation and alike Administrative Controls.
- Including permits, training, signage, reduction in time or personnel exposure
- Personal Protective Equipment
- Control of Ignition Sources

#### Factors Contributing To Fires:

To eliminate chances of fire, its causes must be identified. The most common ones are summarized below:

- Electrical Safety: This is a leading cause of fire. Most electrical fire starts in wiring and can be prevented by proper installation.
- Smoking: Smoking must be strictly prohibited in storage area. It can be permitted in clearly designated safe areas only.
- •
- Static Sparks: Ignition of flammable processes getting out of control, chemicals reacting with other materials, and decomposition of unstable chemicals can cause
  - fires. These can be prevented by proper operation, Instrumentation and controls; and by careful handling and storage, particularly avoiding conditions of heat and shock.

## 10.0. Incident Accident Report and Investigation:

- 10.1. Incident Report:
  - The objective of incident reporting, investigation & analysis is to identify the cause(s)
    of an incident to allow for preparation of recommendations, to avoid recurrence of
    such incident(s) in future.
  - As soon as an incident occurs, Supervisor/Area Engineer will immediately inform the Area Supervisor, who will communicate the incident to the HSEHead.
  - For a restricted work injury/lost time injury/fatal case or any serious incident involving damage or loss to property or a near-miss, email to PM, Initial Incident Report, within one hours of the incident; a copy of the report will also be provided to.
  - If an injury results from an incident or causes damage to the EMPLOYER assets, HSE Engineer would classify the injury and estimate the cost of damage.
  - HSE In-charge will issue a Weekly HSE Report to Head Office, with one copy to.
  - In the internal Weekly Site Meetings, HSE Head shall brief the attendees about the incident(s).
  - The HSE Engineer, covering each and every incident, including all the first aid cases shall also fill monthly injury record format.
  - One copy of the monthly injury record shall be sent to Head HSE while one copy of each report will be kept in the office of the HSE Manager.

#### 10.2. Incident Investigation:

- As soon as an incident occurs, the Area Supervisor and HSE Head shall go to the location and investigate the cause of the incident.
- HSE Head will involve the Site Manager and together take immediate corrective action(s), if required.
- As soon as possible the HSE Manager and Site Manager with input from the area engineer will compile an incident report. The incident report should include where appropriate, statements from the people involved, eye witnesses and technical experts.
- Based on the incident report the HSE Manager would indicate responsibility for the incident and make recommendations on the corrective actions on the incident Report.

## 10.3. Accident Report:

The objective of accident report and investigation is to Identify the causes, draw lessons, avoid reoccurrence, and specify the procedure. The following accident report and investigation procedure, include near misses/incidents.

 As soon as an accident occurs, the partles or relevant personnel as supervisor, engineer, team leader, etc. at site, must immediately inform Site Manager and Safety Head.

### 10.4. Accident Investigation:

As soon as an accident occurs, Safety Head, Site manager shall go to the site and investigate the cause.

- Safety Manager involve the Site Manager and together take immediate corrective actions.
- As soon as possible the Safety Manager and Site Manager will compile an accident report after investigation. The accident report should include casualty, causes, responsible personnel, witnesses and technical measures.

#### 11.0. Permit To Work:

PTW procedure will be followed at operations. The Work Permit System incorporates procedure, commonly used to ensure that necessary communication takes place and hazards are controlled. Project areas are potentially hazardous. However, people using proper procedures can perform work tasks efficiently and safely.

## 12.0. Emergency Response:

## 12.1. Emergency Communication:

Mobile Phones will be the main communication method for emergency purposes. Location of accidents should be clearly communicated by area according to the area identification system. All emergency contact numbers should be saved on all project line management's mobile phones. All emergency contact numbers should be clearly displayed in all project site working and office areas.

| Emergency Telephone Number |    |  |  |  |  |
|----------------------------|----|--|--|--|--|
| Police Help line           | 15 |  |  |  |  |
| <b>_</b>                   |    |  |  |  |  |
|                            | ,  |  |  |  |  |

## 12.2. Emergency Response Plan:

Relying on emergency rescue system, according to actual engineering Project will formulate and publish the following site response plan, as an emergency response guidance documents.

- Site response plan for falling accident
- Site response plan for mechanical injury

- Site response plan for electric stroke
- Site response plan for fire accident

## 13.0. Emergency response drill:

- Emergency response drills shall be conducted based on Risk Assessment but at least quarterly and Risk assessment will be conducted after the TSF construction. Emergency drill should be carried out on quarterly basis.
- The observations and debrief notes shall be recorded. Safety Manager shall analyze the findings and identify any remedial actions required.
- The emergency procedure shall be updated from time to time to reflect observations made.
- Training shall be conducted on regular basis for emergency response teams.
- The location of emergency facilities e.g. firefighting appliances shall be clearly identified on plans displayed at conspicuous locations.
- Shall be also very clearly marked on this plan.

## 13.1. Plan C Emergency Procedure:

In an emergency or on hearing the Stop Work Alarm, every employee shall ensure the following:

- All work is stopped at once.
- All equipment is shut down and put in a safe place.
- All men are evacuated to a pre-determined assembly point in an orderly manner.
- No one is permitted to return to work until notification has been received from operations or from the company representative that it is safe to do so.

## 13.2. Emergency Layout Plan:

To be added at site

## 14.0. Safety Work Practices

!

## 14.1. Electrical:

- The Electrical HV side to MV generation, prior to back energizing all HSE
  precautionary measurements should be taken, and confirm with concerned
  department. All work on electrical equipment is subject to 'Permit to Work'
  handled by key persons.
- All electrical work, installation, modification and wire capacities shall be in accordance with the pertinent provisions of the national electric code, and shall be approved by contractor's electrical engineer.
- All temporary power panels shall have covers installed at all times. All open or exposed breaker spaces shall be adequately covered and is subject to the approval of contractor's HSE Manager and/or electrical engineer.

## 14.2. Mand & Fower Tools:

All hand tools shall be kept in satisfactory condition and used only for the purpose for which they are designed.

Regularly cleaned and, where necessary, slightly oiled to prevent corrosion.

- Non-conductive and properly insulated hand tools will be used in areas where activities are exposed to electrical risks.
- Appropriate type of hand tools will be used depending upon the nature of work, as determined by the competent foreman or supervisor.
- Damaged hand tools will immediately be taken out of serviced and repaired.
   If the damaged tool cannot be effectively repaired, it will be removed from Client facilities.
- All applicable requirements of Hand Tools and Power Tools will be adhered. All Power tools shall be kept in satisfactory condition and used only for the purpose for which they are designed. Prior to use, power tools shall be inspected and tested to ensure safe operating conditions. Periodic inspections shall be made to assure safe operating conditions.
- A designated competent electrician to conduct a periodic and ensure proper maintenance is performed on all power tools.
- Rotating tools, such as grinders, will have to be switched off and held until rotation has completely stopped before they are set down.
- Only authorized / competent persons will be allowed to operate portable power tools.
- ONLY the designated competent maintenance personnel will perform repair of defective power tools
- ٠

#### 14.3. Work At Height:

All subcontractors must take three-step systematic approach to protect the employees who work at height from falling. This approach consists of falling elimination, falling protection and falling arresting.

**Falling Elimination**: The first step in this approach is to assess the workplace and the work itself in the earliest design/engineering stages of the project/site and during the planning stages of all work. The objective is to eliminate all fall hazards..

Falling Protection: The second step in continuous fall protection also requires assessing the workplace and work processes. If fall hazards cannot be eliminated during the first step, management must take a proactive approach to the prevention of falls by improving the workplace. Early installation of stairs, guardrails, barriers, and travel restriction systems can ensure a safe work environment.

Falling Arresting: The third step, the last line of defense against falls, is to use fallarresting equipment. Use fall-arresting equipment, however, ONLY after determining that potential falls cannot be eliminated by changing work procedures or the workplace. Equipment such as harnesses, lanyards, shock absorbers, fall arresters, lifelines, anchorages, and safety nets can reduce the risk of injury if a fall occurs. Carefully assess the workplace and work processes to select the most appropriate equipment and to install and use it correctly.

#### 14.4. Ladders:

When using A-shape ladders, both side should be fix tight, no standing on the top side, no position change allowed on ladder. When operate on slippery surface, ladder foot should be fixed with cloth or other measures.

## 15.0. Hazardous Materiai:

Any substance or compound that has the ability to produce an adverse health effect in a worker

## 15.1. Guidelines:

Subcontractors and vendors who introduce a material onto the Project shall provide a Material Safety Data Sheet (MSDS Annexure:008), if available, shall be submitted to the Site HSE office.

## 15.2. Emission Control:

Air quality emissions associated with the project are to be managed during construction. These potential impacts include:

- Emissions to the atmosphere generated by combustion of fuel from construction plant including small volumes of particulates, carbon monoxide, carbon dioxide, hydrocarbons and nitrogen oxides.
- The Contractor shall control dust and other airborne emissions from such activities as, but not limited to, vehicular and machinery movement, demolition and/or decommissioning of existing structures, stockpiling of soils or other construction materials.
- Burning of refuse or other material is prohibited, to control emissions to the atmosphere due to construction activities including small volumes of particulates, carbon monoxide, carbon dioxide, hydrocarbons, etc.
- Construction machine and equipment will be well maintained and regularly serviced so that vehicular emissions remain within relevant air quality guidelines and standards.
- Investigate and implement corrective/preventative control measures, and report corrective action.

## 15.8. Noise Control:

#### 15.3.1. Hazard Identification:

The steps that must be taken in order to effectively and efficiently control the noise in the workplace are:

- Identify the sound sources: vibrating sources.
- Identify the path of the noise from the source to the worker.
- Determine the sound level of each source.
- Identify solutions by taking into consideration the degree of sound attenuation, operation, and productivity restraints and cost.

## 15.3.2. Control Measure:

The exposure to noise can be reduced by eliminating the source of noise (if possible), substituting the source with a quieter one, applying engineering modifications, using administrative controls, and by using protective equipment.

#### 16.0. Housekeeping:

- Housekeeping is the act of keeping the work environment cleared of all unnecessary waste and materials thereby providing a first-line defense against accidents and injuries. Housekeeping is the responsibility of all site personnel.
- The main road in construction site should be smooth, firm, clear and keep regular watering to reduce dust, advocate beautify, hardening.
- The construction site must be standardized enclosure, make it tidy and nondestructive. The site should be neat and clean, smooth drainage, garbage should be placed at fixed-point and removed regularly.
- Machinery, equipment, materials such as woods, bricks, sand and so on must be classified and placed neatly with sign broad.
- Site area should be identified respectively with safety signs and warning signs.
- Construction site must be kept clean by three work: clear after work, clear the rest of materials, clear remaining work.
- In the duration of construction process, everyone must respect the neighbors, no disturbing.
- Mess must be cleaned up daily and kept tidy at all times. Cook should have health certificates.
- All spillages of liquids, especially oily or greasy liquids, shall be immediately cleared by absorption in inert sand or other sultable materials. All material used to mop up spills shall be immediately removed to a safe place and stored in closed containers for safe disposal.
- Tools, equipment and raw materials at the workplace should be kept to a minimum, commensurate with efficient working practice. Finished work, tools and equipment should be removed as soon as possible to the area defined storage, such that the workplace is maintained clear.
- Any instances of poor housekeeping that results in the creation of a tripping, slipping or fire hazard shall be immediately dealt with.
- Materials shall be stacked or stored in a safe manner that prevents sliding, falling or collapse.

#### 17.0. Site Security:

The site contractor has the overall responsibility for security access control at the project.

#### 17.1. Control Measure:

All project employees, including subcontractors and/or vendors and visitors shall use only the designated gate for entrance and exit to and from the job site and lay-down facilities. Access of project personnel, subcontractors, vendors and visitors, vehicles and equipment will only be allowed with a valid entry pass.

## 17.2. Identification Control:

Security will conduct random searches of vehicles, property and personal carry items of project personnel and visitors as they enter or exit the project. Bags and attach

cases hand-carried by persons authorized to have access shall be voluntarily presented for inspection to the security guards on duty at the main gates.

## 17.3. Material Concol:

All tools and materials, other than trash, that is removed from the project must be accompanied by a material gate pass. All trash that is removed from site will be checked by security to verify the content.

#### 17.4. Incoming Material:

All packages for delivery to personnel on site shall be inspected by the security guards at the access gates. The addressee shall be informed about the arrival of the package prior to inspection. After inspection, the package may be collected by the addressee, or stored in the Security office, depending on the addressee's advice or the contents of the package.

## 17.5. Outgoing Material:

All supplies, materials and equipment to be taken off the site or lay-down facilities shall be presented for inspection to the security guards on duty at the gate and signed off by the supervisor. The corresponding gate pass for said items shall be presented to the security guards on duty. A designated representative(s) of Management must sign the material gate pass to authorize material exit. All signatures will be checked against a list of authorized signatories, which will be maintained at the security office. A copy (original) of the gate pass shall be retained with the Security.

#### 18.0. Fire Frevention:

## 18.1. <u>General:</u>

Contractor shall appoint a Fire coordinator with adequate training and experience in fire prevention and firefighting to coordinate the Sub Contractor's overall fire prevention and firefighting program, fire prevention/fighting training program, and the training of Fire-watchers at the jobsite.

#### 18.2. Fire Prevention Guide:

- Good Housekeeping shall be maintained in all work areas. (Accumulation of
- flammables is prohibited.
- Fire protection equipment will be provided in all areas where combustible materials are present. Regular inspections will be made by the Safety Department to assure that fire extinguishers, hydrants are in good working order.
- A clear access to all fire protection equipment will be maintained. (Including extinguishers, hydrants, etc.
- Fire protection equipment is to be used only for that purpose.
- Smoking will be permitted only in designated areas.

## 18.3. Requirements:

Contractor/Subcontractor shall at a minimum comply to the following requirements:

- Adequate distance for firefighting equipment shall be maintained.
- Provide portable or permanently mounted extinguishers shall be available within 10 meters of a workforce involving welding, burning or the use of an open flame.
- All fire prevention/firefighting equipment shall be inspected monthly to ensure they are in a good working order and replaced if faulty. Records of inspections shall be maintained for review, as applicable.
- Extinguishers shall be conspicuously located where they shall be readily accessible and immediately available in case of fire, and their locations shall be conspicuously marked. Extinguishers shall be installed on hangers or in the brackets provided.

## 19.0. Engagement of Maff and Labour:

- 19.1. General:
  - The object of the act is to provide for health, safety and welfare of the workers and to regulate the employment in the factories.
  - The law is meant for the welfare of the worker and as such the beneficial operation of the legislation should not be limited.
  - The underlying sprit of act is to eliminate condition which so often renders the job in the factory hazardous, unpleasant, monotonous, and even lacking in comfort.

## 19.2. Labour Law:

Article 11(3) of Pakistan' constitution expressly prohibit the employment of children below the age of fourteen years in any factor, mine or other hazardous employment.

The factories act,1934 allow the employment of children between the age of 14 and 18 years provided that each adolescent obtain a certificate of fitness from a certifying surgeon

Under the employment of children rule anyone who employs a child to work in contravention of the constitution is punishable by imprisonment from a term extending up to one year or may be fined up to 20000 or subject to both.

# Sub HSES Plans/Policies

Security Management Plan Health and Safety Policy Health and Safety Policy Health and safety handbook Emergency Response Plan Safety Practices and Procedures Code of Practice for hezardous equipment and materials Traffic Management Plan Environmental Policy Environmental Procedures Manual Hazardous waste management procedure Emission and dust control procedure Noise omission and control procedure Water conservation procedure Policy on sexual harassment

Adult worker manor woman maximum working time daily should not exceed more than 9 hours a day. In case seasonal factory 10 hours.

# MINUTES OF MEETING

| Meeting Attendees: | Location: |
|--------------------|-----------|
|                    |           |
| ······             | ····      |
|                    |           |

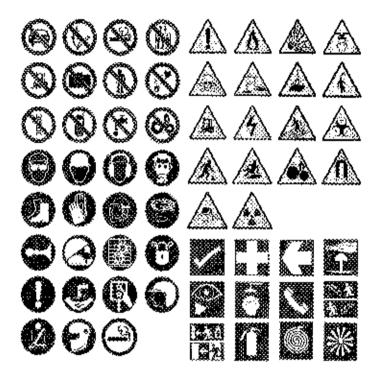
Meeting Date:\_\_\_\_\_

| bility    | Responsibil | Current status | Resolution {          | Description                           | Ref#                                  |
|-----------|-------------|----------------|-----------------------|---------------------------------------|---------------------------------------|
|           | ·           | · ·            |                       | · · · · · · · · · · · · · · · · · · · | i                                     |
|           |             |                | · · · · · · · · · · · | ·····                                 | · · · · ·                             |
|           |             |                | ·                     |                                       | ••••••                                |
|           |             |                |                       |                                       |                                       |
|           |             |                | ф                     | ·                                     | ·· : ··                               |
|           |             |                |                       |                                       | · · · · · · · · · · · · · · · · · · · |
|           |             |                | ļi                    |                                       | ·                                     |
|           |             |                | ┥∔                    |                                       |                                       |
|           | ~~          |                |                       | ·····                                 |                                       |
|           |             |                |                       | ····                                  | <u> </u>                              |
|           |             |                |                       |                                       | ·                                     |
|           |             |                | L                     |                                       | ·~···                                 |
|           |             |                | L!                    |                                       |                                       |
|           |             |                | ļ                     | <u> </u>                              |                                       |
|           |             |                | <u>i</u>              |                                       |                                       |
|           |             |                |                       |                                       |                                       |
|           |             |                |                       | · · · · · · · · · · · · · · · · · · · |                                       |
| _         |             |                |                       |                                       |                                       |
|           |             |                |                       |                                       |                                       |
|           |             |                |                       |                                       | :                                     |
| ···· · ·} |             |                | 1                     |                                       |                                       |

## Action Item Summery

# Site Safety Signs List:

i



## Environmental Site Inspection

| اماممط    | 1    |
|-----------|------|
| <br>hecki | ោទ្យ |

Note: This form is designed for general use and may not be exhaustive. Modifications and additions may be necessary to suit individual projects and to address specific environmental issues and associated mitigation measures. Project : Bits Lousilon -

Construction stage / status during inspection : Inspection Date : Inspection Time : Inspected by ; Weather : . . . . . . . . . . . Remarks Implemented? itio, apecity togation, good practices, Inspection items N/A problem observed, possible cause of nonconformity and/or proposed Yes 20 corrective/ansventative actions) Air Pullution Control 1. 1.1. Are Rus construction enes watered to minimize generated? dust 1.2. Are stockpiles of dusty materials (size with more than 20 begs coment) coverad or watered? Cermotit debagging process undertaken in sholtered areas
 Are all vehiclos carrying dusty loads coverad/watered even prior to seaving the site? 1.5 Are corrolition work areas watered? (e.g. biraming activities by using toreaker) 1.6. Are dusty roads peved and/or sprayed with water? 1.7. Are dist controlled during Are plant controlled surmo;
 percussive dolling (c rock)
 breaking?
 1.8. Are plant and equipment well
 maintained? (any black emote
 occervod, steese indicate the plant/oquipment and location) 1.9. Is dark smoke controlled from plant? 1,10. Are there enclosures around the main dust-generating activities? (B.g. grout Inixing) 1.11. Hoarding (nut <2.4m) provided elong boundaries and property: maintained (any domage / opening observed, pieses indexte the bordies. the location). 1.12. Are speed control measures applied? (e.g. speed limit sign) 1.13. Others (please speed) \_\_\_\_\_

Page 1

#### **Hazardous Waste Checklist** Hazardous Waste Inspection Checklist inspection information Contained or area being inspected (number/contents/todation); Date and time: Date lest respected: enspection completed by: Hazardous Waste Y7N **Corrective** Action 223 Employee Are controllers property and clearly labeled ("Razardous Waste." the specific contents, and the Responsible cofraction date)? Are containers tightly closed? ------. . . . . . . . Ats wastes stored in compatible containers? is there evidence of container dotorioration? Are spaces between containers clear of dearls? Are incompatible wastes proparly segregated? Are there any signs of teaks or splits? . . . . Is aply response aquipmont,adequate and accessible? Does each container havs adequate secondary containment for its volume? If required, is an events in second ob-and ready for use? Are "Hazardous Waste" signs in place and

Annexure 005

olearly visible?

waste storage area?

and grounded/bonded?

is a tire extinguisties in place and clearly visible? }

Are all waste containers stored baids the

Is the total volume of wostos stored below the facility's generator status? Ato flammable wastes property stored

| General  | Needs<br>Repair | Condition<br>OK |
|--|-----------------|-----------------|
| Splinters on side rails and legs                         | ø               | ü               |
| Joints tight between the side mit and steps              | 10              | ()              |
| Metal hardware is secure,                                | Ð               | 13              |
| Spills in side rais                                      | n               | D               |
| Couges, dents greater than 10% of intokness              | ¢1              | a               |
| steps, tops or platforms                                 | 8               | 57              |
| Play of ½ luch in the rails due to loose rungs or steps  | Ω               | C1              |
| Broken or boot guide frans, sprauder or looks            | ©               | Ü               |
| Rusted or corroded spots                                 | С               | Ē               |
| Damaged or wom non-slip bases                            | 13              | ų               |
| Rivets shoared, pulled through, uncuried, konsened       | a               | G               |
| Steplacklers   |                 |                 |
| Loose or bent hinge spreaders                            | Q               | D               |
| Stop on hinge spreaders broken                           | 0               | <b>[</b> ]      |
| locse hages  | £3              | ρ               |
| Damage to the pail shelf                                 | f.1             | b               |
| Extension ladders  |                 |                 |
| .oose, broken, missing extension tocks                   | . a             | ដ               |
| Defective locks that do not seat property                | C (             | ü               |
| eqes to dollarioneloc                                    | . <b>¤</b>      | Ŋ               |
| Foxed ladders  |                 |                 |
| .cose worn or demaged rungs or side rais                 | ۳.              | c               |
| Damaged or corrocted parts of the cage                   |                 | ΰ               |
| Connided botts and rivet heads on inside of metal stacks |                 | c,              |
| Damaged or conocled handraits or breckets on pladarms    |                 | 10              |
| Neakened or damaged turgs on brick or concrete slabs     |                 | æ               |
| Sase of ladder obstructed                                |                 | ŝ               |

# Ladder Inspection Checklist

If any item needs repair tag the ladder 'Do Not Use' and remove from service.

|            | ••••••        |  |                      | Parn                                     | nil to We    |         |  |             | Penal No:                              |           |
|------------|---------------|--|----------------------|--|--------------|---------|--|-------------|--|-----------|
|            | <b>.</b>      |  | Price                | Si da sen: Yarûg (ter Me                 | ne (ölen 124 | nov.    | a vitrostreautoovanity                         | 4           |  |           |
| _          |               | est Section  |                      |  |              | 0       | 2000-000-000-000-000-000-000-000-000-00        |             |  |           |
| <b>.</b> . | ، محرک        | of Work Requesies,                                   | <sup>-</sup> ∺∞ ₩    | orh 👘 Colle Wa                           | n 's         | Jee     | iotool Additional                              | Percell     | s Required;                            |           |
| {          | ៍ រទ          | EA completeletecter                                  | ð                    |  |              |         | 1010 Perm                                      | ıli≭        |  |           |
|            | issue         | Liager Tallie  |                      |  |              |         | Continue St                                    |             | any 9                                  |           |
| 1          | Explici       | a Dote: Time   |                      |  |              |         | Graund Dia                                     |             |  |           |
|            | Looat         |  |                      |  | D 🔐 (        | a       | Contractor GampMay                             |             | ~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~ |           |
|            | :             | iption of Work                                       |                      |  | · · ·        |         |  |             |  |           |
|            |               |  |                      |  |              |         |  |             |  |           |
|            | Conte         |  |                      |  |              |         |  |             |  |           |
| 2          |               | t PersorvSuperviser                                  | CALCUID G            | mpicted by Partoin                       | Plaze No.    |         |  | 3 N 2       |  | Yeperes   |
| -          |               |  |                      |  | 1 marie fact |         |  |             | Рафія Біезьтору                        |           |
| 88         | Edrild        | ment Condition                                       |                      | optoleo og Parlorn                       | ios Autop    | 4       | and Veritted by heaven                         | o Avin      | onty                                   |           |
|            | យ៍            | Oul ⊯ Şervi¢e  | ត                    | O2provagneć                              | i.           | ť.      | 2)-Risen                                       | Aim         | usphere shorked for:                   |           |
| z.         |               | in Szavios<br>Dechargiostifiscāgaja                  | 띧                    | Neoscealego<br>Locked see                |              |         | NOS EXPANSIÓ                                   |             | 5. C/14 (8-1                           |           |
| - T        | 뜅             | Mediniously Emergized                                | 1.1                  | Соскед Бол<br>Сірафија орел              |              |         | · · ·  | · ·         |  |           |
| :          | : ``          | Gitter Danscorps.                                    |                      |  |              | • • • • |  | [           | PPM loc                                | i koej    |
| 20         | Work          | Hazonts  | Co                   | noioteo BV Parlimin                      | Mat Author   | ni.     | and wannied by leguin                          | 1           | and Second Second                      |           |
|            | <u>, o</u>    | 214075   | C                    |  | Ţ            | 2       |  |             | ****                                   |           |
| . :        | : <u>Q</u>    | Fower tools  | <u> </u>             | Chygon doliciumry<br>Try Stocarbon yngwr | 0            | -       | Phone Leaves                                   | ĉ           | Нособизмерлии)                         |           |
|            |               | Vice of Cor  |                      | Channeo: naa//wr                         |              |         | Walking of herefolds<br>Steelman               |             | Cold en ingrogely                      |           |
| 4          | 님             | Лофи понулика  | 8                    | 55054000066                              |              | 9       | Oversiad wark                                  |             | i Antony Pallog<br>Phalang segona      |           |
|            | Ē             | Service Wood A                                       | Ē                    | Seconds of Ignition                      |              |         | Eye have do                                    | 2           | estany sejesa<br>Mga natap             |           |
|            | . 🗑           | Annelses cal Mang                                    | ă                    | Expansion                                | Ē            |         | HapCold and some                               | 님           | Stheep eigenty.                        |           |
|            | - 10 L        | Stored energy  |                      | istate and strategy as                   | • •          | -       | Welking/Working sustance                       | ä           | SwoobSve moties                        |           |
|            |               | Ottos: Nerende.                                      |                      |  |              | \       |  | _           | MSDOV                                  |           |
| 98X        | Contr         | ols 6  | О́Ю.                 | notested by lossening                    | and amound   | ۴ł      | inerily of the second second                   |             |  |           |
|            | ° g           | Оалбоераз  | ß                    | P-MH waterr                              | Ç            | 1       |  | <u>ii</u>   |  | 000000000 |
|            | - 8           | Парлал кодото  | 岩                    | Plantaky include public                  | ikat E       |         | Additional Baccellog www.<br>Additional Agents | _ <u>Q</u>  | Tracio)<br>Téolo: 2011 (2020) device   |           |
| _          | 8             | F05.0  | ö                    | idented to carry or op,                  |              |         | All Cover request                              | 6.1         | -340X                                  |           |
| ₹.         | : <u>C</u>    | Linki 2 Kilk Associated)<br>Conspond (symmetry mappe |                      | Use sag )ava                             |              | _       | Generation in a short exists                   | аас Тури    | 4                                      |           |
|            | 0             | Additional processes                                 |                      |  |              |         |  |             |  |           |
|            | <u>500.00</u> | e Activity and a service of the 188                  | રહેલ્ટ્રીસી પ્રત     | iedates.os                               |              |         |  |             |  |           |
|            | PPF<br>L      |  | C vy                 | adoled by Parloan                        | lng Author   | i.      | sight become Authority.                        |             |  | - 2-22    |
|            | ីកី           | diandard Registed PPD:                               | (solely <u>inp</u>   | f bools, transfers, coder,               | X 934142)    |         | iii<br>[]: Protestive soft                     | 1ape        |  |           |
| :          | 5             | Platibes honis<br>Pase shok/soggles                  |                      | Cooling vite:                            |              |         | 🔁 Rospitator, 1y                               | ro i        |  |           |
| ຮ່         | · H           | Haming proveling                                     |                      | Robertop ougt<br>Divide                  |              |         | Diaves, Yyjst<br>Fileti@al-nors                |             |  |           |
|            |               | Soppled et   | ω.                   | Safety barrison longer                   | dfodaalo     |         | D 1750   | ະ.ຫຼະ<br>ຕິ | -<br>8 m.                              |           |
| :          | 8             | Any according PPE                                    |                      |  |              |         | 10.05  |             | 46 eu:                                 |           |
|            |               |  |                      |  |              | -       |  |             |  |           |
|            | Autho         | rization   | ः अस्ति              | NUL & NOT Voled Line                     | li Standal   |         |  |             |  | 2.0       |
|            |               |  |                      |  | Prior        |         |  |             | 22gn                                   |           |
| •          | Padom         | NUD Approxity  |                      |  |              |         |  |             |  |           |
|            |               |  |                      |  |              |         |  |             |  |           |
|            |               | Automly  |                      |  |              |         |  | ~~~~~       | ·····                                  | ~~~       |
| 7          | Ance A        | othersty/Fachity Manager                             | :                    |  |              | _       |  |             |  |           |
|            | News          | d heating Astrony (SINC                              | ж <u>я</u> 184к      |  |              |         |  |             |  |           |
| L          | .il<br>Are    | a Astronty noticed by pa                             | ince and a           | vaniovas (fai silice in                  | ALC: MOLES   |         | D-4+02   |             |  |           |
| - 1        |               |  |                      |  | over a work) |         | 1100.1000                                      |             |  | ·         |
|            | Paroni        | C <u>errific Alea Aubic (ist</u> w<br>( Sign Off     | (dis work in<br>Colo |  |              |         |  | 000000      |  |           |
|            | ~~ <u>C</u> " |  |                      | 12                                       |              |         |  |             |  |           |
| -          |               | Ward Chaustain                                       |                      | When means                               | We Masse     | 94      | l executions                                   |             |  |           |
|            |               |  |                      |  |              |         |  |             |  |           |
| θ.         | Par           | alisen <b>g</b> Asalisnay                            |                      |  |              |         | e: Astiseardy                                  |             |  |           |
|            |               |  |                      |  |              |         | d; Authority                                   |             |  |           |
|            |               |  |                      | QONY OF PROVIDE                          | non be gt    | , v     | sh Losatina                                    |             |  |           |
| :          |               |  |                      |  |              |         | -  |             |  |           |
|            |               |  |                      |  |              |         |  |             |  |           |

#### CONFINED SPACE EMTRY CHECKLIST

#### Conduced Space Lucation/Decoription/D Nukober:\_\_\_\_\_\_Date:\_\_\_\_Date:\_\_\_\_\_\_Date:\_\_\_\_\_Date:\_\_\_\_\_Date:\_\_\_\_\_Date:\_\_\_\_\_Date:\_\_\_\_\_\_Date:\_\_\_\_\_Dat

Entry Purpose:\_\_\_\_\_Supervisor:

| Hazards of<br>Confined<br>Space | Y96 .         | No      | Special Recomments                     | Yes      | No          |
|---------------------------------|---------------|---------|--|----------|-------------|
| Dxygen deficiency               |               | ~~~~~   | Hat Work Permit Respired               | {···     |             |
| Combustible gas/vanor           |               |         | LockoutTagout                          | ÷        |             |
| Compustible dvst                | 777777}       |         | Lines broken, capport, or bianked      | 1        |             |
| Carbon Morsoxide                | 1             |         | Purge-Rush and very                    | 1        | ·····       |
| Hydrogen Sullide                |               |         | Secure Area-Post and Flag              | **       |             |
| Foxic gas/vapor                 |               | ~~      | Ventilation                            | i        |             |
| loxic fames                     | 1             |         | Other-List:                            | i        |             |
| www.chemicathazards             |               |         | Special Equipment                      | j        |             |
| Becrical hexand                 |               |         | Breathing apparatus testicator         | 1        | · · · · · · |
| lechanical hazard               |               |         | Escape harress required                | j~       |             |
| ngukment hazzoc                 |               | ******* | Tripod emergency escape usid           | *******  |             |
| Intraprovent hazard             | · [ · · · · ] |         | Lifelines                              | †        | :           |
| narmal hazard                   | -1~~~~        |         | Lighting (explosive prout/low voltage) | <u> </u> |             |
| Slip or tail reazand            |               | ~~~~~   | PPE goggles, gloves, clattory, Mc.     | 1        |             |
|                                 | -1¥           |         | Fire Extinatisher                      | ;        |             |

| DO NOT ENTER IF P<br>LEVELS<br>AHE EXCEEDED | ERMISSARR E ENTRY  | Test Starl and Stop Thno<br>Start | "<br>Stop  |
|---|--------------------|-----------------------------------|--|
|   | Ponsileshie Ecory  |                                   |  |
| i   | Leve               |                                   | }  |
| % of Oxygen                                 | 1 19.5 % 16 23 5 % |                                   |  |
| % of LEL                                    | Lase mon 10%       |                                   | <ul> <li>A state of the sta</li></ul> |
| Carbon Montxide                             | 35 PPM (B15.)      |                                   | ****   |
| Hydrogen Sullida                            | (.cf 8) M99.01     |                                   | ~  |
| 108ior                                      | ~~~~               |                                   |  |
| Namo(s) or Parson(                          | e) leating:        | Communications P.                 | 02820125:  |

-----Test lostroment(s) used-include hame. Modet, Sensi Number and Date Last Calibrateri:

| CFIS-VeroSidion  | Size-Cubb;<br>Fed | Pre Entry Time  | þ       | Supervision<br>Notified Defere  | Time Nation:   |       |
|------------------|-------------------|-----------------|---------|---------------------------------|----------------|-------|
|                  |                   |                 | 1       | Bupervisor<br>Notified<br>Alter | Timo Nesilies; |       |
| Aviborized Ensiz | inte              |                 |         | Authorized Asea                 | danis          |       |
|                  |                   |                 |         |                                 |                |       |
|                  |                   |                 |         |                                 |                |       |
|                  | Contin            | ed Space Author | ize (b) | 0 and                           |                | ~~~~~ |

------

ł

Name\_\_\_\_\_Date\_Time\_\_\_\_\_ Environmental Safety & Health Department Form

.

|     | Chemical Inventory                     |   |                   |  |  |  |  |
|-----|--|---|-------------------|--|--|--|--|
| Sr: | Material Name                          | Manufacturer                            | MSDS<br>Available |  |  |  |  |
| ŧ . | • • •                                  |   |                   |  |  |  |  |
| 2   |  |   |                   |  |  |  |  |
| 3   |  |   |                   |  |  |  |  |
| 4   |  | • • • · · · · · · · · · · · · · · · · · | · ·               |  |  |  |  |
| 5   |  |   | ····              |  |  |  |  |
| 6   |  |   |                   |  |  |  |  |
| 7   |  |   |                   |  |  |  |  |
| 8   | · · · · · · · · · · · · · · · · · · ·  | n m                                     |                   |  |  |  |  |
| 9   |  |   | ***               |  |  |  |  |
| 10  |  | **************************************  | -                 |  |  |  |  |
| 11  |  | · · · · · · · · · · · · · · · · · · ·   | *                 |  |  |  |  |
| 12  |  | ~                                       |                   |  |  |  |  |
| 13  | · · · · · · · · · · · · · · · · · · ·  | -¦                                      |                   |  |  |  |  |
| 14  |  |   |                   |  |  |  |  |
| 15  | · · · · · · · · · · · · · · · · · · ·  | ······································  |                   |  |  |  |  |
| 16  | ·····                                  |   |                   |  |  |  |  |
| 17  |  | ·····                                   |                   |  |  |  |  |
| 18  |  | · · · · · · · · · · · · · · · · · · ·   |                   |  |  |  |  |
| 19  |  | ······································  |                   |  |  |  |  |
| ··· | · · · · · · · · · · · · · · · · · · ·  | ·                                       |                   |  |  |  |  |
| 20  |  |   |                   |  |  |  |  |
| 21  | · · · · · · · · · · · · · · · · · · ·  | · · · · · · · · · · · · · · · · · · ·   |                   |  |  |  |  |
| 22  |  |   |                   |  |  |  |  |
| 23  |  |   |                   |  |  |  |  |
| 24  |  |   |                   |  |  |  |  |
| 25  | ······                                 | ····· · ···········                     |                   |  |  |  |  |
| 26  |  |   |                   |  |  |  |  |
| 27  |  |   |                   |  |  |  |  |
| 28  | · · · · · · · · · · · · · · · · · · ·  |   |                   |  |  |  |  |
| 29  |  |   |                   |  |  |  |  |
| 30  | 0000.000000                            |   |                   |  |  |  |  |
| 31  | 00000000000000000000000000000000000000 |   |                   |  |  |  |  |
| 32  |  | [                                       |                   |  |  |  |  |

~ .... ....

# Fall Protection Checklist

|                | Pre-Join  |     | [ |
|----------------|---|-----|---|
| 1.             | Does this project implies a low-slope roof (4:12 or less)?  | Y   | N |
| ₽,             | Does this project involve a sieep-slope root (greater than 4:12)?   | Y   | N |
| <b>3</b> . '   | Is the distance from the roof to the ground or a lower level 6 feet or grazier?   | Ŷ   | Ñ |
| <del>4</del> . | is the roof a residential roof (dwelling) and constructed using residential-type methods (6.g., wood framing or trusses and sheathing)? | Y   | R |
| 5.             | If a residential root, is conventional fall protoction inteasible or does its use creater hazard?                                       |     |   |
| 5.             | Is the reof orea in proximity to dangerous equipment, machinery, open tanks or<br>electrical equipment?                                 | Y   | N |
| 7.             | Will the project involve use of a debris chole?   | Y   | N |
| 8.             | WIR the project involve a holst?  | Y   | N |
| ġ              | ts material and equipment storage located at loast 8 feet from the 1001 edge?   | Y   | Ñ |
| 10.            | Are there skylights or other dangerous structural openings on the roof (HVAC openings, southe holes, attiums etc.)?                     | Y   | N |
| 51,            | Are there any holds 2 inches wide or more?  | Y   | N |
| 12.            | Are there any permanent anchorages on the roof capable of supporting a 6,000 to the lifeline attachment?                                | Y   | N |
| 19,            | Will mechanics? equipment (such as roof cutters, power washers, power sweepers sto.) be used on the roof?                               | Ŷ   | N |
| 4.             | Does the roof have different levels?  | Y   | N |
| 5,             | Is the roof more than 60 feet wide?   | Y   | ĸ |
| 6.             | Does the roof have a parapet of basit 39 inches high?   | Y ~ | N |
| 7.             | Have at employees on the project been trained in fail protection?   | Y   | N |
| Ð.             | Have all employees on the project been trained in the use of the fall-protection system to be used on the project?                      | · . | Ñ |

.

#### JOB SAFETY ANALYSIS

| JOB SAFETY ANALYSIS          | JOB TASK:            | PAGE OF<br>NO | 354    | DATE:<br>REVIEW: | ©≊NEW<br>⊜∂revised |
|------------------------------|----------------------|---------------|--------|------------------|--------------------|
| INSTRUCTIONS ON NEXT FAGE    | EMPLOYEE JOB         | SUPERVISOR:   |        | ANALYSIS BY      |                    |
| ORGANIZATION:                | LOCATION:            | DEFARIMENT    | :      | REVIEWED BY:     |                    |
| REQUIRED AND/OR RECOVERED EN | D PERSONA), PROTECTO | E EOUIPMENT   |        |                  |                    |
| SEQUENCE OF BASIC JOB STEPS  | POTENTIAL HAZAFDS    |               | RECOMM | ENDED ACTION OF  | R PROCEDURE        |
|                              |                      |               |        |                  |                    |
|                              |                      |               |        |                  |                    |

Page 1 of 1

# Diesel Generator Inspection Check List

trapacied 57

| Serial<br>Ro | Subject                             | Obiowelan ( | Action to be Inken | Sentorbs. |
|--------------|-------------------------------------|-------------|--------------------|-----------|
|              |                                     | Yes/MO/RA   |                    |           |
| 1            | is the UG is freely accessible      | :           |                    |           |
| ···          | trancial aking                      | :           |                    | L         |
| ş            | The overall                         |             |                    |           |
|              | soust nuclearly condition of DB see | 1           |                    |           |
|              | 45 RCCEPT2882                       | <u> </u>    |                    | ·.        |
| з            | Weather she along acquirit 156      |             |                    |           |
|              | QLS set is asceptable?              |             |                    | i ·       |
| 4            | Were zer the DE K filler with       | 1           |                    |           |
|              | silesser?                           | (           |                    |           |
| 5            | Websycloan (55 operator 55          | 1           |                    | ·         |
|              | sweited                             | ļį          |                    |           |
| 0            | Weather the DG postato has          | T           |                    |           |
|              | follow-see die bookenig deed        |             |                    |           |
| 7            | Weather stud 3/S/2 phyored or       |             |                    |           |
|              | provided with a sited?              |             |                    |           |
| \$           | Weston the 05 easyout k!            |             |                    |           |
|              | diverted outside the shad?          |             |                    |           |
| 2            | Weather the cooles DG get and       |             |                    |           |
| i            | sound (covered                      |             |                    |           |
| £ΰ           | Wendher servourid area of the       |             | ******             |           |
|              | PG set to 5 Set from hommable       |             |                    |           |
| l            | material                            |             | 1                  |           |
| 11           | Weating mailance is provided        | ~           | ~~~~~              |           |
|              | on the bettery tormitial.           |             | i                  |           |
| 12           | Woother Rotry is realificted in to  |             | ~~~~~~             |           |
|              | the DG shed?                        |             |                    |           |
| 57           | Weather the CG shed is free         | ~~~~÷       |                    |           |
|              | from storage of personal            |             |                    |           |
|              | resteriut)                          |             |                    |           |
| 14           | Weather the rotación parts of       | ·····       |                    |           |
|              | ØG are-cately gaardve?              |             |                    |           |
| 25           | Weether there is any leakage of     | ~÷.         | ~~~~~              |           |
|              | iubsizetion, fuel, eij etc.?        | ;           |                    |           |

## **Checklist for Electrical Safety**

|   | 703     | No    | Action Required                        |
|---|---------|-------|--|
| Are all plugs, sockets and electrical littings sufficiently   |         |       |  |
| tobust for use in the factory?  | - 1     | 1     |  |
| Are as orectrical fuser junctions boyers in the factory secondly  |         |       |  |
| Fixed.  |         |       |  |
| Briston and Undamedials   | j       |       |  |
| Are heres, circuit breakers and other costinios: devices  | "       |       |  |
| ocesectly.  | - ?     |       |  |
| asted for the coould they proteou?  |         |       |  |
| to access to have excess prevacies, and the key held by a   | j       |       |  |
| responsive person?  | [       |       |  |
| Are main sweches readily occussible and clearcy ideosited,  | i       |       |  |
| with  | ł       |       |  |
| all workers knowing how to use there in as parangency?  |         |       |  |
| Are all electricity installians theoked periodically and  |         | ·i    | ······································ |
| renol/s-  |         | 1     |  |
| catcled cut by a competent electrician?   |         |       |  |
| Are there any calles or whes will out proper prairies, touter in  | rrrrð.  | ~~~   |  |
| loa   | ŝ       |       |  |
| lacioss7  | - {     |       |  |
| Are any electrical winds improperly revised at 199667   | ~~;     | ····· |  |
|   |         |       |  |
| is electrical equipment properly greatered to prevent   | ····†   | ~~~;  |  |
| £'820000000007/ [847  | ł       | ÷     |  |
| Are any electrical whos tours in size a reas ar sizeden   | · ·   · | ·-··; |  |
| witter?   |         |       |  |
| Are any otablication was abstrating alotas as passageways?  |         | ·     |  |
|   |         | 1     |  |
| Are all vision cloco has when securely there?   | ~-~~þ   | ÷     |  |
| and the strength offers and a cold strength (1981).   | Į       |       |  |
| ے ہے۔<br>روال کے اور اور اور ایک ایک کار کا میں میں کا کا کا میں کا |         | mul   |  |

Electrical fillage and includedions must be checked on a regular back.

## Monthly Fire Extinguisher Inspection

Check there delight during a identify the extinct-isher inspection.

- Confirm the ensinguisher is visible, uscout outed, and in its designated location.
- Verify the locking pin is intact and the temper seal is unbroken. Exercise the extinguisher for gradous gradies, curronion, leakage, or cleaged negate.
- · Continu dis pressure gauge or inclinator is in the green range, and ist the extanguisher to ensure it is set full.
- Make sure the operating instructions on the nameplate are logible and facing autward.
- Check the sast professions service date on the tag. (A knowed fire extragulated maintenance, contractor must have inspected the extinguisher within the past 12 modehs.)
- Initial and date the book of the tag.

#### Note: An A.S.C. the existing the can be used on all kinds of these

#### MURAVICANA INARAGEN ANDRE USED ENTINGUISHEDEN DIE MAIN OPPHIE AND SERE BERLAUUNTE BERTIST VOM ANDREAMER DASSEPTATELYS

| MONID     | TYPE<br>Fample: All(, Water | LOCATION<br>Ecosyle Med foll for solidatin Price or | INSPECTION DATE | SIGNATURE                             |
|-----------|-----------------------------|---|-----------------|---------------------------------------|
| Statemy   | }                           |   |                 |                                       |
| February  |                             |   |                 |                                       |
| 8 kovin   | 1                           |   |                 |                                       |
| Agril     |                             | ••••••  |                 | · · · · · · · · · · · · · · · · · · · |
| Мау       |                             | ~~~~~   |                 |                                       |
| Jusé      | 1                           |   |                 |                                       |
|           | 1                           |   |                 |                                       |
| August    |                             | ,,  | ~~~             |                                       |
| September | 11                          |   |                 |                                       |
| October   |                             |   | ···             |                                       |
| November  |                             |   |                 |                                       |
| December  | ··                          |   | ~~              |                                       |
|           | _!                          |   | <u> </u>        |                                       |

Principal/Operator Signature \_\_\_\_\_ Duite: \_\_\_\_\_ Preshy Location: \_\_\_\_\_ Duite: \_\_\_\_\_ Duite: \_\_\_\_\_

## Working at Height

#### Hazard Identification Checklist

This structlist is provided as help meangues identify hazardo and risks associated with working at height. IT IS NGCA RESEASCHERT and It is in means on exhaustive list.

Please answer zit of the following satisfiens. Theny masked box is ticked when an working to a question, this indistics that a tak is present and you should transfer it note a Societsi bisk Assessment from for further seekytis,

| Workplace / WAR Location:   |     |    |       |          |
|---|-----|----|-------|----------|
| Date of Ascessifient:   |     |    | ~~~~~ |          |
| Name of Assessme  |     |    |       |          |
| Joh Tile:   |     |    |       |          |
|   | Yes | No | N/A   | Comments |
| <ol> <li>is working at (wights available? consider<br/>alternatives, e.g. provision of long handled<br/>agailyment)</li> </ol>  |     |    |       |          |
| <ol> <li>If staff hows to work at helpht, is appropriate<br/>access equipment to available?</li> </ol>                          |     |    |       |          |
| <ol> <li>Flave you considered if staff should be working on<br/>a scaffold or platform rather than factors or steps?</li> </ol> |     |    |       |          |
| <ol> <li>We there be any risk of especials dust,<br/>disturbance or actionnent? (see premises<br/>aspostos rogistor)</li> </ol> |     |    |       |          |
| 5. Do any services (e.g. gas, electricity) need to be<br>isolated before work commerces?  |     |    |       |          |
| Seletov opione work contribute (  |     |    |       |          |

Page 2 of 3

#### Scattolding inspection Checklist

| Date Inspecied:             | राजांधः          | { Convactor: |
|-----------------------------|------------------|--------------|
| Location of Scalfold:       |                  | ) College:   |
| Inspected by (designated co | ៣០៩០១( ០៩ឆ្នោត). | Protect      |

ı

.

SCAFFOLD SAFETY INSPECTION ORECORDST - Use this let the remined yourist? of what is took for in order to prevent soliderile. Check pack Sen as yes upointed to the sen of work goorations and have pilote the instructive prevantions BEFORE USING THE SCAFFOLD-In Has his work twallen been examined inders the sent of work goorations and have pilote allestoprize prevantions been taken? (a.g., checking for evalued allyants, talling to tripping respond, upening only a door) Will the potection be received why a stirt the statistic? Will the coefficie been eable assorities to interference?

| General Rules for All Scottblds   | YES                                     | NO | Applicable |
|---|---|----|------------|
| Scalisid geingersone can expoort at least four lines their meannum intender load  | 1                                       | 2  |            |
| Scaftolo is fully granked- Ko mora (hpri 3° gap batwaen planks.   |   | 1  |            |
| Pis Korn is galasest 16 states wide (12 inches on stimp jecks).   |   |    |            |
| Guardralis are vacid or accessment fail extent averant is used, in your, acophuis violated<br>Guardrali averant <u>Top rail</u> <u>Motival</u> <u>Top boend</u> , Poste | · [~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~ |    |            |
| Resilture 15" or lease com fabel of work of workers resholve from guardiads (18" for<br>plesito(rs)   |   |    | ·····      |
| Pleaks do not extend onal the reading flip application frames more than \$2 (neises   | ;<br>;                                  |    |            |
| Couters are looked baland wants begins.   | <u>)</u>                                |    |            |
| Work platform free of alution bigg gill or any tripping barand  |   |    |            |
| <u> Maninger prover has elevanance (1946-91)</u>  | ;                                       | 1  |            |
| If the sattleid in oxide IVa, itas it seen recoved from service and tagged dut?<br>General Rules for Supported Scatteride   | :                                       |    |            |
| Height to base with ratio is: Lens than 4.4 Into passing, Ses, to breese requiring  | 1 .                                     |    | ·          |
| Over 4-1 seasons are acceled from opping to paying, using or bracing.   | 1                                       |    |            |
| All scatted barrans and uprigone unit been plated thand sills required if on stell  | i                                       |    |            |
| Focusings and Level, smooth, and right, He settling has passived.   | 1                                       |    |            |
| Direxhie objects sijen ve blocks, Mides, butains, etc. are not avors planams<br>ar te suppart seaflokts   | ]                                       |    |            |
| Art riggers secured and installed correctly?  | (                                       |    |            |
| Geoscal Rules for Access  | [                                       | Ì  | :          |
| My coure then 2' ster up of down if a 14' step across it get on or eff a distribution   |   |    |            |
| Legder rist sting is jot more they 24" above the proved   |   |    |            |
| Fook-on and aluppheten leviders are designed for the scatterd,  |   |    |            |
| Acking produkars must have a rang length of al lease 11 %   |   |    |            |
| Built in follows furt of the scattered thereast more barries have a much bench of at social at  | L                                       |    |            |
| Bongs lide up verbeally for Reporting beings of the seaffold.   | ł                                       |    |            |
| State & even int used for climbles up or shown from the sections.   |   |    |            |

# House Keeping Inspection Checklist

the this shocklist velow to detoroute if there are housekeeping loster to positive righter. If you are one the to any affin questions holds you may need to happened below increases ing provides in your workplace.

|  | Yee    | 8/A                                     | No     | Adves                                   |
|--|--------|---|--------|---|
| HEALTH AND SAPETY POLICIES   |        |   |        | ~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~ |
| See a characteristic according (an according to a solid to condition according to a solid to a solid to condition according to a solid to a solid to condition according to a solid to condition according to a solid to condition according to a solid  |        |   |        |   |
| ébore wurdents inconstantioned in general bassachrenning provintions and rada<br>Spécialing severatory sé  |        |   |        |   |
| we have been been based as a survey and a second presidents.   |        |   |        |   |
| there the reference may use to the second and the been election of the second mode and the second mode and the   | -      |   |        |   |
| es flower e report loge som her dies im place "dag groepe floatseke op ing<br>iterasje og, also oge poeldenes, breke oorpel proese barato weitiget bedee<br>Angerd Sollet, stel is   |        |   |        |   |
| NORK AREAS   |        |   |        |   |
| Are rel warde und surveys access for a floore herdered also de und vesser<br>Stronghund the newsplay?  |        |   |        |   |
| ethe access to this retains so, stall says, and case generates happeness<br>and applicated at settimes?  |        |   |        |   |
| is the sen as the adaptation first   | • ••   | •                                       |        |   |
| we reptileties galoos keet steat of day, details and shorecessory  |        | ·····                                   |        |   |
| XITS/ENTRAKCS  |        |   |        |   |
| exercite noise converse ways buggi transformation, discontral dry root to<br>real contribution of all frames   | ·      |   |        |   |
| are all or accession and projulation of provident?   |        |   | • •••• |   |
| #OUND/FLOORS/STAIRWAYS   |        |   |        | ****                                    |
| the floore post regis have not a product of the post of the section of the sectio |        | ~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~ |        |   |
| cord participation of the second state of the self-charactery for  |        |   |        |   |
| or Broos, stairs and accore ways been taining randed, clean, and do and  |        | • • • • • • • •                         |        | ·····                                   |
| a good condition at althouse?  |        |   |        |   |
| of the second  |        | •                                       |        |   |
| w water swife on agh for equipment and solory accessible?  |        |   |        |   |
| foress from costs and where been more relieve toped-down on they may<br>extension out in the work?   | ••• •• | • • • • • •                             |        |   |
| in cases and closes in morely and property?  |        |   |        | ···· •• ··· · ····                      |
| in her index on the start of the set in a particular is  |        |   | ,      |   |

.

| Fileprivers:            |              | ······································  | ·····      |  |
|-------------------------|--------------|---|------------|--|
| <b>101</b> 100039877777 |              | ······································  |            |  |
| 208/00/5-mbs            |              |   |            |  |
| Nape                    | 1 Draunallan | ······                                  | Senature   |  |
|                         |              | <u>,</u>                                | 1 360 HOLE |  |
|                         |              |   |            |  |
|                         | ~^~~~~       |   | f          |  |
| ·                       | -†           | ~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~ | ·          |  |
|                         | ~~~~~        |   |            |  |
|                         |              |   |            |  |
|                         |              |   | ;<br>;     |  |
|                         |              |   | <u> </u>   |  |
| ~~~~~                   | ··{          | · · · · · · · · · · · · · · · · · · ·   | L          |  |
|                         | ·            | nt saats aa                             | <u></u>    |  |
|                         |              |   | l          |  |
|                         |              |   | :          |  |
|                         | <u> </u>     |   |            |  |
|                         |              |   | ·····      |  |
|                         | <u> </u>     |   |            |  |
|                         |              |   |            |  |
|                         | }            |   |            |  |
|                         |              |   |            |  |
|                         | +            |   | ·          |  |
| ~~~~                    |              |   |            |  |
|                         | ·/····       |   |            |  |
| ·                       | +            | •                                       |            |  |
|                         | ·ተ           |   |            |  |
|                         | - <u>;</u>   |   |            |  |
| ****                    |              | ·····                                   |            |  |
|                         | +            |   |            |  |
|                         | <u> </u>     |   |            |  |

#### Printed version of this dovument in UNCONTROLLER

3

<u>Tool Box Talk Topics</u>: Work At Height, Importance of PPEs, Tools Inspection, Work Stress, Sharp Edges, Pinch Points, Electrical hazard, Fire Hazard, Entanglement, Manual handling, Hot Work etc.

#### **HSE RULES**

نې،كېللار اور دايلى تې،كېدنورون اۇ تمام نېر كاركنون كو كام شروع كېرنى سے بېلې BBE اورېتىرشان يېر گاريا بېوگا، نىڭبو گارېل لانىڭ انوچى بېرتىيوىت تمايلا كى HSE يا،دىر.كې حمدېنا اور HSE كې فواغد بار عمار كويا جارىي.

ذائی حداظتی مذمان میہا کرنا جانے کا اور جب شہرورت ہو تو بہنا جاہئے۔ مقاطعی جوتے ، سائٹ کے تمام حدموں ، ماسک ، مادستانے اور ایئر بلگس جیسے شہرورت کے مطابق سخت توہاں ، فرغیرہ

سالت پر نصب HSE بورنڈز بن دکھنے لے گئے پہندامان اور پندایات پر معل کریں۔ بینڈی اسمیٹی پوائنٹس اور اطرار کے راستوں سے آگاہ روپی، تسمیر بینڈی صورت حال ہیر گھررائیں نہ ، سانیہ کے بینڈامی ردسال کے طریقہ کار پر عمل کریں

تدام حادثانت کی اطلاع فوری عابور بر سانٹ پر نبایر سیرونانرو نور ارچ ایس ای آفلیسر کار دیں۔ زخمدود، کو فوری طور ار استدائی طبی اسدند قراریم کریں اور میڈر۔ ن حلب کریں۔

ایک معدود مگه میر، کم کرانے موال یہ بقدی بنانیں گه آپ کا قریبی ساتھی تور سھریاتار اچھی طرح کے انجبر تھے۔

جہی یات کو پنیپنی بیٹرین کہ بات کی شفاوں میں گام کے لئے یا بینگامی روضعلے لیک Odequate منتسب ریٹ نے کی مگاہ ۔ موجود بہہ -

تهميراتي فيهرود کے اندیشام کے متصوبے کے مطابق تمام سکریے ، فعضله مواد اور کمچنوں کو شافع کرنا پیوگا۔

لیؤکری یا دیدین ماندان کریز کے بعد بیمیشه کام کی سافٹ کو صافف کو یں۔ غیرویوں کے مطابق منامیب بڑاوقتی دیلرار وکھی۔ برق کیپلز اور الادن کے معاقبہ کنہیں چیپیز چھاڑ تہ کرہی۔ سائلت میں کمپھی بھی وولم ولسٹ کویٹیں داخلی نہ کریں ، بلک جنامیب پلگ استعمال کوہیں۔

اولردانی پر کام کررنی بر منتسب طور پر زوال کی گرفتاری کے مناسب نظام کے بغیر معترم بھے۔ مشہوط سالیڈ ریلنگ کی موجودگی کو رقبینی پیدانه نہی میں کوئی خلام لہیں ہونا چاہئی ٹور یہ یغینی بندنا چاہؤ گہ نمام نخیر مناسب طور پر محفوظ باہی

كېږي لويږ گرېټانش مال داخل نه بدون جس لک وساني 🔍 لېد لېگ تېنې يې.-

سپاروں یا سپڑھی کو جنروی بندی یا فیری جائے بقد، : کال یا مواد کاو تہیں لے جاتا جامیے۔ اس مدہب کے لئے باؤچ یا دسان استعمال کریں۔

الدېكرېدىد توشى فته كوين كونې كې كالاستخطار مصلوع ايم.

کام کی جگہوں پر تعام گیدک ویز اور گیوں کو صاف زکیجہ

کازیپی کو ایک نیز رفتان میں جاننا جامونی ، رفتار کی حدود کو دیکھیز موالی۔ ڈیندوروں کے یامن درست ڈیزاندونگ افٹا سلس سوتا ہر بری ہیں۔ کازیاں سرف مخصوص بارکنڈ والے علاق ہیں میں کھڑی کی جائیں گی۔

ł

.

| Denijnen; Same  | EHS Daily Report  | Form:<br>Hepselae | Bris Doly Repor                           |
|---|---|-------------------|---|
| Praject<br>Equipment<br>Missic<br>Set Bintlatics ; Il Sociudes<br>Set head Could mark hors,<br>sitematege & mit dispard<br>observations | Cutronier       Project       Project <th></th> <th></th>   |                   |   |
| EHS Isques;<br>Gio vast: Sown   | A Inddext     Autodext     Autodext | <br>              | દાન્લ, 6Rs 1.eec                          |
| EHS Corrective Actions:<br>Actions taken to Implexo<br>EVIS<br>Permits to work  |   |                   | <u>Site Tanın, SHS</u><br>9!ta Tazın, EHS |
|   |   |                   | erant to work was<br>swed by rustanser    |
|   | factallen Kapperen done by dugnemer.  |                   | Veriikad by EHS                           |
| 923HH ( 1505  |   |                   | КМЗ, Supervisor                           |
| Werk a belah:   |   |                   | SUpervisor, Grew<br>Teare                 |
| Come Operatings   |   |                   | Suctory)por                               |

|                                      | Major                      | & Critical Lift Per                        | rmit   | Jimus Doje                    |
|--------------------------------------|----------------------------|--|--|-------------------------------|
|                                      |                            | Mobile Crane                               |  | 1                             |
| Parten e (1998) Eroathy De           |                            |  |  |                               |
|                                      | C Fridagero                | 15.10 Say                                  | 454105/001   |                               |
| •                                    | i                          | 1  |  |                               |
| <ol> <li>Deve Manifecture</li> </ol> | 1. 0.22                    | 7,7914-6                                   | 1. The same line in the second   | A VE NO. POWER LESS           |
| 10. 150 Conne Aure Mires 2.          | S Stepter And Dignates     |  |  | butte softers:                |
| Yang, she say                        | w/4                        |  | ti, teen kiyo  |                               |
| the law of a Decendral Jong Amore    | 10-                        | 15 White Atlantic to a way of the          | da14 u32   |                               |
| 3 "rh. 3043 (to): tos                |                            |  |  |                               |
| Ledor Yrk Stever                     | 70%                        | <u> </u>                                   |  |                               |
| 15 Component Wagow                   |                            | 17 3ce3 0ec6cen                            | 10 NO.SIDEMARTINE CONTRACTOR   | n   33                        |
| Ja / Boss.4%stg.cm                   |                            |  | Chaff an ouder a la Distin S - 14 (Cang)   | ſ                             |
| Covered to Del Deve                  |                            |  | D. WALK J LCCT , MS  |                               |
| Loan Bing Sper                       |                            | 1  | 32 YOM CO LAND STAR HER (1) 714  | s                             |
| Artis: Oron dest.                    | •                          | 1  | H Loss to & O're Capital prove to  |                               |
|                                      |                            | -  | 26% ( 15;  | 20020000                      |
| Weigebrof-Constituting of Jag St     | ୍ୟା<br>                    | _  | Kinadire / Vice at before proventioned<br>Kinadire / Vice at before proventioned<br>Kinadire proveder arou | h h f                         |
| \$2155.\$266-0. Oʻlardar             | . Dell'                    | 1  | Caufie man 55% ho port and   | vərd vərasyngav<br>and vəfasi |
| ACCORDENCE OF Deep                   |                            | 1  | 2. (apader) et ar  |                               |
| Alaxanze Bri Caratagon               | əl                         | St Obselent Yes                            | Der eiler Genörgentagspraciel Mit  |                               |
| Nadadalla Bylangy;                   |                            | Di THE CONSILIN'                           |  |                               |
| Ohe:                                 |                            | Catulations -                              | too Guo  |                               |
| 10 al Coreported Vingites            |                            |  | rection  |                               |
| 6 Federe hergend"                    | St. Germa - afert and larg | Cope Style v                               | beared MeLG-spined   | <u>A., </u>                   |
| We merely the more                   | Even models                |  | Show againer Fariway, Ficklabour da  |                               |
|                                      | Overdeeu?                  |  | "You, and an Engeneers, the South Control  |                               |
| Er Grenn unsellerne                  | U Programation             | · · · · · · · · · · · · · · · · · · ·      | il Teo regivo  |                               |
| Conditation XXXXXX []                | 0+x.17                     | ~~~ <sup>**</sup> * ~~~ <sup>**</sup> ~~ * | I Tel colore provide a serie   |                               |
| N Nethol Conclusion (1)              | ee volk verseen vereeste   | Provincia Lington                          | Paulty Corp You Lin  |                               |
|                                      |                            |  | 1  |                               |
|                                      |                            |  | 1  |                               |
|                                      |                            |  |  |                               |
|                                      |                            |  |  |                               |
|                                      |                            |  |  |                               |
|                                      |                            |  | i i  |                               |
|                                      |                            |  |  |                               |
|                                      |                            |  |  |                               |
|                                      |                            |  |  |                               |
|                                      |                            |  |  |                               |
|                                      |                            |  | 1  |                               |
|                                      |                            |  |  |                               |
|                                      |                            |  |  |                               |
| ari m 4-4-qr-1966                    |                            |  |  |                               |
| weight MicalDe                       |                            |  |  |                               |
|                                      |                            |  |  |                               |
|                                      |                            |  |  |                               |
| . Ope etar                           |                            | - me                                       |  |                               |
| 110                                  |                            |  |  |                               |
| - Siller                             |                            | S. Soldy Rogins                            |  |                               |
|                                      |                            | 2 State Parts                              |  |                               |
|                                      |                            |  |  |                               |
| Array Mat Ogeni Person               |                            | 2 September                                |  |                               |
|                                      |                            |  |  |                               |
|                                      | 7 - 5/6¢(D6y 59.1'e4       | 1001001 224                                |  |                               |

.

•

| The missions                      |   |  |                  |   |   |
|-----------------------------------|---|--|------------------|---|---|
| Reported by                       |   |  | Department       |   |   |
| Ensald                            | <b></b>                                 |  | рукро <u>е</u>   | £s1                                     |   |
| Date of accurrence                |   |  | t)roz            |   |   |
| Exact location                    |   |  |                  |   |   |
| Rezident 门                        | inchance ()                             | 1/201 mitts 门                            | vieksee 🖂        | (8 h2011) 🗀                             | saiary 🙄                                |
| What happened<br>Use additional g | i? Report any deta<br>seper as necessar | uls that may bave<br>y and attach to fee | contributed to a | he incident (i.e., p                    | oor Ughtingj.                           |
|                                   |   |  |                  |   |   |
|                                   |   |  |                  |   |   |
| Describe the ou                   | toome: harm/hea                         | ith effects/classing                     | 6.               |   | *                                       |
| Describe the ou                   | toome: haem/nea                         | ith effects/damag                        | (č.              | *************************************** | 1                                       |
|                                   | ·····                                   |  |                  |   | *·····                                  |
|                                   | ·····                                   |  |                  | elatesi to inckient.                    | ••••••••••••••••••••••••••••••••••••••• |
|                                   | ·····                                   |  |                  | elatesi to incident.                    | •                                       |

| Risk Assessment Templat | :e                                    |                             |                |                    | ······                       |
|-------------------------|---------------------------------------|-----------------------------|----------------|--------------------|------------------------------|
| Prospective Risks       | Who is<br>Affected by<br>risk?        | On Hand Control<br>Measures | Rick<br>Rating | Defensive Measures | Errands/<br>Responsibilities |
|                         | · · · · · · · · · · · · · · · · · · · |                             | <u>!</u>       | ·                  |                              |
|                         |                                       | ·                           |                |                    |                              |
|                         |                                       |                             |                |                    |                              |
|                         |                                       |                             |                |                    |                              |
|                         | · · ·                                 |                             |                |                    | · · · ·                      |
|                         |                                       |                             | <u> </u>       |                    | ,<br>                        |

.

# Site EHS orientation

| A   | Genoral<br>Orientation              | ÷              | EHS politice and procedures evaluable to workars;<br>- Hazem<br>- EHS manuel<br>- Lacal/Country specific   |
|-----|-------------------------------------|----------------|--|
|     |                                     |                | Customer Site Specific SHS Ruise   |
|     | ··· -                               | 9 <sup>i</sup> | Work sign boundaries, off their group of the produce access  |
|     |                                     | ця<br>Ц        | Brief four of facility including:  |
|     |                                     |                | - tst ald equip - traffic areas areas<br>Are conformed - traffic areas areas<br>Areas areas - washroons<br>- showetsteyewash - easing area                   |
|     |                                     | ø              | Safety goals for the Ouloga  |
|     |                                     | Ŷ              | Inspections and safety meetings<br>- daily pre-issic meeting - wessiving-action<br>- westly safety meeting - responsibilities for inspection                 |
|     |                                     | 8              | Disciplinary action/consequences of failure to comply  |
|     |                                     |                |  |
| Ta. | Modicel &<br>Emergenity<br>Platniny | <b>9</b> .     | Reporting Injury/Illness of emergency or uncode condition<br>- how, when where and to inform<br>- investigation of Incidents<br>- Becarity Flandbe-Pot Rosta |
|     |                                     | 9              | Smorgency Exite<br>- Ideality access and ogress froations and raily points<br>- source weather tesponse<br>- meaning of plant alarity                        |
| ~   |                                     | 8              | A. M   |
| Ç.  | PPE)<br>Dress code                  |                | Costomer requirements on wearing jawainy, wolchoo, etc.  |
|     |                                     | 9              | FPE required, and ensuring sitis to evaluate   |
|     |                                     | 17             |  |
| Ð.  | Pornits                             | 7              | Lock Ovt/Tag Out - vesik down procedute  |

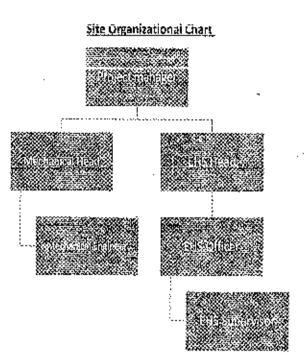
#### Works' basish and safety training plan and second template

Profesil Barre / coupled .

•: ....

. .

| Sxill/KAOA/edgs             | Flagment | dial world | Bripleyee          |   | estes     |
|-----------------------------|----------|------------|--------------------|---|-----------|
|                             | Cala     | by         | The second         | Flammed                                 | Completer |
| Rashiraha Kategy            | 1        |            | ·                  |   |           |
| mapposibilities             |          |            | ş                  |   |           |
| Socidemontpration and       |          |            | ****************** |   |           |
| managansant                 | 1        |            | ĺ                  |   |           |
| Preident screenting and     | 1 1      |            | [                  | <u> </u>                                |           |
| and Ing                     | 1 1      |            |                    |   |           |
| See were underland          | 1        |            |                    |   |           |
| Sectore of prevalenced      |          |            | ·····              | l                                       |           |
| and prevale relevant highly |          |            |                    |   |           |
| worker is oothery           |          |            | ł                  |   |           |
| Use say maintenappe of      |          |            |                    | r • • • • • • • • • • • • • • • • • • • |           |
| shypersseal presseave       | 1 1      |            |                    |   | -         |
| rsupport.                   | 1        |            | 1                  |   | •         |
| Safe non precision the of   | 7        |            |                    | ~~                                      |           |
| haonabausasbotences         |          |            | [                  |   |           |
| Proafeo (Cristicadure),     |          |            |                    | · · · · ·                               | - · ·     |
| inclusing rescuellant       | ( }      |            |                    |   |           |
| protections and use of      | 2        |            | 1                  | 1                                       |           |
| envergiency mout private    |          |            | {                  |   |           |
| First Aid                   | 1        |            |                    |   |           |
| 003 anevention              | +        |            |                    |   |           |
| Хама пальдинева.            | 1        |            |                    | !                                       |           |
| uanasiyua +ap-              | ·        |            |                    |   |           |
| March Der                   | 1 1      |            | • I                |   |           |
| aic handling and lithing    | 1 1      |            | ·                  | •                                       |           |
|                             |          |            | L                  |   |           |



# Annex - M (Environmental Study)

#### Introduction:

Extensive fossil fuel consumption in almost all human activities has led to some undesirable phenomena such as atmospheric and environmental pollution, which have not been experienced before in known human history. Consequently, global warming, greenhouse effect, climate change, ozone layer depletion, and acid rain terminologies started to appear in the literature frequently. Since 1970, it has been understood scientifically by experiments and researches that these phenomena are closely related to fossil fuel use because they emit greenhouse gases such as carbon dioxide (CO2) and methane (CH4), which hinder the tongwave terrestrial radiation escape into space, and, consequently, the earth troposphere becomes warmer. In order to avoid further impacts of these phenomena, the two concentrative alternatives are either to improve the fossil fuel quality with reductions in their harmful emissions into the atmosphere or, more significantly, to replace fossil fuel usage as much as possible with environmentally friendly, clean, and renewable energy sources. Among these sources, solar energy comes at the top of the list due to its abundance and more even distribution in nature than any other renewable energy type, such as wind, geothermal, hydro, wave, and tidal energies. Solar energy technologies are essential components of a sustainable energy future. Energy from fossil fuels may be inexpensive and assurances may have been given of the plentiful supplies of petroleum and other fossil fuels, but these fuels are finite in nature and a major source of greenhouse gas emissions.

#### Objective:

Pakistan is located in the Sunny Belt and can take advantage of its ideal situation for utilization of solar energy. The country's potential for solar generation is beyond doubt as it has high solar irradiation and enough space for installation of generation system those are ideal for PV and other solar energy applications. Villages and other areas which are away from grid or distribution system of utilities can also benefit from solar power generation which will also save the extra cost of laying the system and the losses. Every day, for example, the country receives an average of about 19 Mega Joules per square meter of solar energy Pakistan being in the Sun Belt is ideally located to take advantage of solarenergy technologies. This energy source is widely distributed and abundantly available in the country. The mean global irradiation falling on horizontal surface is about 200-250 watt per sq.m in a day. This amounts to about 2500- 3000 sun shine hours and 1.9-2.3 MWh per sq. meter in a year. It has an average daily global isolation of 19 to 20 Mi/sq. meter per day with annual mean sunshine duration of

8 to 8.5 hours (6-7hrs in cold and 10-12 hrs, in hot season) and these values are among the highest in the world.

For daily global radiation up to 23MJ/m2, 24(80%) consecutive days are available in this area for solar energy. Such conditions are ideal for solar thermal applications. Pakistan receives about 15.5x1014 kwh of solar irradiance each year with most regions receiving approximately 8 to 10 sunlight hours per day. The installed capacity of solar photovoltaic power is estimated to be 1600 GW per year, providing approximately 3.5 PWh of electricity (a figure approximately 41 times that of current power generation in the country). To summarize, the sun shines for 250-300 days per years in Pakistan with average sunshine hours of 8-10 per day. This gives huge amount of energy to be used for electricity generation by solar photovoltaic and solar thermal power plants.

#### Environment Assessment:

The Lahore and Okara project will be executed on within the premises of Purchaser, and the Applicant has carried out a detailed environment assessment of the site in preparation of the Solar PV Plant. The assessment of the Project has been considered for both positive and negative effects. The proposed photovoltaic Power Project has been located as per international guidelines. Adoption of green power generation with no emission and effluent discharge with have least impact on the ambient environment and on the host community.

The importance of the sustainable development concept has increased in the whole world. As a result, some new regulations enforce that all development projects should be compatible with the environmental criterions. An environmental impact assessment should be carried out to make sure that projects are compatible with the environmental criterions. Environmental Impact Assessment (EIA) can be defined as a process of environmental management, planning, and decision-making with a purpose of keeping and improving the quality of the environment. The main goal is to develop environmentally friendly industrialization. With this kind of environmentally friendly industrialization, "sustainable development" can be a possibility in the future by keeping the usage/protection balance between economic development and the environmental protection.

Every energy generation and transmission method affect the environment. Conventional generating options can damage air, climate, water, land & wildlife, landscape as well as raise the levels of harmful radiation. PV technology is substantially safer offering a solution to many

environmental and social problems associated with fossil and nuclear fuels. Solar PV energy technology provides obvious environmental advantages in comparison to the conventional energy sources thus contributing to the sustainable development of human activities. Not counting the depletion of the exhausted natural resources, their main advantage is related to the reduced CO2 emissions and normally absence of any air emissions or waste products during their operations.

The use of solar power has additional positive implications such as:-

- Reduction of the emissions of the greenhouse gases (mainly CO2, NOx) and prevention of toxic gas emissions (502, particulates)
- Reduction of the required transmission lines of the electricity grids.

#### Project Environmental Impacts & Mitigation Measure:

This Section discusses the potential environmental impacts, assesses the significance, recommends mitigation measure to minimize the adverse effect and identifies the residual impacts associated with the proposed activities of the project during the construction and operation phase of the proposed project at the proposed site and of secondary actions like potable, raw water and waste water lines. Solar energy is a lot cleaner when compared with conventional energy sources. Solar energy systems have many significant advantages, like being cheaper and not producing any pollutants during operation, and being almost an infinite energy source when compared with fossil fuels. Nevertheless, solar energy systems have some certain negative impacts on the environment just like any other energy system. Some of these impacts will be summarized in this section.

#### Identification of Potential Impacts:

- a) Discharge of Pollutants
- b) Visual Impacts
- c) Impact on Natural Resources
- d) Air Pollution
- c) Noise Intrusion
- f) Impact on Air
- g) Impact on Ground Water! Surface Water
- h) Impact on Solid Waste

i) Impact on Soil

j) Impact on Natural Resources

#### **Discharge of Pollutants:**

Solar cells do not emit any pollutants during their operations. But solar cell modules contain some toxic substances, and there is a potential risk of releasing these chemicals to the environment during a fire. Necessary precautions will be taken for emergency situations like fire.

#### Visual Impacts:

There will be some visual impacts depending on the type of the scheme and the surroundings of the solar cells. Especially for applications on the buildings, solar cells can be used as a eladding material that could be integrated into the building during the construction phase. Solar cell applications after the construction phase of the buildings might cause negative visual impacts. However, through proper planning the Applicant will minimize this impact.

#### Impacts on Natural Resources:

Despite being a benign energy system during operation, solar cells have some negative impacts on the environment during their production phase like many other systems. The energy needed for the production of solar energy systems is still produced in conventional methods today. Some toxic chemical substances used during the production phase are produced as a byproduct. However, the solar panels to be

utilized for this project have been manufactured in China therefore, there is no direct impact on the designated vicinity.

#### Air Pollution:

Solar cells do not enuit any substances to the air during operation. But there could be some emissions during manufacturing and transport. The emissions associated with the transport of the modules are insignificant when compared with the emissions associated with the manufacture, Transport emissions are 0.1-1% of the manufacturing emissions.

#### Noise Intrusion:

Solar cells do not make a noise during operation. But during the construction phase, there will be a little noise as usual in other construction activities. However, since the solar panels to be utilized for this project have been manufactured in China, this is not a risk for the designated vicinity.

#### Impact on Air:

There would be no hazardous emissions at site as well as during construction phase except Motor Vehicle and Crane. Moreover, there are no objectionable odors as well as alternation of air temperature.

#### Impact on Ground Water/ Surface Water:

There would be no use of water during design phase except curing of civil pads during construction, which have no negative impact on environment.

#### Impact on Solid Waste:

It may only Create litter and trash waste which is recyclable and may be cleared from site after construction. Impact on Soil: No impacts as all installed systems are roof top.

#### Impact on Natural Resources:

There won't be any increase in the rate of usage of any natural resource like any minerals, additional fuel other than vehicles. But there would be increase in the amount of usage of Paper for mapping, enlisting items etc. However, paper may be recycled by throwing it in ordinary dustbin, further maximum usage of electronic system e.g., emails will be done.

#### **Environment Assessment:**

a) Almost all conventional methods of energy generation have varying degrees of adverse environmental impact. These methods have far reached detrimental effects on the climate, air, water, land and wildlife of the adjacent vicinities. However, Solar PV energy technology provides significant environmental advantages in comparison

to the conventional energy sources while contributing to the sustainable development of human activities. Besides slowing down the depletion of natural resources, the main environmental advantage is zero air emissions, waste production and eventual reduction in emissions of greenhouse gases (COx, NOx) and toxic gases (SOx).

b) Solar power plants have zero fuel requirement and hence limit the depletion of natural resources, fossil fuels. Unlike conventional thermal power plants, no water consumption is required for cooling purposes. A very optimized quantity of water is occasionally used for plant maintenance / cleaning. As stated earlier, the proposed system of 507p DC will offset approximately 607 tons of carbon dioxide annually.

| Environment           | Level of | Reasons               | Mitigation            |
|-----------------------|----------|-----------------------|-----------------------|
| Parameters            | Impact   |                       | Méasures              |
| Air Impact            | Low      | Solar Energy          | No Emissions,         |
| · ·                   |          | Carbon Uree           | however, during       |
| -                     |          |                       | construction          |
| 1                     |          |                       | adequate measures     |
| -<br>-<br>-<br>-<br>- |          |                       | to limit dust         |
|                       |          |                       | pollution will be     |
|                       |          |                       | taken,                |
| Water                 | Low      | Plant will require a  | Specialized           |
|                       |          | very low quantity of  | equipment that        |
|                       |          | water for cleaning    | conserves water will  |
|                       |          | purpose only          | be used to cleaning   |
|                       |          |                       | the PV modules.       |
| Land                  | Low      | No Impact on          | The land being        |
|                       |          | , Land                | allocated for this    |
|                       |          |                       | facility is baren.    |
| Ecosystem             | Low      | No                    | There is no           |
|                       |          | ecologically          | significant           |
|                       |          | sensitive area        | vegetation cover      |
|                       |          | lies with in premises | within the selected   |
|                       |          |                       | area, land is barren. |

The Applicant has carried out environment assessment of the Site for installation of solar:

| Socio EcoSystem | Low | Total area identified | Not Applicable |
|-----------------|-----|-----------------------|----------------|
|                 |     | for said project is   |                |
|                 |     | adjacent to the plant |                |
|                 |     | premises and no       |                |
|                 |     | acquisitions needed.  | ĺ              |
|                 |     | No displacement       |                |
|                 |     | will occur.           |                |

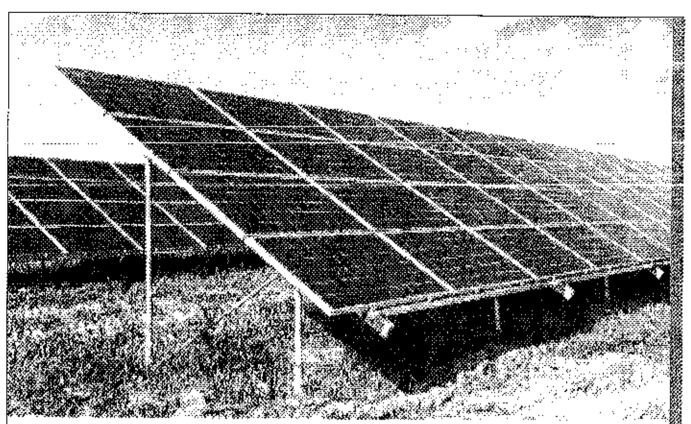
.

1

· · · ·

.

.







# SYSTEM STUDY ANALYSIS OF COMBINED MILITARY HOSPITAL (CMH) 999kW SOLAR PV SYSTEM

Report

ARCO Energy

PAKISTAN Tel: +92-300-8827101





# CONTENTS

|             | SUMMARY   |
|-------------|---|
|             | 0.CHON  |
| 1.1 Proje   | ect Description   |
| 1.2 Inter   | connection Arrangement  |
| 1.3 Ођје    | ctive of System Study Analysis  |
| 1.4 Study   | y Components  |
| 2 STUDY 2   | METHODOLOGY   |
|             | y Criteria  |
| 2.2 Stead   | ly State Analysis   |
| 2.2.1 Sys   | stem Intact Analysis  |
| 2.2.2 Ter   | ansmission Line Loading Analysis                                      |
| 2.2.3 Vo    | ltage Analysis  |
| 3 STEADY    | STATE ANALYSIS  |
|             | el Development  |
| 3.2 Powe    | er Flow Assessment Without CMH PP and with Sanctioned Load In Service |
| 3.2.1 Bas   | se Year 2025: Peak Loading Summet with Sanctioned Load in Service     |
| 3.3 Powe    | r Flow Assessment with CMH PP   |
| 3.3.1 Bas   | se Year 2025: Peak Loading Summer with Sanctioned Load In Service     |
| 3.4 Conc    | husion  |
| 4 CONCLU    | ISTON   |
|             | y State Assessment  |
| LIST OF ANN | TEXURES   |





### **EXECUTIVE SUMMARY**

This report provides the documentation of an assessment that has been performed for the interconnection of a 999EW Solar PV Power Generation project at Combined Military Hospital (CMH) distribution system at 11kV project of "Military Engineering Services" (MES). The project will be a Grid tied 999kW Solar PV based system connected with the power network of CMH. The '999kW CMH solar PV Power Generation project' is located at CMH, Cantt, Lahore, Punjab, Pakistan.

The integration of solar power generation at the CMH premises necessitates a comprehensive system study analysis to ensure optimal operation of the electrical network. CMH currently receives a single point supply from LESCO with a sanctioned load of 4.6MW. The introduction of solar power generation will influence the flow of electricity within the premises, impacting both consumption and injection dynamics.

The existing scup includes transformers, switchgear, and distribution panels to distribute electricity throughout the premises. The sanctioned load of 4.6MW is the maximum load that can be drawn from LESCO's grid.

The entire solar generation within the CMH premises will be consumed internally without exporting any power to the grid. To ensure the safe and efficient integration of solar power, a load flow study is required to analyze the impact of this interconnection on the existing electrical network. This study will assist in obtaining solar generation concurrence and ensuring compliance with relevant technical and regulatory requirements.

The analyses have been carried out in following scenarios;

- Without 999kW CMII solar PV system with sanctioned load in service.
- With 999kW CMH solar PV system with sanctioned load in service.

Steady state power flow assessment has been performed using the network data of CMH. Power flow study was conducted without Solar Project with sanctioned load in service to analyze the magnitude and phase angles of bus voltages, line loadings and power flows under steady-state conditions. Power flow analysis was also conducted with sanctioned load in service after the interconnection of the Solar project with the CMH distribution system. The power flow results for the system intact shows that the power flows on all the CMH transmission and distribution line branches are within their normal

Ί





line loading limit. There is no capacity constraint in terms of power flow or voltage ratings within the study area.

This systems study is a critical step in obtaining solar generation concurrence for CMII. By cosuting the stability and reliability of the electrical system, the study facilitates scantless solar power integration while maintaining compliance with CMH and regulatory requirements.

Based on the study results, it is concluded that proposed generation interconnection assessment for 999kW CMII solar PV Power Generation project meets the NEPRA grid code planning criteria.





### **1** INTRODUCTION

#### 1.1 Project Description

This report provides the documentation of an assessment that has been performed by ARCO Energy in response to a request made by Combined Military Hospital (CMH) ("Project Owner" or "PO") for the interconnection of a 999kWp Solar PV Power Generation project ("Project") to the CMH power System at 11kV.

The '999kW CMH solar PV Power Generation project' is located at CMII, Cantt, Lahore, Punjab, Pakistan, Figure 1.1 shows Google site map of the project.

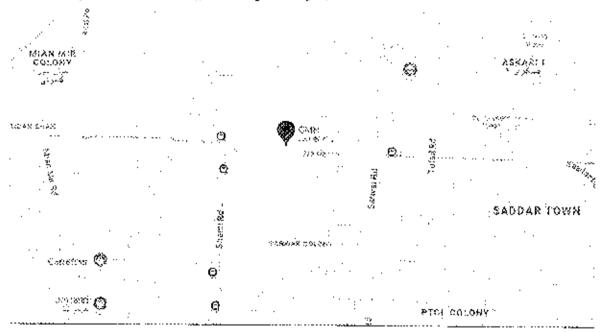


Figure 1.1: Google Site Map of the Solar PV Power Generation Project.





#### 1.2 Interconnection Arrangement

CMII aims to integrate solar power generation into its existing electrical infrastructure. CMH currently receives a single-point power supply from LESCO with a sanctioned load of 4.6MW. The entire solar generation within the CMH premises will be consumed internally without exporting any power to the grid. The objective of the analyses is to evaluate the impact of the solar power plant on the CMH transmission and distribution system.

#### 1.3 Objective of System Study Analysis

The primary objectives of the load flow study are:

- To evaluate the impact of solar power injection on the voltage levels and power distribution within CMH premises.
- To determine the changes in power flow patterns resulting from the integration of solar generation.
- To ensure that the existing electrical infrastructure can support the additional solar power without causing instability or operational issues.
- To verify compliance with regulatory requirements for solar power interconnection and obtain concurrence for solar generation.

#### 1.4 Study Components

999kW solar PV system is modelled into the CMH distribution system by ARCO Energy. Technical analysis includes:

- i) Data gathering and modelling
- ii) Steady state analysis
- iii) Conclusion

The above scope of work involved in the technical analysis has been carried to demonstrate that connection assessment of this PV system meets the National Electric Power Regulatory Authority (NEPRA) distribution code.

The analyses have been carried out in following scenarios;

- Without 999kW CMH solar PV system with sanctioned load in service.
- With 999kW CMH solar PV system with sanctioned load in service.





This report documents the results of the steady state analyses. The principal objective of these analyses is to evaluate the impact of 999kW solar PV system to the distribution system of CMH and vice versa.





### 2 STUDY METHODOLOGY

#### 2.1 Study Criteria

The study has been carried out based on the National Electric Power Regulatory Authority (NEPRA) Grid Code planning criteria. Key parameters and their corresponding limits have been summarized in table below.

| Parameter      |                  | Range   |
|----------------|------------------|---|
| Voltage Level  | Normal Condition | ±5 % p.u at 132kV and below<br>+8%,-5% p.u at 220kV and above |
|                | Contingency      | ±10 % p.u   |
| T/Line Loading | Normal Condition | 100%  |
| Capacity       | Contingency      | 100%  |
| Frequency      | Nominal          | 50 Hz   |
|                | Normal Variation | 49.8 Hz - 50.2 Hz   |
|                | Contingency Band | 49.4 Hz - 50.5 Hz   |
| Power Factor   | Lagging          | 0.95  |
|                | Leading          | 0.95  |

#### 2.2 Steady State Analysis

The purpose of steady-state analysis is to analyse the impact of the proposed solar power plant on distribution system facilities under steady-state conditions. It involves two distinct analyses: line loading analysis and voltage analysis. Power flow solutions using the PSS/E® program (Version 33.4) has been performed.

A "study area" was defined to represent the areas of interest within CMH.

#### 2.2.1 System Intact Analysis

The incremental impact of the project on substations and transmission line loading under normal conditions was evaluated by comparing transmission and distribution system power flows through different scenarios for the project.

#### 2.2.2 Transmission Line Loading Analysis

11kV and 0.4kV rated transmission and distribution facilities in the study area have been monitored for line loadings.





### 2.2.3 Voltage Analysis

Voltages at buses inside the study area have been monitored for possible for voltage violations in accordance with NEPRA Grid Code guidelines.





### **3 STEADY STATE ANALYSIS**

#### 3.1 Model Development

Project specific data was provided by the plant owner and it has been compiled and presented in **Annexure-A**. The steady state model of the power plant is presented in table below:

|  | Generator                  |  |  |  |  |  |
|--|----------------------------|--|--|--|--|--|
| No. of Collector Units   | 1                          |  |  |  |  |  |
| Generation size of each<br>collector (kVA)                             | 811                        |  |  |  |  |  |
| Active Fower of each<br>collector Pgen. (kW)                           | 799                        |  |  |  |  |  |
| Power Factor   | 0.95 lagging, 0.95 leading |  |  |  |  |  |
| $\overline{\text{Qmin}}, \text{Qmax} \langle k \vee \Lambda R \rangle$ | - 0.2626, 0.2626           |  |  |  |  |  |
| Rated Frequency  | 50 Hz                      |  |  |  |  |  |
| Generation Voltage   |                            |  |  |  |  |  |
| Xsource  | 30                         |  |  |  |  |  |
| Genera   | tion Step Up Transformer   |  |  |  |  |  |
| No of Transformer  | 1                          |  |  |  |  |  |
| kVA Capacity of each<br>GSU  | 1250                       |  |  |  |  |  |
| % Reactance (X)  | 5%                         |  |  |  |  |  |
|  | СМН                        |  |  |  |  |  |
| Sanctioned Load (LESCO)  | 4600 kW                    |  |  |  |  |  |

Steady state power flow assessment has been performed using the network data of CMH.

## 3.2 Power Flow Assessment Without CMH PP and with Sanctioned Load In Service

Power flow study without CMH solar and with sanctioned load in service, was conducted to analyze the magnitude and phase angles of bus voltages, line loadings and power flows under steady-state conditions.

The result of this power flow analysis is in Annexure-B.





#### 3.2.1 Base Year 2025: Peak Loading Summer with Sanctioned Load in Service

Power flow analysis has been performed on the peak loading summer (June) 2025 case of CMHI network. This base case included a detailed representation of the CMHI transmission and distribution system in the study area.

The steady state results, depicts that the power flows on all the CMH distribution line branches are within their normal loading limits. There is no capacity constraint in terms of load flow or voltage ratings around the study area. Result of the power flow analysis is attached in **Figure B-1**.

#### 3.3 Power Flow Assessment with CMH PP

Power flow study of CMH solar project was conducted with sanctioned load (in service and out of service) to determine the reliability impact of the 999kW CMH solar project on the CMH distribution system. This includes the performance of load flow analysis to identify any facility overload or voltage condition that violates the NEPRA planning criteria. Any such violation that is either directly attributable to this project or for which it will have a shared responsibility is included in this report.

The results of the project power flow analysis are plotted in Annexure-B.

#### 3.3.1 Base Year 2025: Peak Loading Summer with Sanctioned Load In Service

A base case has been developed with sanctioned load in service at CMII solar for peak loading summer (June) 2025 that allow us to judge the impact of CMH solar project on the CMII network. Project power flow analysis has been performed after the connection of the project with the CMII distribution system. This includes the detailed representation of the power plant.

The steady state result, with sanctioned load in service at CMH solar depicts that the power flows on all the transmission line branches are within their normal loading limits. There is no capacity constraint in terms of load flow or voltage ratings around the study area.

Result of the power flow analysis is attached in Figure B-2.

The results of the project bus voltages analysis are attached in Annexure-C.

#### 3.4 Conclusion

Steady state power flow assessment has been performed. Power flow study was conducted without solar Project with sanctioned load in service to analyze the magnitude and phase angles of bus voltages, line loadings and power flows under steady-state conditions. Power flow analysis was also conducted





with sanctioned load in service after the interconnection of the Solar project with the CMH distribution system. The power flow results for the system intact shows that the power flows on all the CMH distribution line branches are within their normal line loading limit. There is no capacity constraint in terms of power flow or voltage ratings within the study area.





### 4 CONCLUSION

#### 4.1 Steady State Assessment

Steady state power flow assessment has been performed. Power flow study was conducted without CMH solar with sanctioned load in service, to analyze the magnitude and phase angles of bus voltages, line loadings, and power flows under steady state conditions. Power flow analysis was also conducted with CMH solar and with sanctioned load in service with CMH distribution system. Power flow results showed that the power flows on all the CMH distribution branches are within their normal loading limit. There is no capacity constraint in terms of power flow or voltage ratings within the study area.

The steady state results found no capacity constraint in terms of power flow and voltage ranges.

Hence, it is concluded that based on the study results the Interconnection Assessment for 999kW CMH solar PV system with CMH Transmission and Distribution Network, meets the NEPRA grid code planning criteria.





### LIST OF ANNEXURES

Annex A: Project Specific Data.

Annex A-1: Project Site Map.

Annex A-2: Power Plant Data.

Annex B: Fower Flow Steady State Analysis Result

Figure B-1: Base Year 2025 - Peak loading summer without CMH solar and Sanctioned load in service.

Figure B-2: Base Year 2025 - Peak loading summer with CMH solar and Sanctioned load in service.

Annex C: Assessment of Bus Voltages.

Annex C-1: Without CMH solar and with Sanctioned Load In Service.

Annex C-2: With CMH solar and with Sanctioned Load In Service.

## Annexure-A

Project Specific Data

## Annexure-A-1

Project Site Map

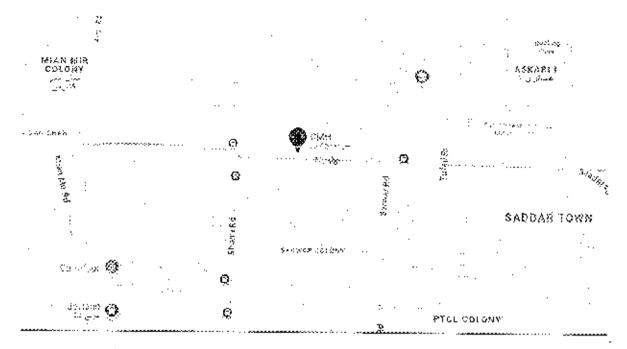
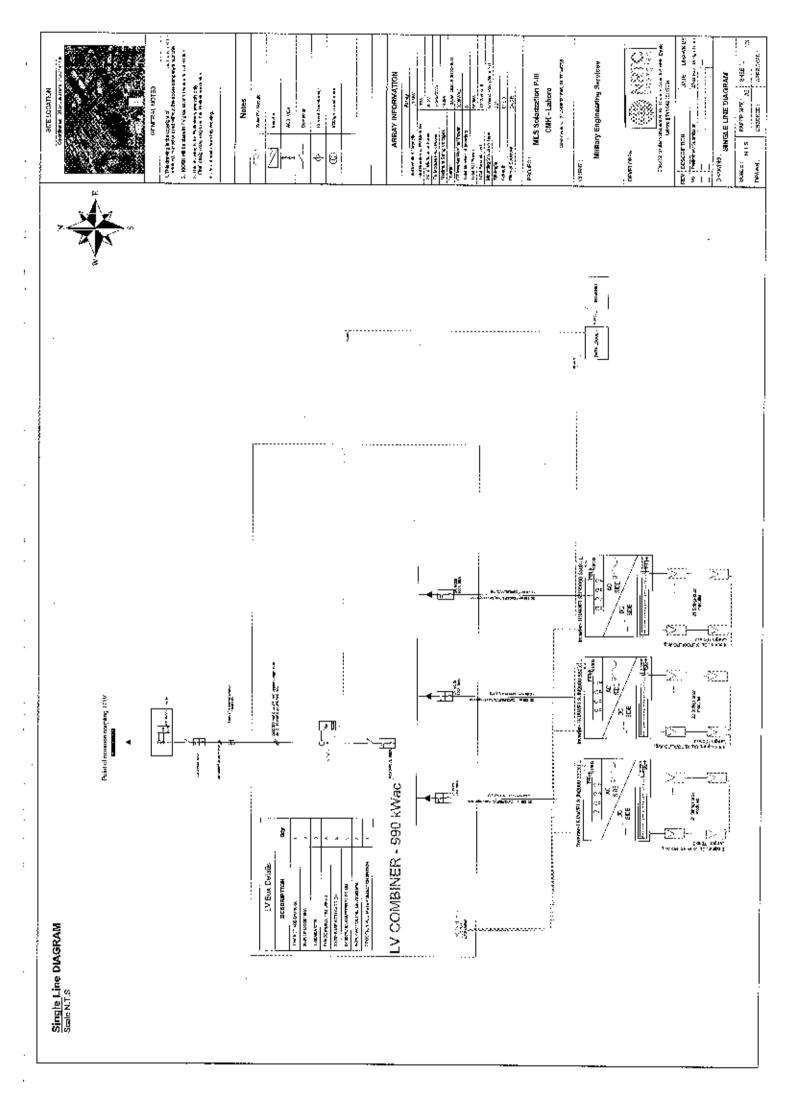
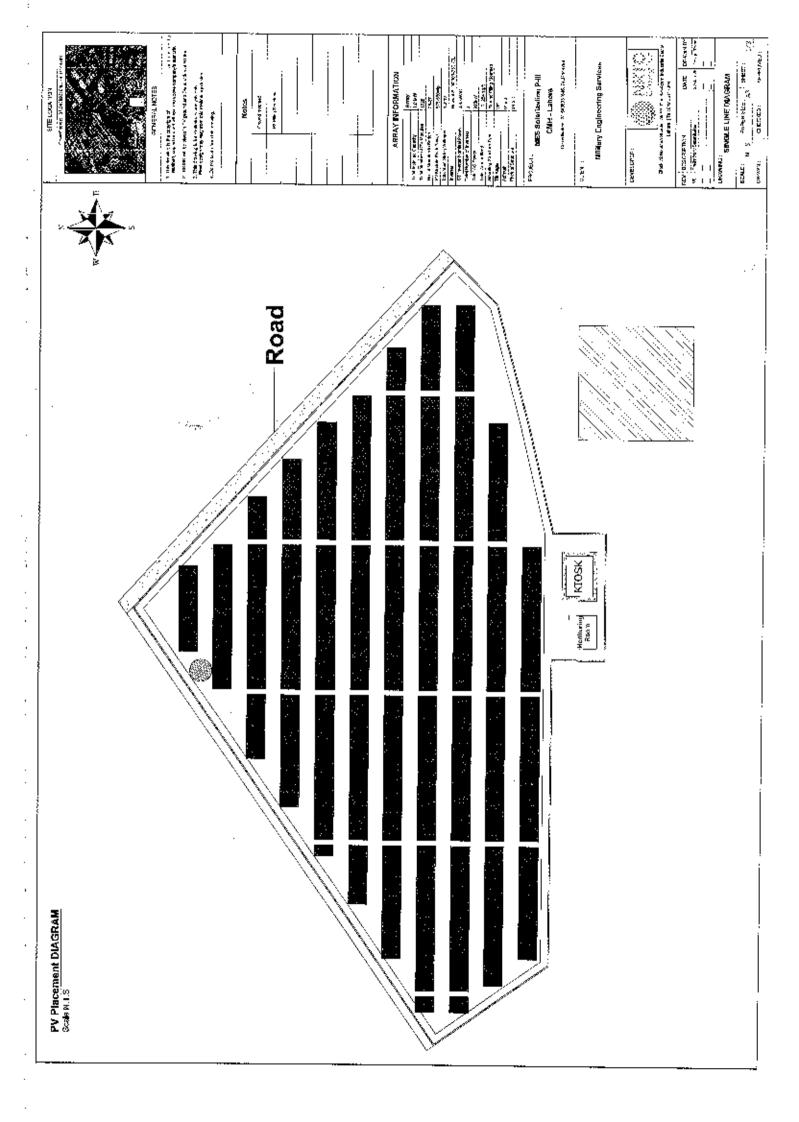


Figure 1.1: Google Site Map of the Solar PV Power Generation Project.

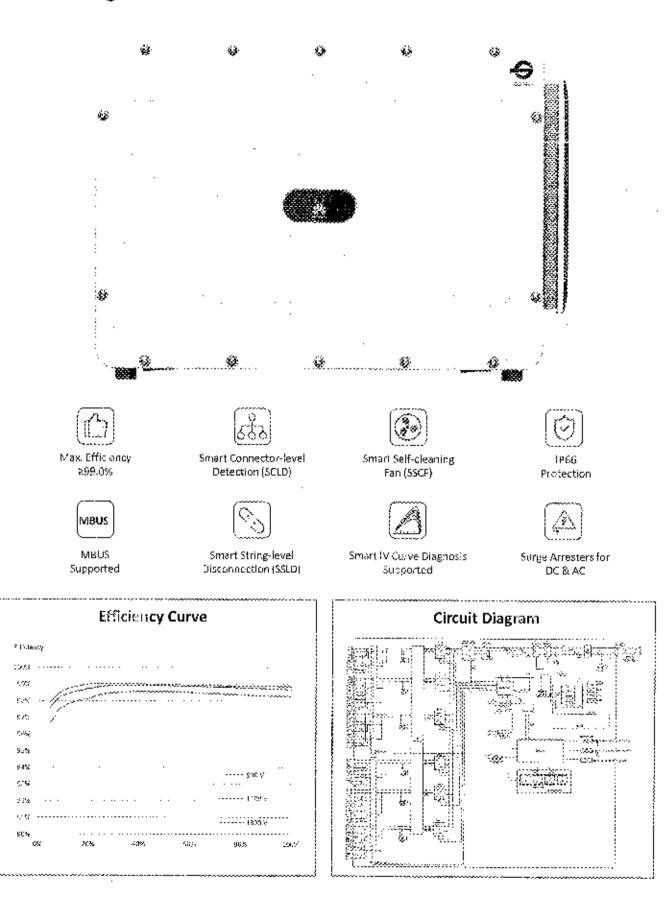
## Annexure-A-2

Power Plant Data





## SUN2000-330KTL-H1 Smart String Inverter



#### зоцая нем мылоо м

## SUN2000-330Ki)u II...

|     | £fficiency   |  |
|-----|--|--|
|     | Max. Efficiency  | 295.0%   |
|     | Burdoean Efficiency  | 292.8%   |
|     |  |  |
|     | Max. nout. Voltage   |  |
|     | Rumber of MPP Trockers   |  |
|     | Max. Current per MPPT  |  |
|     | a faith and a grant a second |  |
|     | Max. Short Circuit Current per MPPT  | 1)5A   |
|     | Max. PV Inputs per MPPT  | 4/5/5/4/3/5  |
|     | Start Vo tage  | 550 V  |
|     | MPPT Operating Voltage Range   | 500 V ~ 1,500 V  |
|     | Nominal leput Voltage  | 1,CB0 V  |
|     | Output   |  |
|     | Vominal AC Active Rower  | 500,000 W  |
|     | Max. AC Apparent Power   | 330,000 VA   |
|     | Mark AC Active Power (cost) (1)  | 330,000 W  |
|     | Nominal Output Voltage   | 800 V, 3W + PE   |
| :   | Bated AC Grid Frequency  | 50 · 2 / 50 Hz   |
|     | Namical Output Correct   | 236.6 A  |
|     | Max. Output Corrent  | 238 2 A  |
| •   | Adjustopic Powe: Factor Range  | 0.816 0.810  |
|     | Total warmonic Distortion  | ··· ·· ·· ·· ·· ·· ·· ·· ·· ·· ·· ·· ··  |
|     | Protection   | ······································   |
|     | Smart String-Level Disconnector(SS.D)  | Yes  |
|     | Anti-is anding Protection  | Yes  |
|     | AC Oversurveyt Protection  | Ye:  |
|     | DC Reverse polarity Protection   | Yes  |
|     | PV-erray Scring Fault Monitoring   | · ··· ·· ··· ···   |
|     | DC Surge Arrester  | יייין איז  |
|     | AC Surge Arrester  | and the second |
|     | DC Insulation Resistance Detection   | Type I   |
|     | AC Grounding Hault Protection  | Yes  |
|     | Desidual Correst Monitoring Unit   | Y25  |
|     |  | Y=s  |
|     | Communication  | · · · · · · · · · · · · · · · · · · ·  |
| • • | Display  | LED Indicators, WLAN + APP   |
|     |  | YPS  |
|     | MBUS   | Yes  |
|     | R5485  | Y25  |
|     | General  |  |
|     | Dimensions (W x H x D)   | 1,018 x 732 x 395 mm   |
|     | Weight (with mounting slote)   | <312 kg  |
|     | Operating Temperature Ronge  | -25 °C ~ 60 °C   |
|     | Cooling Method   | Smart Air Coping   |
|     | Max. Operating AUTude without Denating   | 4,000 m (13,125 H.)  |
|     | Relative Humidity  | 0~100%   |
|     | AC Connector Wa  | terproof Connector + OT/DT Terminal  |
| :   | Protection Degrae  | IP 65  |
|     | lopology   | Transformentess  |
|     |  |  |

÷

## Harvest the Sunshine

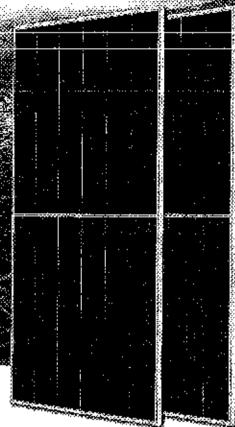
## DEEP BLUE 4.0

580W n-type Bifacial Double Glass High Efficiency Mono Module JAM72D40 555-580/GB

#### Introduction

Mono

Power by the lastisst SMBB in type solar cell, half-bell toning paten and gapless abbon connection test noting; these mouth's have trigher authors gower, lawer ND, tabler weak alumination responses and celler temperature postficient.





#### Higher power generation better LCOE



ri-type with very Lower L(D)



Better weak illumination response



#### Setter Temperature Coofficient

Suparior Warranty

- 12-year product warranty
- 30-year linear power output warranty.



- n-type Bifacial Coubte Glass Modula Linear Performance Warranty
- Standard Module Linear Performance Warranly

## Comprehensive Certificates

- 第三〇台1235, 第三〇台1730
- (SO 9001: 2015 Quality management systems)
- ISC 34001: 2015 Environmental management systems
- < ISO 45001: 2018 Occupational hould: and safety management systems
- IEG 62941: 2019 Terrestrial photovoltalo (PV) modules -Quality system for PV module manufacturing



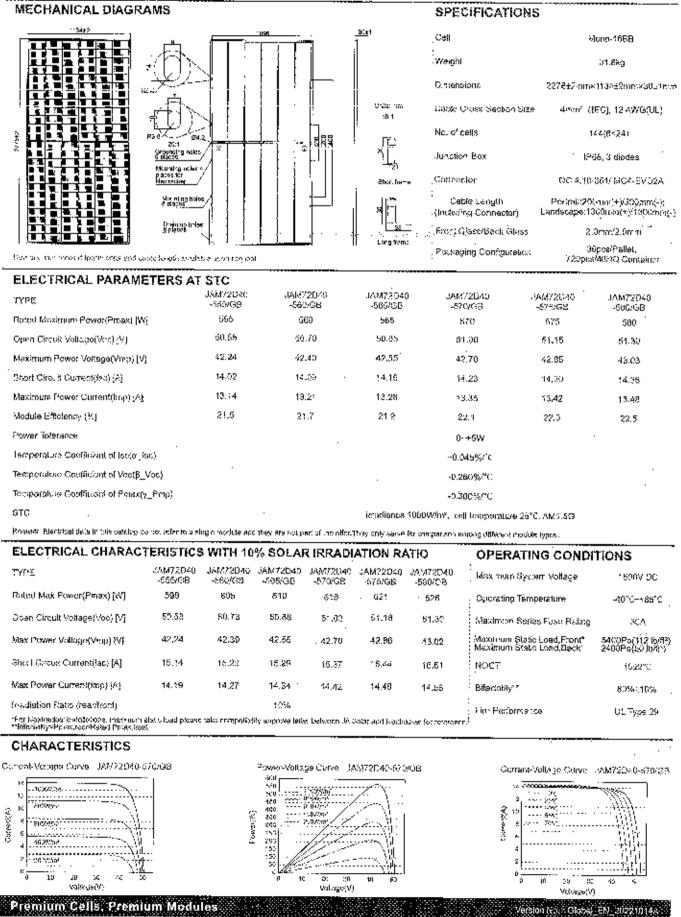
WWW JOSOIAN COM C WWW JOSOIAN COM C SUDE 1 10 Inchical program and ress. Accessions the cold of fine interpretation.





## JA SOLAR

JAM72D40 555-580/GR

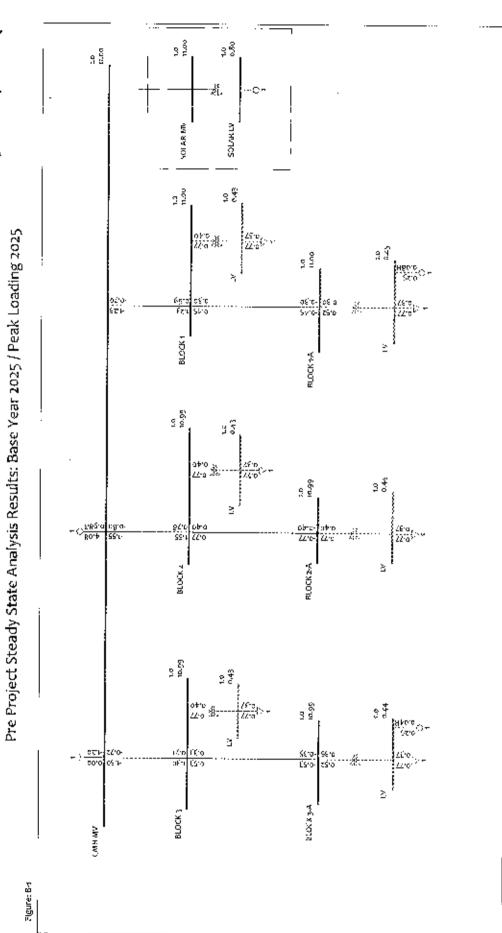


## Annexure-B

ł

Steady State Analysis Results

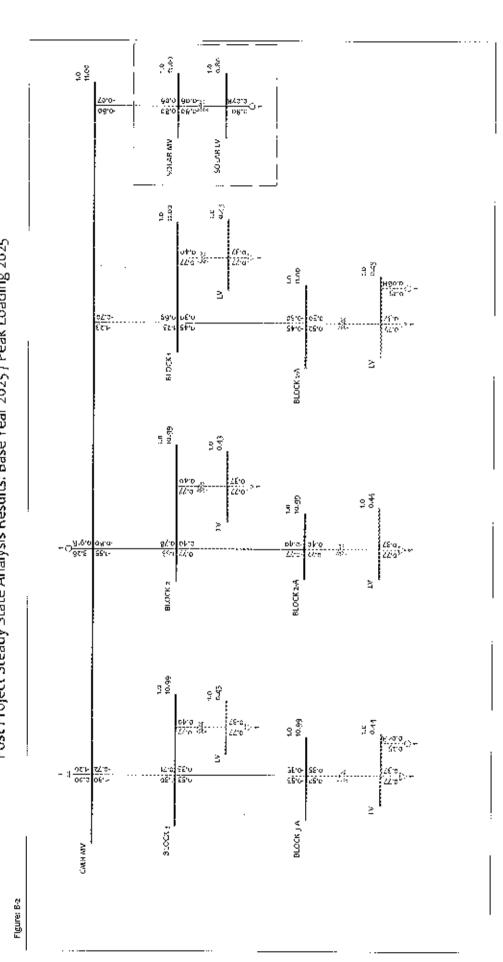
Load Flow Analysis of 999kW Solar PV System at Combined Military Hospital (CMH)



• 11 .

<del>ب</del>

Load Flow Analysis of 990kW Solar PV System at Combined Military Hospital (CMH) Post Project Steady State Analysis Results: Base Year 2025 / Peak Loading 2025



## Annexure-C

۰.

ī

± + ∠,

## Assessment of bus voltages

## Annexure-C-1

## Without CMH PP and With Sanctioned Load In Service

|  | CMD SOLAR          | n,      | L INTERA<br>SYSTEM | CTIVE PO9       | JER SYSTE                         | VIJKIS N | 241 INTRACTIVE PONER SYSTEM SIMULACHPSS(2)" | SAT, FER IN 2025<br>SAVA FOR TRANS<br>VI FOR NOR-D | 8.2          | 1771)<br>RMERS<br>Lérornet | SERCIVER |
|--|--------------------|---------|--------------------|-----------------|-----------------------------------|----------|---|--|--------------|----------------------------|----------|
| X FROM 203X<br>TRAV3703MEX RATING<br>BUS# X NAMX 3ASKV | X AREA<br>SKV ZONE | NA/NJ   | ANGUS              | GGN<br>Mai/Murr | GTN LOAD SHUFT<br>MA/MYRR NA/MVAR |          | MAVAX #302                                  | AX25td X   | X<br>Rea ckt | ММ                         | AVAR.    |
| 1.0 RNGAS & SEF & 4130 CMF MV 11,000                   | -11                | 1.0200  | 0.0                | 4,1             | 0, C                              | 0.0      |   |  |              |                            |          |
|  | .1                 | 11,000  |                    | 1. OR           | 0.0                               | -1-2     | I MOOTE 10017                               | 11.003   | <br>•*       | 1.2                        | 7.<br>19 |
| 10   |                    |         |                    |                 |                                   |          | 41005 3203 2                                | C00.II   | -<br>•       | ۹,°.                       | 9.0      |
| 2 T  |                    |         |                    |                 |                                   |          | 41009 RLCCX 3                               | 11.000   | 1 1          | <u>.</u>                   | 0.17     |
| 41001 BLOCK 1 11, 300                                  | Ţ                  | 0.9967  | -0.0               | 0.0             | 0.0                               | · 0 · 0  |   |  |              |                            |          |
| Ģ  | L Ľ                | 786'JI  |                    | 0-0             | 0'0                               | 0.0      | 4100 CML WV                                 | 11,000   | ų<br>1       | -1.2                       | 1.10-    |
|  |                    |         |                    |                 |                                   |          | V1002 IN                                    | 007F'2   | e1<br><2     | 0.8                        | 6.4      |
| 5  |                    |         |                    |                 |                                   |          | с1003 3500K 1-д                             | 11.000   | i I<br>N     | 010<br>U                   | 613      |
| 41002 LV 0.4420  | **                 | 3,9875  | -1.4               | 0-0             | 0.8                               | 0        |   |  |              |                            |          |
| 1.00000K 54 2  | ÷                  | 0.4345  |                    | 0.0             | 0.4                               | 0.0      | 41000 RECK 2                                | 000.11   |              | -0.0                       | -0,4     |
| 41003 BLOCK 1-N 11.300                                 | с. <sup>1</sup>    | 9566-0  | с.<br>-0-          | 0.0             | 0.0                               | 0,0      |   |  |              |                            |          |
|  | г<br>7             | 369.CI  |                    | 0.0             | 0.0                               | 0':      | 1 NOOTA 10015                               | 21.300   | ۰.1<br>جه    | -0-5                       | -0.3     |
| 0.37514 38 2<br>41604 LV 0.4400                        | ম                  | 1.6160  | e.0-               | r:<br>          | 0.9                               | - 0.0    | 41C04 IV                                    | J. 440C  |              | 0.5                        | с.3<br>  |
| 2 EE   | ÷                  | 0.4470  |                    | 0.1H            | 0.4                               | 0.0      | 41003 BLCCX 1-A                             | 000111   | 4 I          | 5°C-                       | 6.0      |
| 4.005 BLOCK 2 11,000                                   | ~                  | 6, 3693 | 0.0-               | 0.0             | 0.0                               | -<br>0'0 |   |  |              |                            |          |
| 11   | Г                  | 10.992  |                    | 0.0             | 0.0                               | 0'C      | 4100 CMF MV                                 | 11,200   | 4<br>1       | -1.5                       | -0,8,    |
|  |                    |         |                    |                 |                                   |          | 41000 EV                                    | 0,4400   | , 1<br>1     | c<br>C                     | 0.4      |

.

.

. . .

÷

. .

ł

!

.

.

י י

:

.

:

.

•

.

.

:

ð.4 -0.4 7.6 0.4-0.4 0.3 ð, 6 -0.4 -0.9 0.0 -1.5 0.9 -0,8 о. 8 8°0--0.8 е:<u>-</u> 0.0 0.59.9 9 0.0 5°2-ວ - - --. : ч ч ÷ .--. ! н --·--Ţ s, ÷ s. ÷ ŧ٢ -----÷ ч. .<del>...</del> ÷ ÷ 11.000 100.11 11,000 11.000 0.4430 11.000 0.4400 11.000 11.000 11.000 005610 11.000 0.0 4:007 BLOCK 2-A 0.0 ELCUIL BLOCK R-A 41007 61003 2-3 41301: BLOCK 3-R ٤I 0.3 41305 AuCOA C V NOOTE 60013 DIO 0.0 41003 BLOCK 3 ALOC CML MV A.C. 41035 PLOCK VI CICOIÀ 41000 IV 410012 /// J.C -----0.0 ----i 0.5 è 0.0 0 0 è . 0-0 6.3 \$~C 0.0 0.0 8. 0 £10 0.0 0.0 9''Ê 0.8 0.0 0.0 о, в С 0.4 J. CR 0.0 0.0 0,0 с с 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0 - 3 000--0.0 -1.4 **†** . |--0.6 -1.5 -0.1 4 0.4993 018610 2 0.4343 6566.0 F 1 0.4309 1666'J \$ ≤ 0,9968 4 0.9907 1 10,992 066°0. I 0.4342 1 IC,98≎ 1 0.4420 3 0,4400 --0.4400 41007 SLOOK 2-R 11.000 11.000 0.4400 0.4400 11,000 N ~ 24 ~ ŝ m ŝ í 33 Ť 54 ал Ю 21 3  $\frac{1}{N}$ 410011 BLOOK 3-A 41029 NF2CT 3 01 10 VJ 30015 6 13 412012 :V 41008 LV 41.0012 LV : T : 1.000JN КООСО 10 1.0001.K 9 IC 0.9831.0 1. 200UN 7,9881.7 6 13 1,0000 ¢ u: ъ

i

ł

ł

!

## Annexure-C-2

## With CMH PP and With Sanctioned Load

In Service

SAT, FEB 15 2025 17:12 Sava Mdr Transformses y I For Nom-Thansformer Tranforzs

:

•

į

j

:

.

. :

:

:

X-----ZON PUS ------ZARJA VOLT CZN LOAD SHUNT XTT-----ZOEUS -------X ZRANJZOZMEN ARTIAG BUSÉ XTTARF --X BASZY ZONE DU/KY AXGUR FW/NYRA KW/NYAA KU/NYAA HUSI Y-- UAKE --X BASKY ARZA CAT RATO ANGLE & SUT A

IVAR MM

-

۰.

| 4100 CMH MV          | 20011            | € 1.0UDO          | 0.0  | т,<br>М    | 0.0 | 010                |                 |         |          |              |          |   |
|----------------------|------------------|-------------------|------|------------|-----|--------------------|-----------------|---------|----------|--------------|----------|---|
| OT F                 |                  | 11,300            |      | 0,9R       | 0.0 | . 91<br>- 1<br>- 1 | I MOODE [UD12   | 1,300   |          | 1.2          | 0.7      |   |
|                      |                  |                   |      |            |     |                    | 5 NOON SCOT     | 1.003   |          | "-<br>-      | a'0      |   |
|                      |                  |                   |      |            |     |                    | 4100% Y.CCK 3   | 11.000  | 4 I      | ÷.           | 5.10     |   |
| -                    |                  |                   |      |            |     |                    | ALCOLS SOLAR MA | 020.11  | ب<br>۲   | -0,8         | -1,1     |   |
| 41001 BLCCK 1        | 000.11           | 10°9367           | -0,0 | 0.3        | 0.0 | 0.0                |                 |         |          |              |          | ŀ |
| 14 :0                |                  | 1 IC.997          |      | 0.0        | 0'0 | 0.0                | AL DO CME NA    | 11,1000 | ų<br>į   | -1.2         | Ŀ.O-     |   |
| 1.00045              | 5<br>2           |                   |      |            |     |                    | - AT CODE       | 0.4400  | <br>7    | 0.8          | 0.4      |   |
|                      |                  |                   |      |            |     |                    | AIRUS SICCK 1-A | 11.060  | . ,      | c.5          | (C. C    |   |
| A1 (0)11             | 0.44.00          | 4 J.5875          | 2.1  | <b>J.C</b> | 9.3 | - 0-0              |                 |         |          |              |          | ł |
| 1,0030X              | اد:<br>العام الح | 1 0.4345          |      | 0.0        | 0.4 | 0-0                | 41001 BLOCK 1   | 11-030  | 4 1      | -Q.B         | -0.4     |   |
| ALORA NUCK L-A       | -A il.000        | 6 0 <b>,</b> 9696 | -0.0 | 0.0        | ü-ñ | 0.0<br>-           |                 |         |          | ~            |          | ł |
| 5 10                 | <br> <br>        | 101595            |      | 0.0        | 0.0 | 0.0                | 1 NOOLE ICOLA   | 11.000  | . 1<br>7 | -0°2         | -0.3     |   |
| 0.9751.K<br>41304 LV | 38 %<br>14400    | 4 1.JIGO          | 5°C- | 0.2        | 0.3 | - 0.0              | 41804 EV        | 0.1400  | 4 1      | 5°2          | 0.3      |   |
| L. COUTM             | 38               | 1 0,4470          |      | 91.O       | ٥.٨ | 0.0                | 41003 BLOCKR    | 11,000  | -<br>    | ې.<br>- ن    | -0-3     |   |
| 410.35 ELOCK 2       | 11,000           | 4 3,9993          | 0.0- | 0.0        | 0.0 | 0.0                |                 |         |          |              |          | ł |
| CI ()                |                  | 1 i0.992          |      | 0.0        | 0.0 | 0-0                | ÀN FWC DOTH     | 000.13  | <br>بو   | י.<br>-<br>ו | а.<br>Э- |   |

· • •

.

.. •

|             | 5 - 5<br>5 - 5              |                   | -0.4             |              | 9 " U-            | J. ć                            | -0,4                |             | -9°5             | 0.4       | 0.3               | - 77<br><br><br> |                 | -0.3                | 6-5                    | -0.3                 |                 | 0.1             |
|-------------|-----------------------------|-------------------|------------------|--------------|-------------------|---------------------------------|---------------------|-------------|------------------|-----------|-------------------|------------------|-----------------|---------------------|------------------------|----------------------|-----------------|-----------------|
| с.<br>Т     | 8.0<br>1.8                  |                   | α.<br>Ο-         |              | 8'J-              | 0.8<br>                         | -0.3                |             | с.<br>Т          | 0.8       | 0.5               | 8<br>2<br>1      |                 | -0.5                | C.3                    | -0,5                 |                 | 0.8             |
|             | :<br>ম ম                    | Í                 | 4<br>1           |              | <br>7             | 4 .1                            | רי<br>קי            |             | 4 l              | 4 I       | ן.<br>ק           | ، ،<br>ال        |                 | <del></del> ।<br>चा |                        | ,<br>₹               |                 |                 |
|             | 0.400<br>11.000             |                   | 11.600           |              | 11.000            | 0.4460                          | 1:,000              |             | 11.000           | 0.4430    | 11.000            | 80011.           |                 | 11.000              | J, <u>4</u> 4C2        | 11,000               |                 | 1.000           |
| •<br>•<br>• | 41006 IV<br>41007 BLCCS 2-A |                   | 0.0 4000 BLOCK 2 | J. C         | 0.0 41005 3DOCK 2 | 41308 LV<br>6.0                 | 0.0 41007 BLOCK 2-A | 0.0         | 010 \$100 CKH KA | 410013 IV | 41201) BLOCK 3-R  |                  | C.0             | 0.0 41069 NUOCK 3   | 010<br>AI 31015        | 2-8 XOOTE ELOCIE 010 | J. ß            | 0.6 4100 CMH NV |
| •           |                             | 0.8               | <b>F</b> .0      | 0,0          | 0.5               | 0.8                             | 6.A                 | 0.0         | 0.0              |           |                   |                  | 0.0             | 0.J                 | 0.8                    | 0.4                  | 0'C             | 0.3             |
|             |                             | 0.0               | 0-0              | <u>ر</u> .0  | 0.0               | U-D                             | 0.0                 | 0.0         | 0-D              |           | 0.0               | 0.0              | 0.0             | 0.0                 | 3.3                    | 0.0a                 | 0.0             | 0.0             |
|             |                             | · i . 4           |                  | -0.0         |                   | 3 .<br>11 -                     |                     | -0.0        |                  |           | -1.5              |                  | <br>6           |                     | 9'n-                   |                      | 0.0             |                 |
|             |                             | 4 0.3870          | 1 0.4243         | 0636°U >     | 766-01            | 4 0,9969                        | 1 D.4399            | 1699.0 Å    | £66°€. I         |           | 4 0.9866          | , ci             | 10-9907         | 7 10,985            | 4 1.30/5               | 1 0.4420             | € 1.0602        | 1 11.002        |
|             | 54                          | .0,4⊈ņC           | 54 2             | X 2-A 11.0CD | :                 | 5< 2<br>€,4400                  | े।<br>ज             | r 3 11.003  |                  | 54<br>2   | ن.<br>ن.          |                  | (3-V 11,000     |                     | 21 3<br>0.4400         | 21 S                 | - COOTIE - AM : |                 |
|             | :00:                        | \$ 10<br>41006 Lv | 1.00014          | ¥1007 N DCX  | 9 10              | АТ ВОСТ <del>Р</del><br>ЯТӨЗӨ-О | coory               | 20019 REDUX | 15 1.            | 1.000LK   | 6 10<br>410010 EV |                  | AIGUL BLOCK 2-A | 6<br>10<br>10       | ЧТ 210015<br>€10312 т∨ |                      | 410013 202AA MV | рг<br>В         |

.

.

I

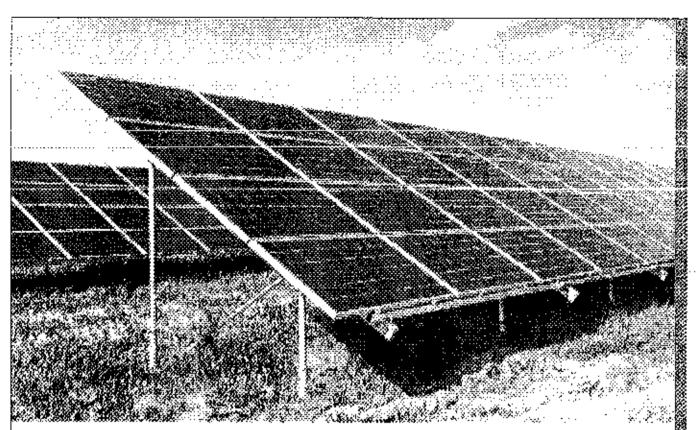
.

;

:

:

:





## SYSTEM STUDY ANALYSIS OF NEW AKRAM LINE (NAL) 500kW SOLAR PV SYSTEM

Report

ARCO Energy

PAKISTAN Tel: +92-300-8827101



## CONTENTS

|               | TTVE SUMMARY   |
|---------------|--|
| 1 INT         | RODUCTION  |
| <b>1</b> .1   | Project Description  |
| 1.2           | Interconnection Arrangement  |
| 1.3           | Objective of System Study Analysis                                       |
| 1.4           | Study Components   |
| 2 STU         | DY METHODOLOGY   |
| 2.1           | Study Criteria   |
| 2.2           | Steady State Analysis  |
| 2.2.1         | 1 System Intact Analysis   |
| 2.2.2         | 2 Transmission Line Loading Analysis                                     |
| 2.2.3         | 8 Voltage Analysis   |
| 3 STE         | ADY STATE ANALYSIS   |
| 3. <b>1</b> · | Model Development  |
| 3.2           | Power Flow Assessment Without NAL PP and with Sanctioned Load In Service |
| 3.2.1         | Base Year 2025: Peak Loading Summer with Sanctioned Load in Service      |
| 3.3           | Power How Assessment with NAL PP   |
| 3.3.1         | Base Year 2025: Peak Loading Summer with Sanctioned Load In Service      |
| 3.4           | Conclusion   |
| 4 CO2         | NCLUSION   |
| <b>4</b> .1   | Steady Stare Assessment  |
| LIST OF       | ANNEXURES  |



### EXECUTIVE SUMMARY

This report provides the documentation of an assessment that has been performed for the interconnection of a 500kW Solar PV Power Generation project at New Akram Line (NAL) distribution system at 11kV project of "Military Engineering Services" (MES). The project will be a Grid field 500kW Solar PV based system connected with the power network of NAL. The '500kW NAL solar PV Power Generation project' is located at G9FV+RF5, Abid Majeed Rd, Cantt, Eahore, Punjab, Pakistan.

The integration of solar power generation at the NAL premises necessitates a comprehensive system study analysis to ensure optimal operation of the electrical network. NAL currently receives a single point supply from LESCO with a sanctioned load of 0.5MW. The introduction of solar power generation will influence the flow of electricity within the premises, impacting both consumption and injection dynamics.

The existing scup includes transformers, switchgear, and distribution panels to distribute electricity throughout the premises. The sanctioned load of 0.5MW is the maximum load that can be drawn from LESCO's grid.

The entire solar generation within the NAL premises will be consumed internally without exporting any power to the grid. To ensure the safe and efficient integration of solar power, a load flow study is required to analyze the impact of this interconnection on the existing electrical network. This study will assist in obtaining solar generation concurrence and ensuring compliance with relevant technical and regulatory requirements.

The analyses have been carried out in following scenarios;

- Without 500kW NAL solar PV with sanctioned load in service.
- With 500kW NAL solar PV with sanctioned load in service.

Steady state power flow assessment has been performed using the network data of NAL. Power flow study was conducted without Solar Project with sanctioned load in service to analyze the magnitude and phase angles of bus voltages, line loadings and power flows under steady-state conditions. Power flow analysis was also conducted with sanctioned load in service after the interconnection of the Solar project with the NAL distribution system. The power flow results for the system intact shows that the



power flows on all the NAL transmission and distribution line branches are within their normal line loading limit. There is no capacity constraint in terms of power flow or voltage ratings within the study area.

This systems study is a critical step in obtaining solar generation concurrence for NAL. By ensuring the stability and reliability of the electrical system, the study facilitates searnless solar power integration while maintaining compliance with NAL and regulatory requirements.

Based on the study results, it is concluded that proposed generation interconnection assessment for 500kW NAL solar PV Power Generation project meets the NEPRA grid code planning criteria.



### **1** INTRODUCTION

#### 1.1 Project Description

This report provides the documentation of an assessment that has been performed by ARCO Energy in response to a request made by New Akram Line (NAL) ("Project Owner" or "PO") for the interconnection of a 500kWp Solar PV Power Generation project ("Project") to the NAL power System at 11kV.

The '500kW NAL solar PV Power Generation project' is located at G9FV+RP5, Abid Majeed Rd, Cantt, Labore, Punjab, Pakistan, Figure 1.1 shows Google site map of the project.

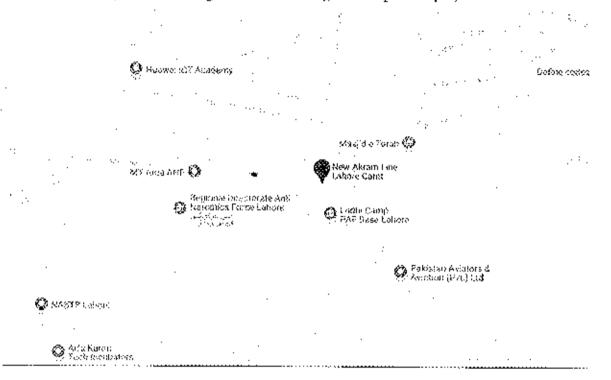


Figure 1.1: Google Site Map of the Solar PV Power Generation Project.



#### 1.2 Interconnection Arrangement

NAL aims to integrate solar power generation into its existing electrical infrastructure. NAL currently teccives a single-point power supply from LESCO with a tanctioned load of 0.5MW. The entire solar generation within the NAL premises will be consumed internally without exporting any power to the grid. The objective of the analyses is to evaluate the impact of the solar power plant on the NAL transmission and distribution system.

### 1.3 Objective of System Study Analysis

The primary objectives of the load flow study are:

- To evaluate the impact of solar power injection on the voltage levels and power distribution within NAL premises.
- To determine the changes in power flow patterns resulting from the integration of solar generation.
- To ensure that the existing electrical infrastructure can support the additional solar power without causing instability or operational issues.
- To verify compliance with regulatory requirements for solar power interconnection and obtain concurrence for solar generation.

#### 1.4 Study Components

500kW solar PV system is modelled into the NAL distribution system by ARCO Energy. Technical analysis includes:

- i) Data gathering and modelling
- ii) Steady state analysis
- iii) Conclusion

The above scope of work involved in the technical analysis has been carried to demonstrate that connection assessment of this PV system meets the National Electric Power Regulatory Authority (NEPRA) distribution code.

The analyses have been carried out in following scenarios;

- Without 500kW NAL solar PV with sanctioned load in service.
- With 500kW NAL solar PV with sanctioned load in service.



This report documents the results of the steady state analyses. The principal objective of these analyses is to evaluate the impact of 500kW solar PV system to the distribution system of NAL and vice versa.

5



### 2 STUDY METHODOLOGY

#### 2.1 Study Criteria

The study has been carried out based on the National Electric Power Regulatory Authority (NEPRA) Grid Code planning criteria. Key parameters and their corresponding limits have been summarized in table below.

| Para           | aneter           | Range  |  |  |  |  |
|----------------|------------------|--|--|--|--|--|
| Voltage Level  | Normal Condition | ±5 % p.p at 132kV and below<br>+8%,-5% p.u at 220kVand above |  |  |  |  |
|                | Contingency      | ±10 % p.u  |  |  |  |  |
| T/Line Loading | Normal Condition | 100%   |  |  |  |  |
| Capacity       | Contingency      | 100%   |  |  |  |  |
|                | Nominal          | 50 T Iz  |  |  |  |  |
| Frequency      | Normal Variation | 49.8 Hz - 50.2 Hz  |  |  |  |  |
|                | Contingency Band | 49.4 Hz - 50.5 Hz  |  |  |  |  |
| Power Factor   | Lagging          | 0.95   |  |  |  |  |
| TOWER PACIN    | Leading          | 0.95   |  |  |  |  |

#### 2.2 Steady State Analysis

The purpose of steady-state analysis is to analyse the impact of the proposed solar power plant on distribution system facilities under steady-state conditions. It involves two distinct analyses: line loading analysis and voltage analysis. Power flow solutions using the PSS/E® program (Version 33.4) has been performed.

A "study area" was defined to represent the areas of interest within NAL.

#### 2.2.1 System Intact Analysis

The incremental impact of the project on substations and transmission line loading under normal conditions was evaluated by comparing transmission and distribution system power flows through different scenarios for the project.

#### 2.2.2 Transmission Line Loading Analysis

11kV and 0.4kV rated transmission and distribution facilities in the study area have been monitored for line loadings.



ł

## **Akram Line**

### 2.2.3 Voltage Analysis

Voltages at buses inside the study area have been monitored for possible for voltage violations in accordance with NEPRA Grid Code guidelines.



### 3 STEADY STATE ANALYSIS

#### 3.1 Model Development

Project specific data was provided by the plant owner and it has been compiled and presented in **Annexure-A**. The steady state model of the power plant is presented in table below:

|  | Generator                  |
|--|----------------------------|
| No. of Collector Units                       | 1                          |
| Generation size of each<br>collector (kVA)   | 421                        |
| Active Power of each<br>collector Pgen. (kW) | 400                        |
| . Power Factor                               | 0.95 lagging, 0.95 leading |
| Qmin, Qmax (kVAR)                            | - 0.1315, 0.1315           |
| Rated Frequency                              | 50 I I z                   |
| Generation Voltage                           | 0.8V                       |
| Xsource                                      |                            |
| Generat                                      | tion Step Up Transformer   |
| No of Transformer                            | 1                          |
| kVA Capacity of each<br>GSU                  | 630                        |
| % Reactance (X)                              | 5%                         |
| ]  | New Akram Line             |
| Sanctioned Load (LESCO)                      | 500 kW                     |

Steady state power flow assessment has been performed using the network data of NAL.

## 3.2 Power Flow Assessment Without NAL PP and with Sanctioned Load In Service

Power flow study without NAL solar and with sanctioned load in service, was conducted to analyze the magnitude and phase angles of bus voltages, line loadings and power flows under steady-state conditions.

The result of this power flow analysis is in Annexure-B.



Contraction and Aug

#### 3.2.1 Base Year 2025: Peak Loading Summer with Sanctioned Load in Service

Power flow analysis has been performed on the peak loading summer (June) 2025 case of NAL network. This base case included a detailed representation of the NAL transmission and distribution system in the study area.

The steady state results, depicts that the power flows on all the NAL distribution line branches are within their normal loading limits. There is no capacity constraint in terms of load flow or voltage ratings around the study area. Result of the power flow analysis is attached in **Figure B-1**.

#### 3.3 Power Flow Assessment with NAL PP

Power flow study of NAL solar project was conducted with sanctioned load (in service and out of service) to determine the reliability impact of the 500kW NAL solar project on the NAL distribution system. This includes the performance of load flow analysis to identify any facility overload or voltage condition that violates the NEPRA planning criteria. Any such violation that is either directly attributable to this project or for which it will have a shared responsibility is included in this report.

The results of the project power flow analysis are plotted in Annexure-B.

#### 3.3.1 Base Year 2025: Peak Loading Summer with Sanctioned Load In Service

A base case has been developed with sanctioned load in service at NAL solar for peak loading summer (June) 2025 that allow us to judge the impact of NAL solar project on the NAL network. Project power flow analysis has been performed after the connection of the project with the NAL distribution system. This includes the detailed representation of the power plant.

The steady state result, with sanctioned load in service at NAL solar depicts that the power flows on all the transmission line branches are within their normal loading limits. There is no capacity constraint in terms of load flow or voltage ratings around the study area.

Result of the power flow analysis is attached in Figure B-2.

The results of the project bus voltages analysis are attached in Annexure-C.

### 3.4 Conclusion

Steady state power flow assessment has been performed. Power flow study was conducted without solar Project with sanctioned load in service to analyze the magnitude and phase angles of bus voltages, line loadings and power flows under steady-state conditions. Power flow analysis was also conducted



with sanctioned load in service after the interconnection of the Solar project with the NAL distribution system. The power flow results for the system intact shows that the power flows on all the NAL distribution line branches are within their normal line loading limit. There is no capacity constraint in terms of power flow or voltage ratings within the study area.

a gran see soonale



### 4 CONCLUSION

#### 4.1 Steady State Assessment

Steady state power flow assessment has been performed. Power flow study was conducted without NAL solar with sanctioned load in service, to analyze the magnitude and phase angles of bus voltages, line loadings, and power flows under steady-state conditions. Power flow analysis was also conducted with NAL solar and with sanctioned load in service with NAL distribution system. Power flow results showed that the power flows on all the NAL distribution branches are within their normal loading limit. There is no capacity constraint in terms of power flow or voltage ratings within the study area.

The steady state results found no capacity constraint in terms of power flow and voltage ranges.

Hence, it is concluded that based on the study results the Interconnection Assessment for 500kW New Akram Line solar PV system with NAL Transmission and Distribution Network, meets the NEPRA grid code planning criteria.



### LIST OF ANNEXURES

Annex A: Project Specific Data.

Annex A-1: Project Site Map.

Annex A-2: Power Plant Data.

Annex B: Power Flow Steady State Analysis Result

Figure B-1: Base Year 2025 - Peak loading summer without NAL solar and Sanctioned load in service.

Figure B-2: Base Year 2025 - Peak loading summer with NAL solar and Sanctioned load in service.

Annex C: Assessment of Bus Voltages.

Annex C-1: Withour NAL solar and with Sanctioned Load In Service.

Annex C-2: With NAL solar and with Sanctioned Load In Service,

## Annexure-A

Project Specific Data

.

## Annexure-A-1

÷

Project Site Map

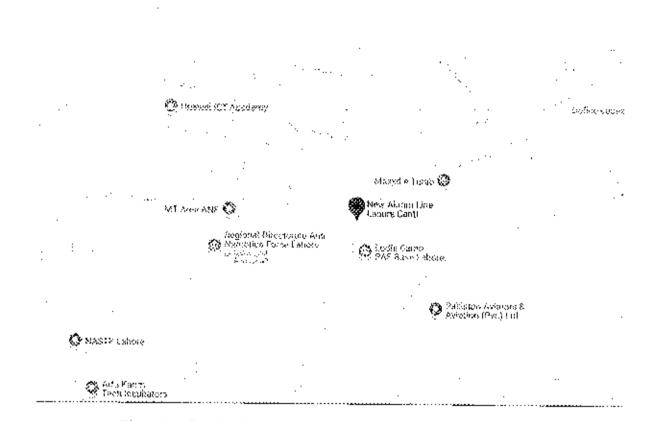
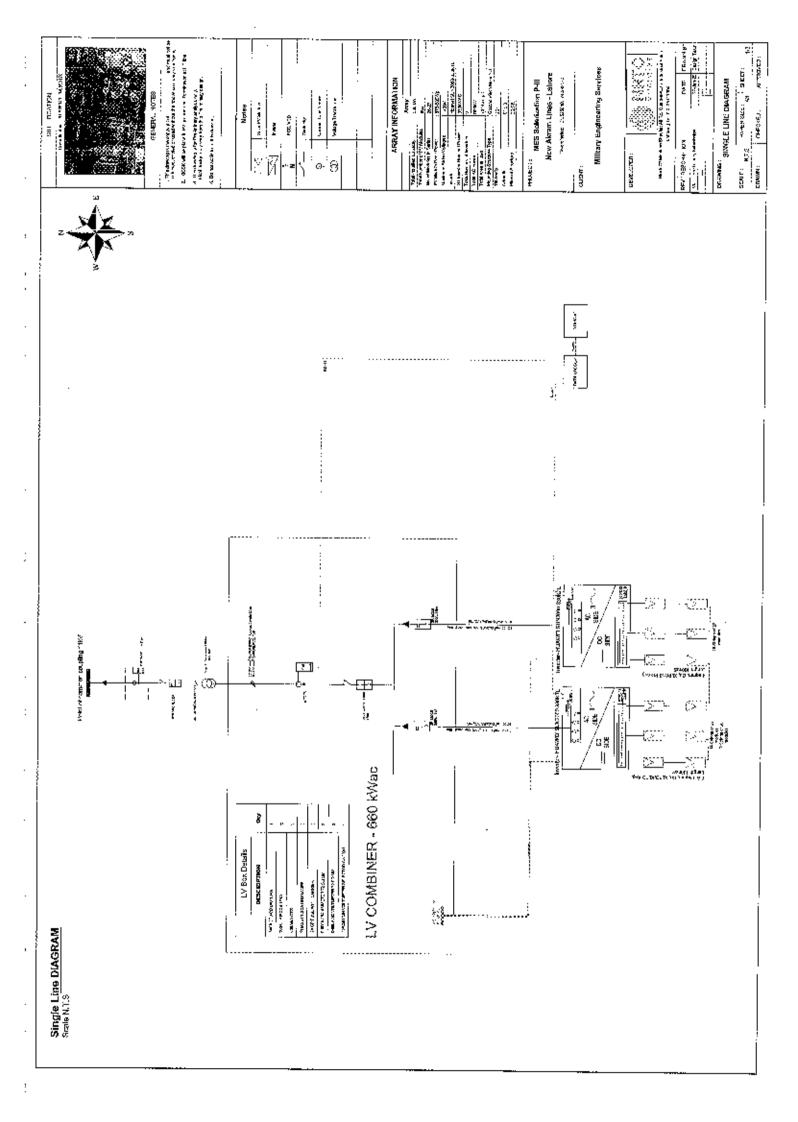


Figure 1.1: Google Site Map of the Solar PV Power Generation Project.

## Annexure-A-2

Power Plant Data



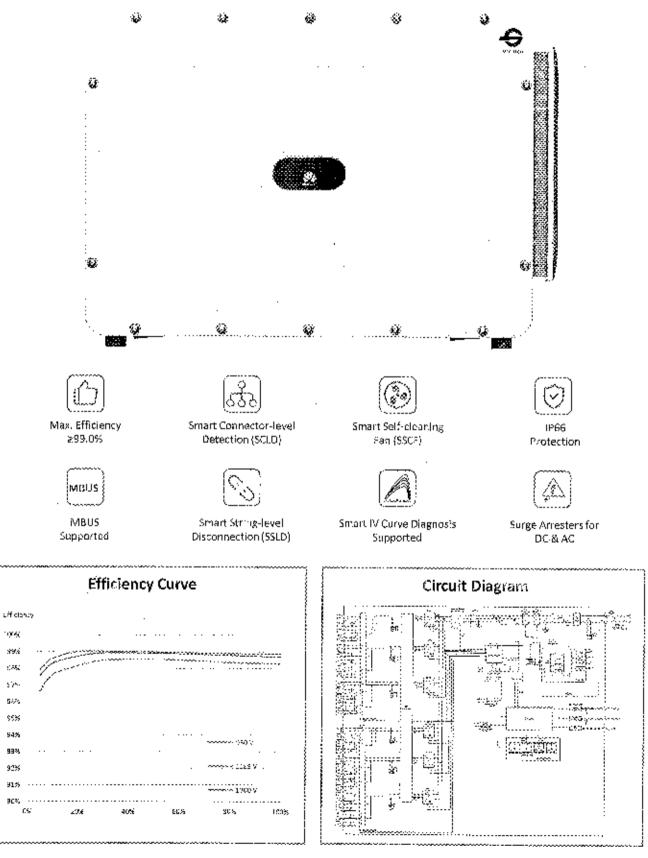
| 2                                   |   |      |  |  |
|-------------------------------------|---|------|--|--|
|                                     |   | 7760 |  |  |
| PV Placement DIAGRAM<br>Scele N.T.S | 1 |      |  |  |

.

## SUN2000-330KTL-H1 Smart String Inverter

i

:



SCLAB UGAWED, COM

## SUN2000-330KTI-H1 Technical Specifications

|          | Efficiency                               |  |
|----------|--|--|
|          | Max, Efficiency                          | 299.0%   |
| •        | European Efficiency                      | 2.98.8%  |
| •        | Input                                    | · · · · · · · · · · · · · · · · · · ·  |
|          | Max. Input Voitage                       | 1,500 V  |
|          | Number of MPP Trackers                   | 5  |
|          | Max. Current per MPPT                    | 65A · · · · · ·  |
|          | Max, Short Cristin Content per IMAPT     | 115 A  |
|          | Max. PV inputs per MEPT                  |  |
|          | Start Vellage                            | 4/5/5/4/5/3  |
|          | MPPT Operating Voltage Bange             | 550 V  |
|          | Nominal Input Voltage                    | 500 V ~ 1,500 V  |
|          | ···· ···· · · · · · · · · · ·            | 1,080 V  |
| ••••     | Output                                   |  |
|          | Norninal AC Active Power                 | 300,000 W  |
|          | Max. AC Apparent Power                   | 350,000 VA   |
|          | Max. AC Active Power (cosh=1)            | Back and a second s |
|          | Nemtral Output Voltage                   | 800 V. 09V + 75  |
|          | Roled AC Grid Frequency                  | 50 Hz / 60 Hz  |
|          | Nominal Oulput Current                   | 215.5 4  |
| •        | Max, Oulgue Current                      | 238.2 A  |
|          | Adjustable Power Factor Range            | 0.8LG 0.8.D  |
|          | Total Harmonic Distorition               | <1%  |
|          | Protection                               |  |
|          | Smart StGing-Level Disconnector(SSLD)    | Yes  |
| ļ        | Anti-is anding Protection                | Yes  |
|          | AC Overcurrent Protection                | ves  |
|          | DC Reverse-polarity Protection           | Yes  |
|          | PV-array String Fault Monitoring         | Yes  |
|          | DC Surge Arroster                        | Туре II  |
| •••      | AC Surge Arrester                        | Τνρεί  |
|          | DCInsulation Resistance Detection        | Yes  |
|          | AC G/ounding Fault Protection            | Yes  |
|          | Residual Curran' Monitoring Unit         | Yes  |
|          | Communication                            |  |
|          | Display                                  | LED Indicators, WLAN + ASP   |
|          | JSB                                      | Yes  |
|          | MBUS                                     | řes  |
|          |  | Yes  |
|          | General                                  |  |
|          | Dimensions (Wix High)                    | 1,048× 732× 095 mm   |
|          | Weight (with occurting place)            | ≤11.° m  |
| • •      | Operating Temperature Range              | -25 °C ~ 60 °C   |
|          | Cooling Method                           |  |
|          | Max. Operating Altitude without Derating | Smart Air Cooling<br>4 000 m (13 133 ft )  |
|          | Relative Humicity                        | 4,000 m (13,123 ft.)   |
|          |  | 0 100%   |
|          | · · · · · · · · · · · · · · · · · · ·    | erproof Connector + CT/DT Terminal   |
| <u>.</u> | Protection Degree                        | F 66   |
|          | Topology                                 | Transformerless  |
|          |  | ·  |

## Harvest the Sunshine

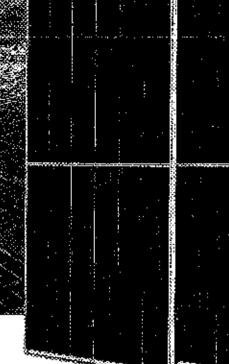
## **PE**EPBLUE4.0

## 580W n-type Bifacial Double Glass High Efficiency Mono Module JAM72D40 555-580/GB 555

### Introduction

Mono

Power by the testest SMBB in typic solar cell, ball cell, configuration and deplese finder charaction technology. Dave moracle have higher subject your, lower LID, better weak illuntituation response, and hetter componante configuration.





#### Higher power generation better LCOE



h-type with very Lower LID.



Setter weak illumination response



### Botter Temperature Coefficient

. . .....

- Superior Warranty
- 12-year product warranty
- S0-year linear power output warranty.



 n-type Bitabial Doublo Glass Models Linear Performance Warranty



Standard Modelle Linear Performance Warrenty

### Comprehensive Certificates

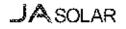
- < iEC 61215, IEC 61700
- ISO 5001: 2015 Quality management systems
- ISO 14001: 2015 Environments) management systema
- ISO 450011 2018 Occupational health and astety manaparient systems
- IEC 62961, 2018 Terrestrial photovolisic (PV) modules -Quality system for PV module manufacturing





WWW.j6360[81.from CWWW.j6360[81.from CWWW.j6360[81.from Construction of the construction of the construction of the construction Construction of the const





#### MECHANICAL DIAGRAMS

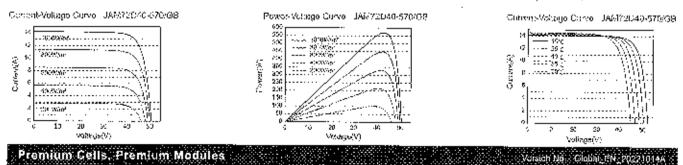
## JAM72D40 555-580/GB



| Mathem     Mathm     Mathem     Mathem     Mathem <th></th> <th></th> <th></th> <th></th> <th></th> <th></th> <th></th>   |  |   |                            |                    |                            |           |                        |
|--|--|---|----------------------------|--------------------|----------------------------|-----------|------------------------|
| Image: Control of the second secon  |  | <u>1.96</u>   |                            | H <sub>38≡</sub> , | Cell                       |           | Monc-1886              |
| Image: Section Size       Amm <sup>2</sup> (EC), 42,4WG(UL)         Image: Section Size       Amm <sup>2</sup> (EC), 42,4WG(UL)         Image: Section Size       Amm <sup>2</sup> (EC), 42,4WG(UL)         Image: Section Size       Image: Size Section Size         Image: Section Size Section Size       Image: Size Section Size         Image: Size Section Size Section Size       Image: Size Section Size Section Size Amm <sup>2</sup> (EC), 42,4WG(UL)         Image: Size Section Size Section Size Amm <sup>2</sup> (EC), 42,4WG(UL)       Image: Size Section Size Amm <sup>2</sup> (EC), 44,55243         Image: Size Section Size Amm <sup>2</sup> (EC), 42,4WG(UL)       Image: Size Section Size Amm <sup>2</sup> (EC), 42,4WG(UL)         Image: Size Section Size Amm <sup>2</sup> (EC), 42,4WG(UL)       Image: Size Section Size Amm <sup>2</sup> (EC), 42,4WG(UL)         Image: Size Section Size Amm <sup>2</sup> (EC), 42,4WG(UL)       Image: Size Section Size Amm <sup>2</sup> (EC), 42,4WG(UL)         Image: Size Section Size Amm <sup>2</sup> (EC), 52,5       Image: Size Section Size Amm <sup>2</sup> (EC), 52,5         Image: Size Section Size Amm <sup>2</sup> (EC), 52,5       Image: Size Section Size Amm <sup>2</sup> (EC), 52,5         Image: Size Section Size Amm <sup>2</sup> (EC), 52,5       Image: Size Section Size Amm <sup>2</sup> (EC), 52,5         Image: Size Section Size Amm <sup>2</sup> (EC), 52,5       Image: Size Section Size Amm <sup>2</sup> (EC), 52,5         Image: Size Section Size Amm <sup>2</sup> (Size A  |  |   |                            |                    | Weight                     |           | Ji.8kg                 |
| Image: Section of Sectin Sectin of Section of Section of Section of Section of Section   |  | 24-3  | '                          | ∥ .<br>∣           | Olmonational               | 22701878  | : 1841-04420)×80851.50 |
| Image: Section of the sectin the sectin the sectin the sectin the section of the  |  |   |                            |                    | Cable Cross Section Size   | 4ភេណ      | * (IEC), 42,AWG/QL)    |
| Advice from the analysis of the second   |  | - 022   |                            |                    | No. of colls               |           | '44(8×24)              |
| Image: Start Start       Start Start       Connector       CC 4.10-357/ MC 1-EV02A         Image: Start Start       Image: Start Start       Image: Start Start       Start Start         Image: Start Start       Image: Start Start       Image: Start Start       Start Start         Image: Start Start       Image: Start Start       Image: Start Start       Start Start         Image: Start Start       Image: Start Start       Start Start       Start Start         TYPE       JAM 72DAC   |  | 20.1<br>nding rolas   |                            | . ส่ฏ              | Junction Slox              |           | 1968, 3 diades         |
| Image: Interview       Image: Interview       Image: Image  | 다 그는 김 옷 김 옷 다 가지?   | ssfär ∕il ! I I   |                            | Strant frame       | Connector                  | QC 4.     | 10-351/ MC 1-EV02A     |
| FLACE         Issue from         Decksoging Costiguration         Steposifyedial,<br>720008/04HQ Container           ELECTRICAL PARAMETERS AT STC           TYPE         JAM72020         JAM72040   |  | r.nkpy holes<br>Suzes   |                            |                    | *                          |           |                        |
| Packaging Configuration         Packaging Configuration         Separation         Separation           ELECTRICAL PARAMETERS AT STC         JAM720A0   |  | airne Irba  |                            |                    | Front Glass/Back/Class.    |           | 2.6mw/2.0mm            |
| TYPE         JAM 720-00<br>-550/08         JAM 720-00<br>-550/08         JAM 720-00<br>-570/08         JAM 720-00<br>-570/08 <thjam 720-00<br="">-570/08         JAM 720-00<br/>-570/08<td>interaction of the state of the</td><td>line in the second s</td><td><u></u>.</td><td>   Long frame</td><td>Packaging Coefiguration</td><td>720</td><td></td></thjam> | interaction of the state of the | line in the second s | <u></u> .                  | Long frame         | Packaging Coefiguration    | 720       |                        |
| TYPE         -station         -580/08         -580/08         -580/08         -570/08         -570/08         -500/08 <th< td=""><td>ELECTRICAL PARAMETER</td><td>SAT STC</td><td></td><td></td><td></td><td></td><td></td></th<>  | ELECTRICAL PARAMETER   | SAT STC   |                            |                    |                            |           |                        |
| Roled Maximum Power(Prink) (W]         558         560         502         570         579         580           Open Clint, & Volkage(Volo) [V]         50.55         50.70         50.85         61.00         61.45         61.30           Maximum Power Volkage(Volo) [V]         42.24         42.40         42.55         42.40         42.85         43.03           Shen Cincuit Current(kc) [A]         14.02         14.09         14.16         14.23         -4.30         -4.36           Maximum Power Qurrent(kop) [A]         13.14         13.21         13.20         13.35         13.42         13.48           Medule Efficientry [%]         21.5         21.7         21.9         22.1         22.3         22.5           Power Tolerature   | TYPE   |   |                            |                    |                            |           |                        |
| Maximum Power Vallage(Vorp) [V]         42.24         42.40         42.65         42.40         42.85         43.03           Shint Circuit Current(lac) [A]         14.02         14.09         14.16         14.73         54.30         14.36           Maximum Power Qurss of (kep) [A]         13.14         13.21         13.29         13.35         13.42         13.48           Medule Efficienter (%)         21.5         21.7         21.9         22.1         22.3         22.5           Power Tolerature         0-450V         -0.0480%***C         -0.0480%***********************************  | Roled Meximum Power(Pmax) (W]  | 558   | 560                        | 506                |                            |           |                        |
| Short Oricel Consequences (Mark) (M)       14.02       14.09       14.16       14.73       14.00       14.03         Short Oirouit Content(Roc) (A)       13.14       13.21       13.20       13.35       13.42       13.48         Measimum Power (Surrant(Roc) (A)       21.5       21.7       21.9       22.1       22.3       22.5         Power Toleration       0~+5W       -0.948/5/°C       -0.948/5/°C       -0.948/5/°C       -0.948/5/°C         Temperature Conflictent of Not(Roc) (Sc)       -0.948/5/°C       -0.948/5/°C       -0.948/5/°C       -0.948/5/°C         Temperature Conflictent of Pressly, Prop)       -0.948/5/°C       -0.948/5/°C       -0.948/5/°C       -0.948/5/°C         Temperature Conflictent of Pressly, Prop)       -0.948/5/°C       -0.960/5/°C       -0.960/5/°C       -0.960/5/°C         Temperature Conflictent of Pressly, Prop)       -0.960/5/°C       -0.   | Optin Circ. 3 Volktge(Voc) [V]   | 50.55   | 50,70                      | 50.88              | 61.00                      | 51.15     | 51.30                  |
| Maximum Power (Content(Copp) (A)     13,14     13,21     13,28     13,35     13,42     13,48       Module Efficientay (%)     21,5     21,7     21,9     22,1     22,3     22,5       Power Tolerance     0~+5W     -0.948%/*C     -0.948%/*C       remporature Coefficient of bac(a, las)     -0.260%/*C     -0.260%/*C       Tormwrature Coefficient of Prink(y, Prink)     -0.366%/*C     -0.936%/*C       STC     Irradiance 1000Wink, ce8 temperature 26*C, AM: 5G       Reme kill senders the ceales do net the temperature trif thay are roligen of the effectivity only serve for physicility and the organization types.     OPERATING CONDITIONS       TYPE     JAM78E45     JAM72D40     JAM72D40     JAM72D40     JAM72D40   | Maximum Power Voltage(Verp) (V)  | 42.24   | 42.40                      | 42.65              | 42.40                      | 42.85     | 43.03                  |
| Medule Efficient on plane quipping     ?1.5     ?1.7     ?1.9     ?2.1     ?2.3     ?2.5       Power Tolerature     0~+5W       femperature Coefficient of lac(n_lac)     +0.948%/*C       Temperature Coefficient of Prinacly_Prip)     -0.260%/*C       Tomperature Coefficient of Prinacly_Prip)     -0.360%/*C       STC     timation of 1000Winf, cell temperature 25**C, AM2.5C       Remis & Stepdale risks callege do bet micritic a single merule and trag are roligent of the cell temperature 25**C, AM2.5C       ELECTRICAL CHARACTERISTICS WITH 10% SOLAR IRRADIATION RATIO     OPERATING CONDITIONS       TYPE     //AM72D40_JAM/72D40_JAM72D40  | Shen, Oircuit Cortent(lac) [A]   | 14,02   | 14,09                      | 14,16              | 14.78                      | h4.30     | 14.36                  |
| Power Toleration     0++5W       Perpenditure Coefficient of be(a_fec)     -0,048%/*C       Temperature Coefficient of Voc(β_Voc)     -0,260%/*C       Temperature Coefficient of Pinaxly_Prop)     -0,360%/*C       STG     trradiance 1000Winit, cell temperature 25*C, AM2.5G       Remis & Steaded rate of the cells of a single mercule and the assingle mercule of the cells of the   | Maximum Power Correol(Jop) [A]   | 13.14   | 13.21                      | 13.28              | 19.35                      | :3.42     | 13.48                  |
| femperature Coefficient of loc(a_loc)     -0.948%/*C       Temperature Coefficient of Voc(β_Voc)     -0.280%/*C       Tomperature Coefficient of Prinacly_Prop)     -0.366%/*C       STC     -0.366%/*C       Remis & Senderal rate of Dissocretary do not main to a single memory and panel the effection of the effective server for one particle and the organization of panel.     -0.260%/*C       BELECTRICAL CHARACTERISTICS WITH 10% SOLAR IRRADIATION RATIO     OPERATING CONDITIONS       TYPE     ////78745_0_/AM72040_JAM72  | Nodule Efficientry [%]   | 21.5  | 21.7                       | 21.9               | 22.1                       | 22.3      | 22.5                   |
| Temperature Coefficient of Vec(β_Vec)     0.260%/°C       Temperature Coefficient of Prink(y_Prink)     0.300%/°C       STC     Irradiance 1000Win/, ce8 temperature 26°C, AM2, 5G       Renic K % edited rate of this scaled do bit their to a single merute and they are roligient of the start and they are roligient of they are roligient of they are roligient of the start of the star  | Power Tolerance  |   |                            |                    | 0~+5W/                     |           |                        |
| Tomperature Coefficient of Princip/       0.300%/C         STC       Irradiance 1000Win/, cell temperature 25°C, AM: 150         Remit & Settical rate of this occales do bet the to a single merule and tray are colored of the effective volg save for physelesis anicity different notice types.         ELECTRICAL CHARACTERISTICS WITH 10% SOLAR IRRADIATION RATIO       OPERATING CONDITIONS         TYPE       J/0878E49       JAM72D40       JAM72E40       JAM7   | (emperature Coviliaium) of Isc(a_lisc)   |   |                            |                    | +0.948%/*C                 |           |                        |
| STC     Irradiance 1000Win7, ce8 temperature 26°C, AM2, 5G       Renie & 9 edited rate of this scales do not menus and menus and integers of the site. They are not part of the site is a single menus and integers of the site. They are not part of the site is a single menus and they are not part of the site. They are not part of the site is a single menus and the site is a single menus and they are not part of the site. They are not part of the site is a single menus and they are not part of the site. They are not part of the site is a single menus and the site is a site is a single menus and the s   | Temperature Coefficient of $Vec(\beta_{1},Vec)$  |   |                            |                    | -0.280%/°C                 |           |                        |
| Remise in Second reliance of the second reliance  | Tomperature Coefficient of Pinaxly_Pinp  | ΰ   |                            |                    | -0.360%/°C                 |           |                        |
| Remise is Sendered rate or Diss detailing do not their to a single menute rind it ay are not part of the otion. They only serve for preparison among different residue types.         ELECTRICAL CHARACTERISTICS WITH 10% SOLAR IRRADIATION RATIO       OPERATING CONDITIONS         TYPE       JAM78E 40       JAM72D40  | STC  |   |                            | trradjanos 100     | 0W/m², ceÿ temperature 28° | C, AM2.50 |                        |
| TYPE J/0078E40 JAM72D40 JAM72E40 JAM72E40 JAM72E40 JAM72E40 JAM72D40 Meximum Sustain Boline 15000 Fre  | Roma & Stepiscal riske in Busicetalog do natire  | ver to a single menute and they   | are not part of lite offer |                    |                            |           | ••                     |
| TYPE 3/2672040 JAW72040 JAW72040 JAW72040 JAW72040 JAW72040 Meximum Susters Solitans 15000 Fre   | ELECTRICAL CHARACTERI  | STICS WITH 10% S  | OLAR IRRAD                 | IATION RATIO       | O OPERATI                  |           | DITIONS                |
| REFIGE SEMAR ARE/23 ETO/CE SERVER REPORT FRANKING SEMARATE   | TYPE   |   |                            | JAN72E46 JA        | upapan i                   |           | 1500V DC               |

| J/0372040<br>-555/GB | #AM72040<br>-960/GB                       | JAW(72D40)<br>-585/G8   | JAM72040<br>4570/GB   | JAM72046<br>575/08  | JAM?2040<br>-560/0jb  | Meximum System Voltage  | 1500V DC   |
|----------------------|---|---|---|---|---|---|--|
| 590                  | 605                                       | មាម   | 616   | 621   | 626   | Operating Temperature   | -40°C~+8540  |
| 50.68                | 50.73                                     | 50.28   | 51.03   | 55,16   | \$1.30  | Maximum Sarles Fase Rating  | 39A  |
| 42.94                | 42,09                                     | 42.55   | 42.70   | 42,86   | 43,92   | Maximum Static Lead Front*<br>Maximum Static Lead,Back*   | 5400Pə(112 lb/t²)<br>2400Pə(50 :b/t²)  |
| 15.14                | 15.22                                     | 16.29   | 16,37   | 15.44   | 16.51   | NOCT  | 451210   |
| 14.19                | 14.27                                     | 14,34   | 14.42   | 14.49   | 14.56   | Biferciality**  | 00%±10%  |
|                      |   | 10%   |   |   |   | Fire Portomisanos   | UL Type 29   |
|                      | -555/69<br>590<br>50.56<br>42.94<br>15.14 | -665/69 -666/68<br>590 605<br>59.66 60.73<br>42.24 45,39<br>15.14 16.22 | -655/63         -660/68         -545/68           590         608         610           59.68         50.73         50.28           42.24         42.09         42.55           15.14         16.22         16.29           14.19         14.27         14.34 | -655/63         -660/68         -545/38         4570/68           590         608         610         616           59.58         50.73         50.28         51.03           42.24         42.09         42.36         42.70           15.14         15.22         16.29         16.37           14.19         14.27         14.34         14.42 | -555/GB         -560/GB         -545/GB         -570/GB         -570/GB         -575/GB           590         605         610         616         621           59.56         50.73         50.28         51.03         51.13           42.24         42.39         42.35         42.70         42.86           15.14         15.22         16.29         15.37         15.44           14.19         14.27         14.34         14.42         14.49 | -655/63         -660/68         -5/5/68         -570/68         -575/68         -570/68           590         605         610         616         621         626           59.68         50.73         50.28         51.03         51.16         61.33           42.24         42.39         42.55         42.70         42.86         43.02           15.14         15.22         16.29         15.37         15.44         16.51           14.19         14.27         14.34         14.42         14.49         14.56 | -655/63         -660/68         -545/38         -570/68         -570/68         -580/68         Meximum System validate           590         605         610         616         621         626         Operating Temperature           59.66         90.73         50.88         51.03         51.18         91.30         Maximum System validate           42.94         42.99         42.55         42.70         42.86         43.02         Maximum Static Lose France           15.14         16.22         16.29         16.44         16.51         NOCTT           14.19         14.27         14.34         14.42         14.49         14.56         Bifaciality** |

#### **CHARACTERISTICS**



## Annexure-B

. .

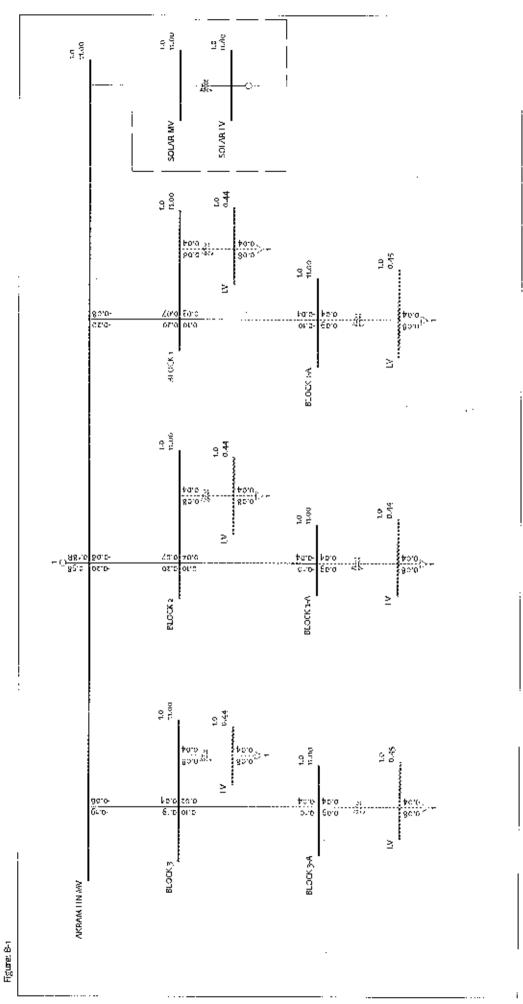
:

ł

Steady State Analysis Results

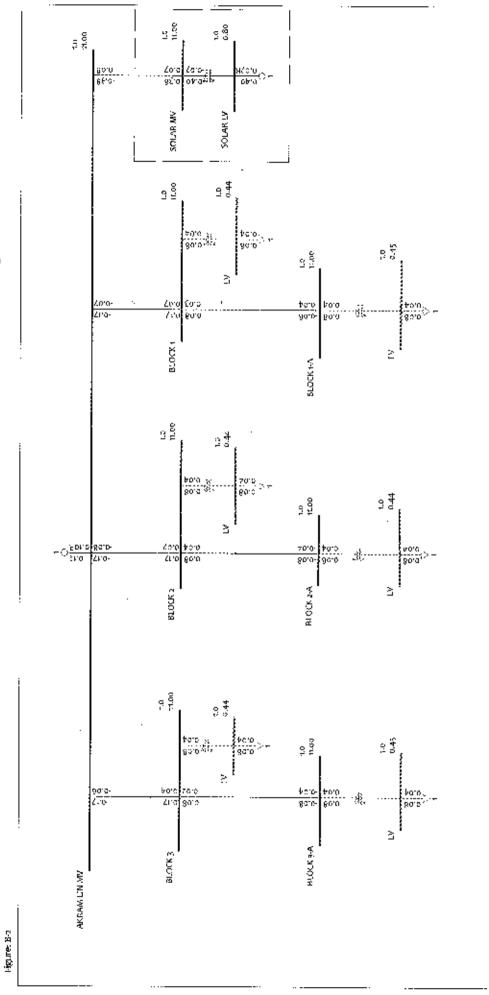
Load Flow Analysis of 500kWp Solar PV System at New Akram Line (NAL)





Load Flow Analysis of 5ookWp Solar PV System at New Akram Line (NAL)





## Annexure-C

1.15

۰.

Assessment of bus voltages

.

## Annexure-C-1

.

## Without NAL PP and With Sanctioned Load In Service

|   |          |   | ļ                       |               |               |               | -      |                         |          |                |          |               |                 |               |          | 1        |                 | ł              |                         |          |
|---|----------|---|-------------------------|---------------|---------------|---------------|--------|-------------------------|----------|----------------|----------|---------------|-----------------|---------------|----------|----------|-----------------|----------------|-------------------------|----------|
| Sances .  |          | rvrs  |                         | 1.0           | 0.i           | 0.0           |        | -0,1                    | 0.0      | 0°C            |          | 0.0.          |                 | -0.0          | 0°0      |          | -0.0            |                | -0.1                    | 0.0      |
| 1.7:14<br>Gauss<br>Andorre  |          | jelec   |                         | 0.2           | 0.2           | 0.2           |        | -0.2                    | U.1      | C.1            |          | -0-           |                 | -0,1          | Ċ.1      |          |                 |                | -0.2                    | Ú.1      |
| L D 25<br>L | ×        | NAL CKT   |                         | ب<br>ب        | ۲<br>۲        | 4 1           |        | .:<br>u                 | . I<br>J | é l            |          | 4 T           |                 | <br>1-2       | .:<br>•4 |          | ۲<br>ب          |                | 4 J                     | <br>F    |
| 32. F35 15<br>3477 708 7<br>3 5 504 6   |          | X BASNA ARRA UKT  |                         | 000'II        | 11.000        | 1.1000        |        | 00011.70                | 0.460    | 000111         |          | 17.000        |                 | 300.11        | 01/400   |          | 000-11          |                | 000.11V                 | C.4400   |
| SXSTEM SIGULATORDS3(R)E   | SJE OL   | 673# X XAME   |                         | 41001 BLOCK 1 | 41905 BLOCK 2 | 5 NOCIS 63016 |        | 4130 AKRAN LIN NV'I.000 | AI ZCDIĐ | 41003 JUCK 1-A |          | . XOOTH LOOIP |                 | 41001 FLOCK 1 | 41004 IV |          | 41000 BLCCN 1-A |                | 4100 AKEAN LEN AVIL 000 | 41036 EV |
| SINUATO   | SHUNT X- |   | 0.1                     | 0.0           | 4             | Ŧ             | C. 0   | J.C                     | 41       | Ŧ              | 0.1      | 0.0           | с. О. Л         | 3-0-C         | ŝ        | 0.0      | 0-0 40          | - O,D          | 0.0                     | ~1       |
|   | 1.070    | IN/NVAR 30  | 0.0                     | 0.0           |               |               | 0.0    | 0.C                     |          |                | 0.1      | 0.0           | 0.0             | 0.0           |          | 0.1      | 0.0             | 0.0            | C.O                     |          |
|   | . NO15   | MM/MV/R MM/MVAR 300/MVAR  | 3.6                     | 0.23          |               |               | 0.0    | 0.0                     |          |                | 0.0      | 0.0           | 0.0             | 0.0           |          | 0-C      | 0.0             | 0.0            | 0.0                     |          |
| . LNTHRACTIVE   |          | ANGLK 1   | 0 <b>.</b> C            |               |               |               | 0.0-   |                         |          |                | 2.0-     |               | 0-0-            |               |          | -0.2     |                 | -0°            |                         |          |
| TOS <u>ONIT</u> MURNU<br>T.T.J  | VOLT     | PL/84   | 4 1.3000                | 010'II I      |               |               | 1.0000 | 11, 200                 |          |                | 7.365.0  | (1,4354       | 0.9993          | 509'CI        |          | 1.,0243  | 0.4307          | 6666°0 y       | 10,539                  |          |
| · · · · · · · · · · · · · · · · · · ·   | JSX AREA | MERURALE RAUTING<br>3USH X NAMEX BASKY ZONG<br>IO ANGLE & SUT A |                         | г             |               |               | 11.000 | . 1                     | 1        |                | 6.4400 4 | و<br>ک        | v000 ∉          | 1.1           | د،<br>د  | 0.44<br> | 6 2 1           | 71.30C A       | 1                       | 6 2      |
|   | E E      | THANSECHMER<br>BUSH X NEME<br>SATIO ANGLE 3                     | 4200 AKRAN LLN MV1'.000 | 2 16          |               |               | 019    | 2                       | 000      | 01             | ÷        | 1,0030%       | 41003 BLOCK 1-A | 0. 1          | 976.     | 41004 LV | 1,0000A         | \$1005 PROCK 2 | 2 .0                    | 1.00055  |

.

.

.

.

.

.

|          |                 |            |                   |                 |                   |                  |          |                    | }             |                             |           |                  |                   |                   |               |                    |           |            |                      |
|----------|-----------------|------------|-------------------|-----------------|-------------------|------------------|----------|--------------------|---------------|-----------------------------|-----------|------------------|-------------------|-------------------|---------------|--------------------|-----------|------------|----------------------|
| ·        | 0.0             |            | 0.0-              |                 | -0.0              | 0.0              |          | -0'0-              |               | -3.1                        | 0°C       | 0.C              |                   | U.O.              |               | 0°0-               | 0.0       |            | -0.0                 |
| :        | 0.1             |            | -0.1              |                 | -0.1              | 0.1              |          | -C.1               |               | -0-2                        | 1.5       | 0.1              |                   | <br>6             |               | -0-                | 0.1       |            | -0.1                 |
|          | 1               |            | 1-1<br>141        |                 | <br>2             | . I<br>.sir      |          | <br>N              |               | í i                         | 4 l       | 4 I              |                   | -<br>             |               | 1 1                | Ē         |            | ар<br>• 1            |
|          | 11,300          |            |                   |                 | 21.300            | 3.4400           |          | 00011.             |               | VII.060                     | 0.4400    | C00.II           |                   | 11.020            |               | 11.600             | 0.4400    |            | 11,000               |
|          | 41007 BLOCK 2-R | 3.0        | 0.0 41035 ELOCK 2 | J.C             | 3.C (1C33 ALOCK 2 | 41 SCJ1+         | J.C.     | 0.6 41007 9000 2-A | 0.U           | 0.0 4100 AKSAM EIN KVIL.000 | AT 012015 | 8-6 XOOTE TICOTA | 0.ùt.             | 0.0 41005 BLCCA 3 | 0°,0          | U.O. 41008 BLOCK 3 | 410012 IV | 0.0        | 3.0 420011 FLOCK 3-R |
| •<br>• : |                 | C.1        | 0.0               | 3.6             | J.C               |                  | 1-1      | 0.G                | 0.0           | 0.3                         |           |                  | 0.1               | 0.0               | 0.0           | 0.0                |           | [-]        | a. 6                 |
|          |                 | 0.0        | 0.0               | 0.0             | 0.0               |                  | 0.0      | 0.0                | 0.0           | 0.3                         |           |                  | . C               | 0.0               | 0-0           | 0-0                |           | 0.0        | 0.0                  |
|          |                 | -0.2       |                   | -0.0            |                   |                  | -0.2     |                    | -0.0-         |                             |           |                  | -0.2              |                   | -0.0          |                    |           | ÷0.1       |                      |
|          |                 | ¢ C.9535   | . G.4334          | 9638.J 🖡        | 2 10.999          |                  | 5120'I ¥ | 1 0.4450           | 9699-1 1      | V 10,999                    |           |                  | 4 0.98E           | 1.0.1394          | 4 0.0909      | 1 IC.998           |           | 4210,122   | . C,4€ol             |
|          |                 | 0.4403     | <i>i</i> e<br>0   | 2-A 11.000      |                   | ۍ<br>۲           | 0.4400   | с                  | 3 11.000      |                             | ۲<br>م    | 2                | 6.4400            | ~1                | 3-A 11,000    |                    |           | 0.0        | en<br>ch             |
|          |                 | AT 30017 . | i.0000M           | 41037 BLOCK 2-A | 0.                | 11882.<br>11882. | 41038 5V | N:000.1            | 5 NOCIE 60015 | <                           | 1001      |                  | 1 10<br>410010 LV | 1.0COUN           | 30054 [[[0]]) | 1                  | N. 998-1N | 41,0012 EV | 1.0001N              |

.

.

.

.

:

÷

## Annexure-C-2

## With NAL PP and With Sanctioned Load In Service

.

| CD e                               | PTT<br>AKRAN LINE SOL  | INTERAC<br>Al 2V SY | CTIVE DOG<br>(STIN | RER SYSTE | 7. A. J. S. W | FTI INTERACTIVE POWER SYSTEM STEULATOR255(R)E<br>Solah av system |                        | 387, 535<br>8778 20<br>8 - 20 | C, FEB 15 2025 (7:15<br>Weve for transfourels<br>% - vok non-transformer branches | 17+15<br>Maeas<br>Mororker | BRANCHES |
|------------------------------------|------------------------|---------------------|--------------------|-----------|---------------|--|------------------------|-------------------------------|---|----------------------------|----------|
| XKR3M BJSK ANEA<br>missinganyan    | AREA VOLT              |                     | <b>JEN</b>         | 0.A.D.    | SULUT         | X  | TO 348                 | S                             | X   |                            |          |
| RACING<br>RANKX RASKV<br>E & SET A | NM/II EKCE             | ANGLE               | MW/MVAR NW/NVAR    |           | NAVN'NK       | 1878 X-  | - 3872                 | X BASKV                       | AREA COF  | Xí                         | KVRR     |
| 4100 REAM LIN RVII.000             | 4 1.0000               | 0.0                 | 0.7                | 0.0       | 0.0           |  |                        |                               |   |                            |          |
| 10                                 | 1 11.030               |                     | 0.13               | 0.0       | C.D           | 4.00; NI   | NDCX 7                 | 0CD.II                        | L<br>F  | 0.2                        | 0.1      |
| ct                                 |                        |                     |                    |           |               | 41.60015   | BLOCK 2                | 11,200                        |   | 5.0                        | 0.1      |
| e.                                 |                        |                     |                    |           |               | an enally  | S NOOTE                | 21.200                        |   | 0.2                        | 0.0      |
|                                    |                        |                     |                    |           |               | V10013 S0  | SOLAR MV               | 11,002                        | <br>.e  | -0.4                       | -0,1     |
| 41601 3LOCK 1 11.000               | 4 1.000                | -0°C-               | 0'C                | 0.0       | 0.0           |  |                        |                               |   |                            |          |
| 10                                 | 11,000                 |                     | 0.0                | 0.0       | 0.0           | MARXE COIP   | á Li                   | MV11.000                      | Ч<br>Т  | -0.2                       | , .0 -   |
| 2 5 2. CUOLK 5                     |                        |                     |                    |           |               | 41002 IV   |                        | 0.4430                        | 4 I   | 0.1                        | 0.0      |
|                                    |                        |                     |                    |           |               | 410U3 BD   | BLOCK I-A              | 11.300                        | е1<br>41  | 0.1                        | 0.0      |
| 41072 LV 0.4400                    | 4 0.9987               | -0.2                | 0.0                | 1,1       | 0-0           |  |                        |                               |   |                            |          |
| 1.000UN 6 2                        | 1 0.4394               |                     | J.C                | 0.0       | 0.3           | 41301 320  | BLOCK 1                | 0011                          | 4<br>1  | -0.1                       | -0.0     |
| 42003 NFOCK 1-A 21.000             | ę 0,3959               | -0-0                | 0.0                | 0.0       | 0.0           |  |                        |                               |   |                            |          |
| 0.                                 | 065'NI V               |                     | 0.0                | 0.0       | 3.0           | 410C1 BIA  | BLOCK 1                | 11,300                        | ۔<br>۲  | -0.1                       | -0.0     |
| 0.9751.K 6 2<br>41204 IV 6 4700    | -                      | -                   | :                  |           |               | VI PCOLÈ   |                        | 3.4400                        | . I<br>NI   | 0.1                        | 0.0      |
|                                    | 1,0040                 | T '0-               | 0.6                | 0         | с.<br>С       |  |                        |                               |   |                            |          |
| . 2 3 X1000X                       | 1 0.45C7               |                     | а <b>г</b> о.      | 0.0       | 0.0           | 41003 вноск 1-8  | ocx 1-A                | 020'II                        | Т<br>Р  | 1,1-                       | ŋ.C-     |
| (1005 BLOCK 2 11.000               | 6636-0 🤉               | -0.0                | 0.0                | 0.0       | 0.0           |  |                        |                               |   |                            |          |
| 10                                 | \$66°01 <sup>°</sup> 7 |                     | 0.0                | J.C       | 0'C           | 4130 ANJ   | 4100 ANJAN L'N KVILJOC | 300°117A)                     |   | 5°0-                       | -0.1     |

. .

| N1C30.1                       | ہ<br>ت         |                      |        |      |                 |                            | 41006 IV                  | 0.4400   | г<br>Ŧ     | 1.0   | <b>J.</b> 6 |
|-------------------------------|----------------|----------------------|--------|------|-----------------|----------------------------|---------------------------|----------|------------|-------|-------------|
| 60                            |                |                      |        |      |                 |                            | 4.00/ BLOCK 2-M           | 11.010   | 4 1        | 1.0   | 0.0         |
| 41006 JV                      | 0.4400<br>     | 4 0.3537             | -0.2   | 0.0  | 0.1             | - 0 <b>-</b> у .           |                           |          |            |       |             |
| 1.000.N                       | гч<br>Ф        | 56 <b>CF</b> 10 (    |        | 0.0  | 0'0             | 0-0<br>1                   | 41000 PLOCK 2             | 11,000   | :-।<br>य   | -0.1  | 0°0×        |
| 41037 BLOCK 2-A               | 000111         | 4 0.9395             | -0-0-  | C.O  | 0.0             | 0.0                        |                           |          |            |       |             |
| 1 10                          |                | 1 <u>10,399</u>      |        | 0°C  | 0.0             | C.O                        | 41005 BIOCK 2             | 000-11   | ן.<br>די   | -0,1  | -0.0        |
| , 963<br>410                  | ξ 2<br>3.440C  | ę 1.0113             | -0.2   | 0.3  | 0.1             | - 0.0                      | 47(00) IV                 | 0.4430   |            | 0.1   | 0.0         |
|                               | ہ ا            | 2 6.4450             |        | .0.0 | 0.0             | 0'5                        | 41607 RIOCK 2-3           | 11.300   | - 1<br>-42 | 1-0-  | -0.0-       |
| \$ NOOLE 20014                | 11.030         | 1 3,9999             | -0,0-  | Ú°U  | 0.0             | 0.0                        |                           |          |            |       |             |
| 2 10                          |                | 1 i0.999             |        | J.C  | 0.0             | C.O                        | 000 HIAN NIT MEENE 00:7   | 000.11VI | 4<br>1     | -J.2  | -0-0        |
| 000.                          | 5<br>C         |                      |        |      |                 | ÷                          | VI3013 ZV                 | 0.4430   | μ          | 0.1   | 0.0         |
| 1. 20<br>ATODIA TO            | 6.JK7 (C       |                      | 2<br>2 | 0    |                 |                            | 410011 BLOCK 3-2          | 11.000   | .ा<br>च    | 0.1   | 0.0         |
|                               | 1              | ± 4.9900<br>1 3.6391 | 1      | 0.0  | 0.0             | -<br>-<br>-<br>-<br>-<br>- | 41909 TROOK 3             | C 20. 11 | 4 I        | -0.1  |             |
| 1.00000<br>Alford: Bizers 3_r | οι ο<br>Γ<br>Έ |                      | 0<br>0 | =    | -<br>-<br>-     | :                          |                           |          |            |       | 1           |
|                               | Í              | 5555°0 V             | P-0-   | 0.0  | 0.0             | - 0,0                      |                           |          |            |       |             |
| 0: T                          |                | 10.538               |        | 0.0  | 0'0             | 0<br>7                     | (1009 PLOCK 3             | 1.100    | ei<br>V    | 1.0.  | -0.0        |
| 0.980LK<br>416312 LV          | у 3<br>С,4£00  | / L-311/             | -D.1   | 9.0  | 0.1             | e − 0.0                    | \$10012 I.V               | 01.400   |            | C.1   | 0-J         |
| cucta                         | ю<br>П         | 1 0.4452             |        | 0.0  | 0.0             | C.0 4                      | C.0 413011 BLOCK 3-8      | 1000     | Г<br>Ŧ     | : "0- | -0.3        |
| 410013 SCIRS KV               | 11,000         | 100011               | 0.0    | 0.0  | 0 <sup>-0</sup> | - 0'C                      |                           |          |            |       |             |
| 4 1C                          |                | T 11-007             |        | 0.0  | 0.0             | 0.0                        | ACLE NATA NAL MARANA OCLE | 300°TTA  | <br>7      | 0.4   | 0.1         |

.

.

.

.

. i

e - 1

;

.

.

:

:

.

.

-

!

•

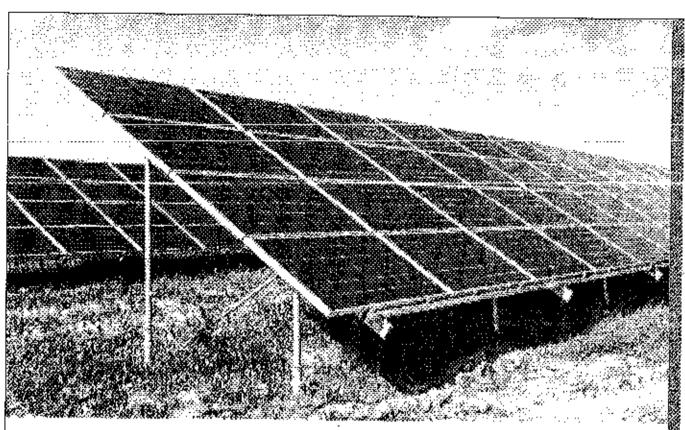
|                           | 1                  |
|---------------------------|--------------------|
|                           |                    |
|                           |                    |
|                           | ्र<br>न<br>म       |
|                           | 90<br>11           |
| 410014 30148 LV           | WE KETOS EICDI C.D |
| . c                       |                    |
| :<br>: 70<br>L            |                    |
|                           |                    |
| . ट्रि                    | 1 0.8012           |
|                           |                    |
| 0<br>1.1001.1<br>1.1001.2 | 1.00.00K           |

:

.

,

:





## SYSTEM STUDY ANALYSIS OF MIAN MIR LINE (MML) 500kW SOLAR PV SYSTEM

Report

ARCO Energy

PAKISTAN Tel: +92-300-8827101



## CONTENTS

|                | TIVE SUMMARY   |
|----------------|--|
| 1 UN1          | TRODUCTION   |
| <b>1</b> .1    | Project Description  |
| 1.2            | Interconnection Arrangement  |
| 1.3            | Objective of System Study Analysis   |
| 1.4            | Study Components   |
| 2 S <b>T</b> U | DY METHODOLOGY   |
| 2.1            | Study Criteria   |
| 2.2            | Steady State Analysis  |
| 2.2.           | 1 System Intact Analysis   |
| 2.2.           | 2 Transmission Line Loading Analysis                                       |
| 2.2.           | 3 Voltage Analysis   |
| 3 STF          | RADY STATE ANALYSIS  |
| 3.1            | Model Development  |
| 3.2            | Power Flow Assessment Without MMD PP and with Sanctioned Load In Service 8 |
| 3.2.           | 1 Base Year 2025: Peak Loading Summer with Sanctioned Load in Service      |
| 3.3            | Power Flow Assessment with MML PP  |
| 3.3.           | 1 Base Year 2025: Peak Loading Summer with Sanctioned Load In Service      |
| 3.4            | Conclusion   |
| 4 CO)          | NCLUSION   |
| 4.1            | Steady State Assessment  |
| UST OF         | ANNEXURES  |





### EXECUTIVE SUMMARY

This report provides the 'documentation of an assessment that has been performed for the interconnection of a 500kW Solar PV Power Generation project at Mian Mir Line (MML) distribution system at 11kV project of "Military Engineering Services" (MES). The project will be a Grid tied 500kW Solar PV based system connected with the power network of MML. The '500kW MML solar PV Power Generation project' is located at Ground of 17 NLI / HQ 106 Bde North Mian Mir Line, Shami Rd, Cantt, Lahore, Pakistan.

The integration of solar power generation at the MML premises pecessitates a comprehensive system study analysis to ensure optimal operation of the electrical network. MML currently receives a single point supply from LESCO with a sanctioned load of 1.918MW. The introduction of solar power generation will influence the flow of electricity within the premises, impacting both consumption and injection dynamics.

The existing sctup includes transformers, switchgear, and distribution panels to distribute electricity throughout the premises. The sanctioned load of 1.918MW is the maximum load that can be drawn from LESCO's grid.

The entire solar generation within the MML premises will be consumed internally without exporting any power to the grid. To ensure the safe and efficient integration of solar power, a load flow study is required to analyze the impact of this interconnection on the existing electrical network. This study will assist in obtaining solar generation concurrence and ensuring compliance with relevant technical and regulatory requirements.

The analyses have been carried out in following scenarios;

- Without 500kW MML solar PV with sanctioned load in service.
- With 500kW MML solar PV with sanctioned load in service.

Steady state power flow assessment has been performed using the network data of MML. Power flow study was conducted without Solar Project with sanctioned load in service to analyze the magnitude and phase angles of bus voltages, line loadings and power flows under steady-state conditions. Power flow analysis was also conducted with sanctioned load in service after the interconnection of the Solar project with the MML distribution system. The power flow results for the system intact shows that



the power flows on all the MMI, transmission and distribution line branches are within their normal line loading limit. There is no capacity constraint in terms of power flow or voltage ratings within the study area.

This systems study is a critical step in obtaining solar generation concurrence for MMT. By ensuring the stability and teliability of the electrical system, the study facilitätes seemless solar power integration while maintaining compliance with MML and regulatory requirements.

Based on the study results, it is concluded that proposed generation interconnection assessment for 500kW MML solar PV Power Generation project meets the NEPRA grid code planning criteria.



## 1 INTRODUCTION

### 1.1 Project Description

This report provides the documentation of an assessment that has been performed by ARCO Energy in response to a request made by Mian Mir Line (MML) ("Project Owner" or "PO") for the interconnection of a 500kWp Solar PV Power Generation project ("Project") to the MML power System at 11kV.

The '500kW MML solar PV Power Generation project' is located at Ground of 17 NL / HQ 106 Bde North Mian Mir Line, Shami Rd, Cantt, Lahore, Pakistan, Figure 1.1 shows Google site map of the project.

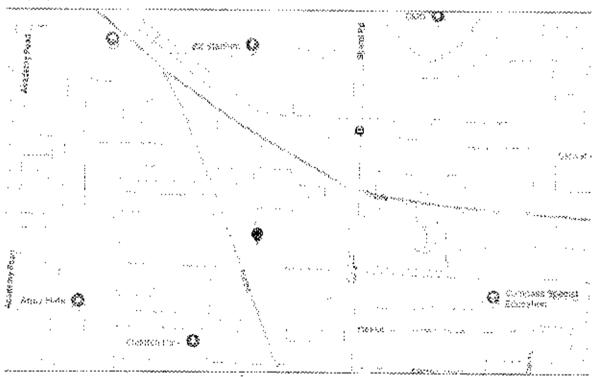


Figure 1.1: Google Site Map of the Solar PV Power Generation Project.



#### 1.2 Interconnection Arrangement

MML aims to integrate solar power generation into its existing electrical infrastructure. MML currently receives a single-point power supply from LESCO with a sanctioned load of 1.918MW. The entire solar generation within the MML premises will be consumed internally without exporting any power to the grid. The objective of the analyses is to evaluate the impact of the solar power plant on the MML transmission and distribution system.

### 1.3 Objective of System Study Analysis

The primary objectives of the load flow-study are: 1999 we

- To evaluate the impact of solar power injection on the voltage levels and power distribution within MML premises.
- To determine the changes in power flow patterns resulting from the integration of solar generation.
- To ensure that the existing electrical infrastructure can support the additional solar power without causing instability or operational issues.
- To verify compliance with regulatory requirements for solar power interconnection and obtain concurrence for solar generation.

### 1.4 Study Components

500kW solat PV system is modelled into the MML distribution system by ARCO Boergy. Technical analysis includes:

- i) Data gathering and modelling
- ii) Steady state analysis
- iii) Conclusion

The above scope of work involved in the technical analysis has been carried to demonstrate that connection assessment of this PV system meets the National Electric Power Regulatory Authority (NEPRA) distribution code.

The analyses have been carried out in following scenarios;

- Without 500kW MML solar PV with sanctioned load in service.
- With 500kW MML solar PV with sanctioned load in service.



This report documents the results of the steady state analyses. The principal objective of these analyses is to evaluate the impact of 500kW solar PV system to the distribution system of MML and vice versa.

5



## 2 STUDY METHODOLOGY

### 2.1 Study Criteria

The study has been carried out based on the National Electric Power Regulatory Authority (NEPRA) Grid Code planoing criteria. Key parameters and their corresponding limits have been summarized in table below.

| Para             | uncter           | Range  |
|------------------|------------------|--|
| Voltage Level    | Normal Condition | ±5 % p.u at 132kV and below<br>18%,-5% p.u at 220kVand above |
|                  | Contingency      | ±10 % p.u  |
| T/Line Loading j | Normal Condition | 100%   |
| Capacity         | Contingency      | 100%   |
|                  | Nominal          | 50 Hz  |
| Frequency        | Normal Variation | 49.8 Hz - 50.2 Hz  |
| ·.               | Contingency Band | 49.4 Hz - 50.5 IJz   |
| Power Factor     | Lagging          | 0.95   |
| 1.00001.001      | Leading          | 0.95   |

#### 2.2 Steady State Analysis

The purpose of steady-state analysis is to analyse the impact of the proposed solar power plant on distribution system facilities under steady-state conditions. It involves two distinct analyses: line loading analysis and voltage analysis. Power flow solutions using the PSS/E® program (Version 33.4) has been performed.

A "study area" was defined to represent the areas of interest within MML.

#### 2.2.1 System Intact Analysis

The incremental impact of the project on substations and transmission line loading under normal conditions was evaluated by comparing transmission and distribution system power flows through different scenarios for the project.

#### 2.2.2 Transmission Line Loading Analysis

11kV and 0.4kV rated transmission and distribution facilities in the study area have been monitored for line loadings.



### 2.2.3 Voltage Analysis

Voltages at buses inside the study area have been monitored for possible for voltage violations in accordance with NEPRA Grid Code guidelines.



## 3 STEADY STATE ANALYSIS

#### 3.1 Model Development

Froject specific data was provided by the plant owner and it has been compiled and presented in **Annexure-A**. The steady state model of the power plant is presented in *t*able below:

| Generator                                    |                            |
|--|----------------------------|
| No. of Collector Units                       | <u> </u>                   |
| Genetation size of each<br>collector (kVA)   | 421                        |
| Active Power of each<br>collector Pgen. (kW) | 400                        |
| Power Factor                                 | 0.95 lagging, 0.95 leading |
| Qruin, Qmax (kVAR)                           | -0.1315, 0.1315            |
| Rated Frequency                              | 50 Hz                      |
| Generation Voltage                           | 0.8V                       |
| Xsource                                      | χ                          |
| Gener  | ation Step Up Transformer  |
| No of Transformer                            |                            |
| kVA Capacity of each<br>GSU                  | 630                        |
| % Reactance (X)                              | 5%                         |
|  | Mian Mir Line              |
| Sanctioned Load (LESCO)                      | 1918 kW                    |

Steady state power flow assessment has been performed using the network data of MML.

## 3.2 Power Flow Assessment Without MML PP and with Sanctioned Load In Service

Power flow study without MML solar and with sanctioned load in service, was conducted to analyze the magnitude and phase angles of bus voltages, line loadings and power flows under steady-state conditions.

The result of this power flow analysis is in Annexure-B.



# MIAN MIR LINE

#### 3.2.1 Base Year 2025: Peak Loading Summer with Sanctioned Load in Service

Power flow analysis has been performed on the peak loading summer (June) 2025 case of MML network. This base case included a detailed representation of the MML transmission and distribution system in the study area.

The steady state results, depicts that the power flows on all the MML distribution line branches are within their normal loading limits. There is no capacity constraint in terms of load flow or voltage ratings around the study area. Result of the power flow analysis is attached in **Figure B-1**.

#### 3.3 Power Flow Assessment with MML PP

Power flow study of MML solar project was conducted with sanctioned load (in service and out of service) to determine the reliability impact of the 500kW MML solar project on the MML distribution system. This includes the performance of load flow analysis to identify any facility overload or voltage condition that violates the NEPRA planning criteria. Any such violation that is either directly attributable to this project or for which it will have a shared responsibility is included in this report.

The results of the project power flow analysis are plotted in Annexure-B.

#### 3.3.1 Base Year 2025: Peak Loading Summer with Sanctioned Load In Service

A base case has been developed with sanctioned load in service at MML solar for peak loading summer ([une) 2025 that allow us to judge the impact of MML solar project on the MML network. Project power flow analysis has been performed after the connection of the project with the MML distribution system. This includes the detailed representation of the power plant.

The steady state result, with sanctioned load in service at MML solar depicts that the power flows on all the transmission line branches are within their normal loading limits. There is no capacity constraint in terms of load flow or voltage ratings around the study area.

Result of the power flow analysis is attached in Figure B-2.

The results of the project bus voltages analysis are attached in Annexure-C.

#### 3.4 Conclusion

Steady state power flow assessment has been performed. Power flow study was conducted without solar Project with sauctioned load in service to analyze the magnitude and phase angles of bus voltages, line loadings and power flows under steady-state conditions. Power flow analysis was also conducted



.1 .7

# MIAN MIR LINE

with sanctioned load in service after the interconnection of the Solar project with the MMI, distribution system. The power flow results for the system intact shows that the power flows on all the MMI, distribution line branches are within their normal line loading limit. There is no capacity constraint in terms of power flow or voltage ratings within the study area.



# MIAN MIR LINE

### 4 CONCLUSION

#### 4.1 Steady State Assessment

Steady state power flow assessment has been performed. Power flow study was conducted without MML solar with sanctioned load in service, to analyze the magnitude and phase angles of hus voltages, line loadings, and power flows under steady-state conditions. Power flow analysis was also conducted with MML solar and with sanctioned load in service with MML distribution system. Power flow results showed that the power flows on all the MML distribution branches are within their normal loading limit. There is no capacity constraint in terms of power flow or voltage ratings within the study area.

The steady state results found no capacity constraint in terms of power flow and voltage ranges.

Hence, it is concluded that based on the study results the Interconnection Assessment for 500kW Mian Mir Line solar PV system with MML Transmission and Distribution Network, meets the NEPRA grid code planning criteria.



# MIAN MIR LINE

### LIST OF ANNEXURES

Annex A: Project Specific Data.

Annex A-1: Project Site Map.

Annex A-2: Power Plant Data.

Annex B: Power Flow Steady State Analysis Result

Figure B-1: Base Year 2025 - Peak loading summer without MML solar and Sanctioned load in service.

Figure B-2: Base Year 2025 - Peak loading summer with MML solar and Sanctioned load in service.

Annex C: Assessment of Bus Voltages.

Annex C-1: Without MML solar and with Sanctioned Load In Service.

Annex C-2: With MML solar and with Sanctioned Load In Service.

# Annexure-A

Project Specific Data

# Annexure-A-1

Project Site Map

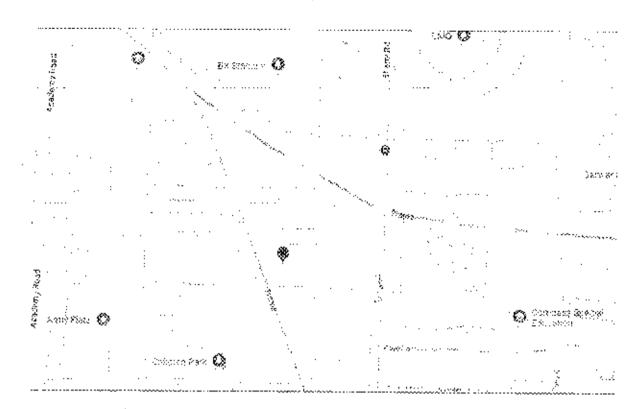
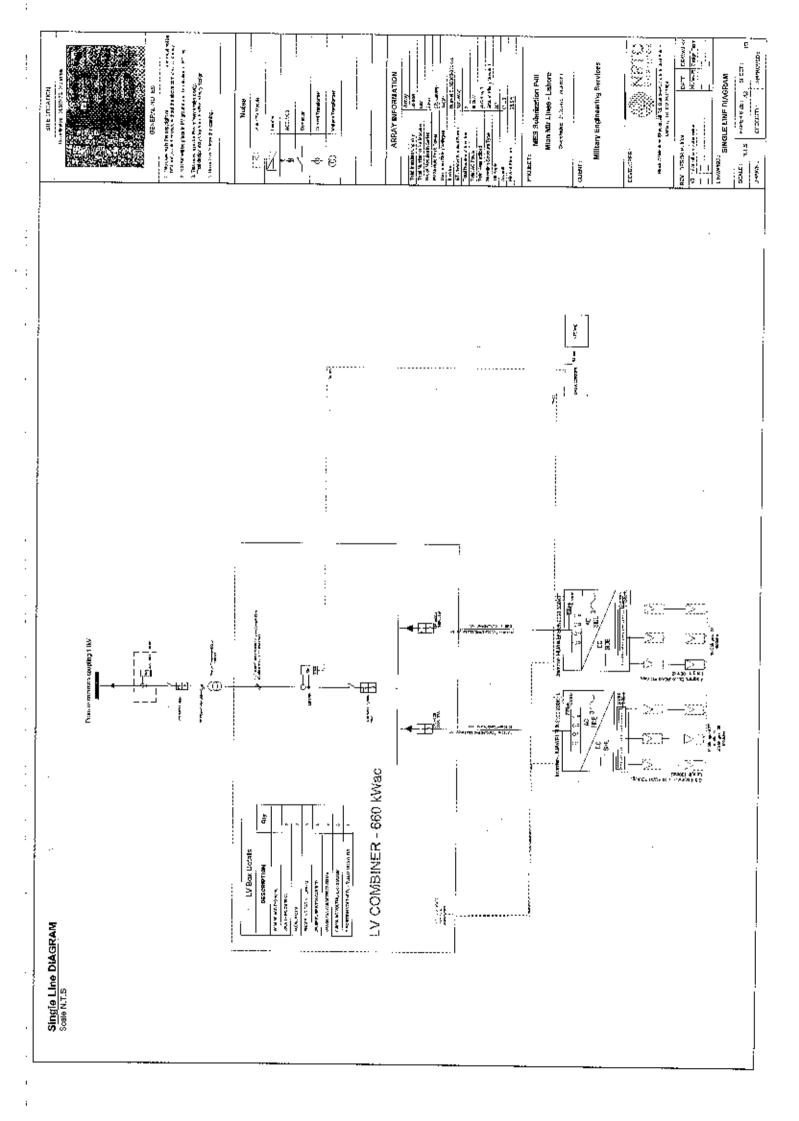
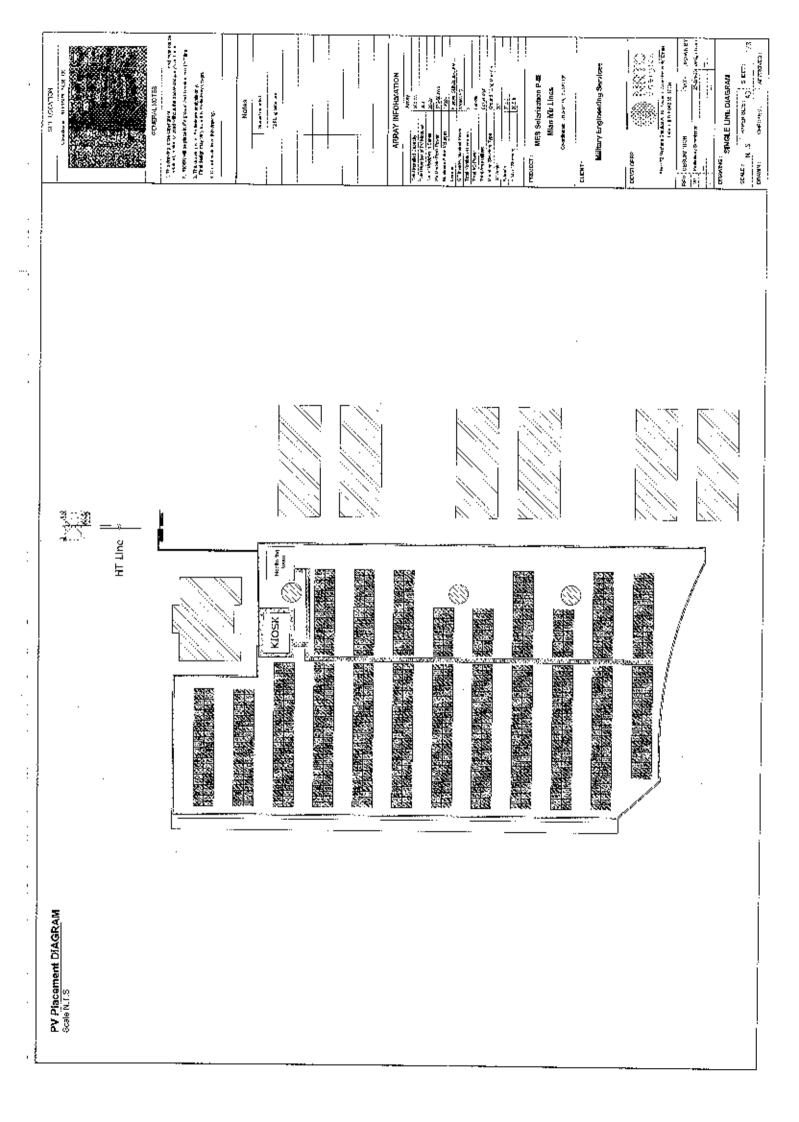


Figure 1.1: Google Site Map of the Solar PV Power Generation Project.

# Annexure-A-2

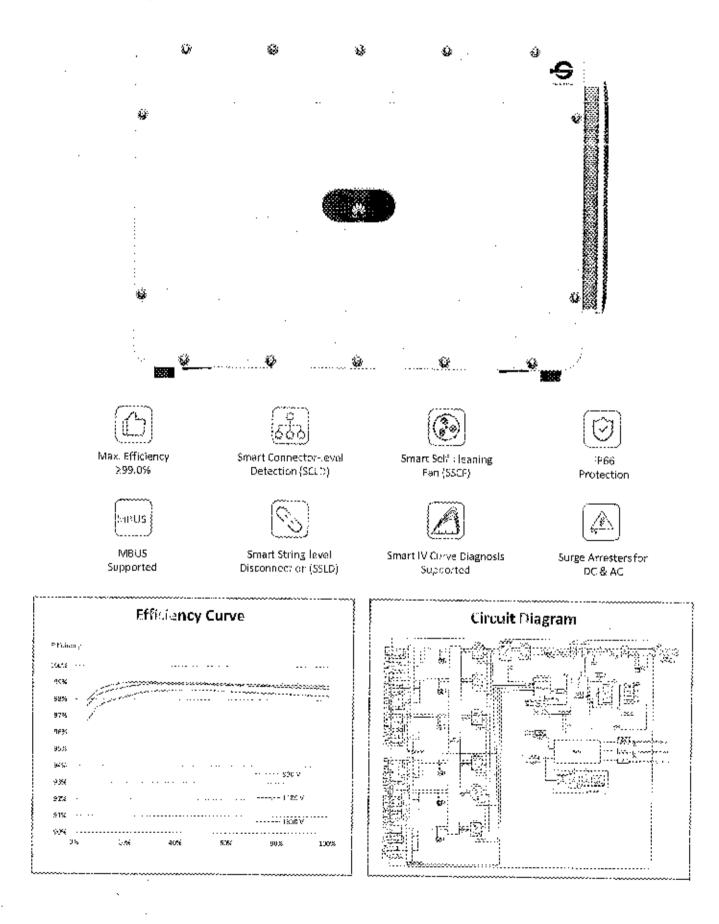
Power Plant Data





# SUN2000-330KTL-H1 Smart String Inverter

÷



/ OLAK, RUAWFILCO 4

# sun2000-330ктьна Technical Specifications

|  | Efficiency                              |                                       |   |
|--|---|---------------------------------------|---|
| ≪ax. t.fflciency                         |   | ≽99.0%                                | · · · · · · · · · · · · · · · · · · ·   |
| Furopean Efficiency                      | · · · · · · · · · · · · · · · · · · ·   | *98.8%                                | • |
|  | input                                   |                                       | ·                                       |
| ivius, nput voitage                      |   | 1,500 V                               | · · ·                                   |
| Number of MPP Trackers                   |   | 6                                     |   |
| Max. Current per MPPT                    | ··· -···                                | <br>65 Λ                              | ••••••••••••••••••••••••••••••••••••••• |
| Max. Short Circuit Current per MPPT      | •                                       | 115 A                                 |   |
| Max. PV Inputs per MPPT                  |   | 4/5/5/4/5/5                           |   |
| Start Voltage                            | · · · ·                                 |                                       | · ····· · ····                          |
| MPPT Opereting Voltage Kango             | ······                                  | 500 V ~ 1,500 V                       |   |
| Nominal Input Voltage                    |   | 1.080 V                               |   |
|  | Output                                  |                                       |   |
| Vortinal AC Active Power                 |   | 300,000 W                             |   |
| Max. AC Apparent Power                   |   | 330,000 VA                            |   |
| Max. AC Active Power (ccsib=1)           | · - ·                                   | 330,000 W                             |   |
| Nominal Only: 6 Voltage                  |   | 800 V, 3W + PE                        |   |
| Bated AC Stid Frequency                  |   | 50 Hz / 50 Hz                         |   |
| Manifal Output Current                   | · · · · · · · · · · · · · · · · · · ·   | 216.6 A                               | ····· ·· ·· -·                          |
| Max. Output Current                      | · · · · · · · · · · · · · · · · · · ·   | 238.2 A                               |   |
| Adjustable Power Factor Range            |   | J.81.S 0.8 :D                         | · · · · · · · · · · ·                   |
| Teta, Harmonic Distortion                | ••••••••••••••••••••••••••••••••••••••• | <1%                                   |   |
|  | Protection                              |                                       | ····· · · · · ·                         |
| Smart String-Level Disconnector(SSLD)    |   | ¥ <del>a</del> s                      |   |
| Anti-islanding Protection                | • • • • • • • • •                       | - ··· <sup>···</sup> ·· ·····<br>Yes  | · •····                                 |
| AC Overcurrent Protection                |   | Yes                                   |   |
| DC Roverse-ac arity Protection           | ·····                                   | ····· ··· ··· ··· ··· ··· ··· ··· ··· |   |
| PV-a may String Fault Monitoring         | · ····· ···                             |                                       |   |
| DCS lage Arrester                        |   | ї≕<br>Турс I                          | ······ ·····                            |
| AC Surge Arrester                        | · · · · · · · · ·                       | Υγρειί                                | ··· <b>·</b> ····· · · · · · ·          |
| DCInsulation Resistance Detection        |   | Ýes                                   |   |
| AC Grounding Fault Protection            |   | Yes                                   | ······                                  |
| Residual Carrent Monitoring Unit         |   |                                       | ··· ··· · · · · ·                       |
|  | Communication                           |                                       |   |
| Disolay                                  |   | .HD indicators, WSAN + APP            |   |
| _5B                                      | ·                                       | Yes                                   | ···· ··· ··                             |
| MB05                                     |   | Yes                                   |   |
| R5465                                    |   | VG                                    |   |
|  | General                                 |                                       |   |
| Dimensions (W × D x D)                   |   | 0.048 x 732 x 395 mm                  |   |
| Weight (with mounting place)             |   | <112 kg                               |   |
| Operating Temperature Range              | ······                                  | -25°C~ey°C                            | ···· <b>·</b> ···· ··                   |
| Cooling Method                           |   | Smart Air Cooling                     |   |
| Max. Operating Actitude without Derating | ·                                       | 4,000 ~ (13,123 ft.)                  | · · · ·                                 |
| R≑lative Humidity                        | · · · · · · · ·                         | 4,000 * (13,125 m.)<br>C ~ 100%       |   |
| AC Connector                             | Wistow                                  | roof Connector + OT/DT Te             | erele si                                |
| Prolociion Degree                        | · · · · · · · · · · · · · · · · · · ·   |                                       | 111 Kud]                                |
| Тэроюду                                  | ······                                  | P 65                                  |   |
|  |   | l ransformerless                      |   |

# Harvest the Sunshme

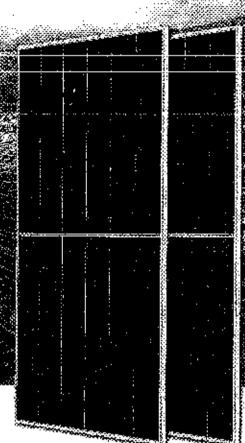
# DEEPBLUE4.0

## 580W n-type Bifacial Double Glass High Efficiency Mono Module JAM72D40 555-580/GB 200

#### Introduction

Mono)

Power by the testes: SINBB n-type splar cell, half velicionitiquiation and gapiess about connection technistagi, these modules have higher adjust power, lower LID, better work Illuminiation response and better temperature discriticient.





#### Higher power generation better LCOE



n-type with very Lower LID.

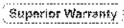


## Better weak illumination response



#### Better Temperature Coefficient

.



- 12-year product werranty.
- 30-yoar linear power output warranty.

---- ....



 n-type Bifacial Double Glass Module Linear Performance Womanty



Standard Modula Great
 Parlonmance Warranty

### Comprehensive Certificates

- 350 61215, ISO 61730
- 350 800 (; 2015 Quality management systems)
- ISO 14001; 2015 Environmentel management systems
- ISO 46000; 2018 Occupational health and safety management systems
- IEC 62241: 2019 Perrostrial photovo(take (PV) modules -Quality system for PV module manufacturing



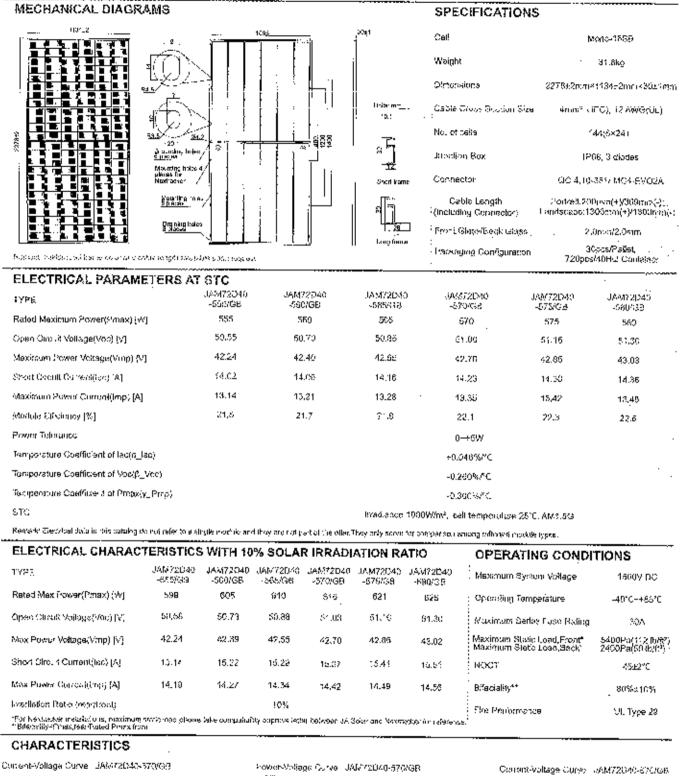
ମେଟେ ଅପରେ (ଏମର ) ଜନ୍ମ ମନ୍ଦ୍ର ଅପରେ ଅପରେ ସେପରେ ଅପରେ

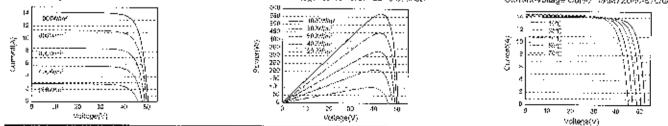




# **JA**SOLAR

JAM72D40 555-580/GB





Premium Cells, Premium Modules

# Annexure-B

--

.

÷ ..

i

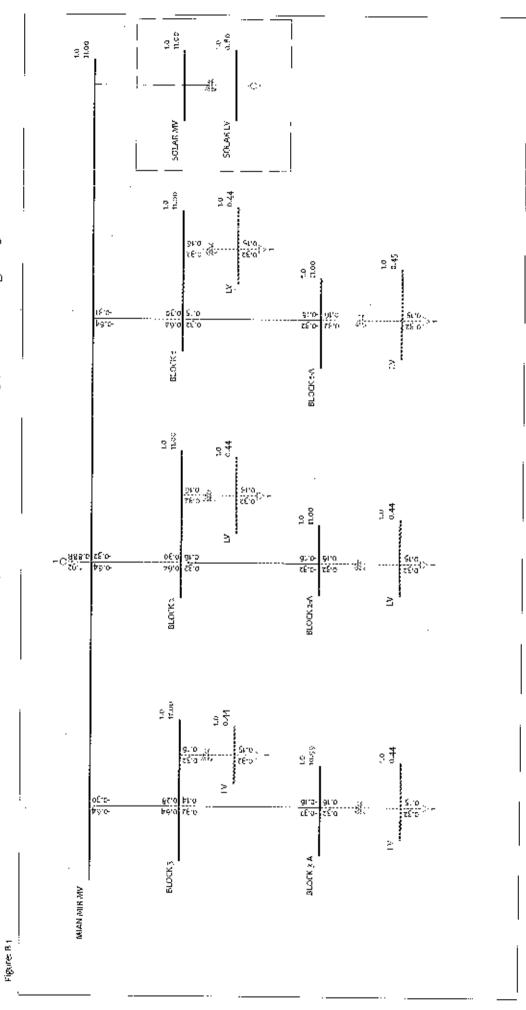
ł

.

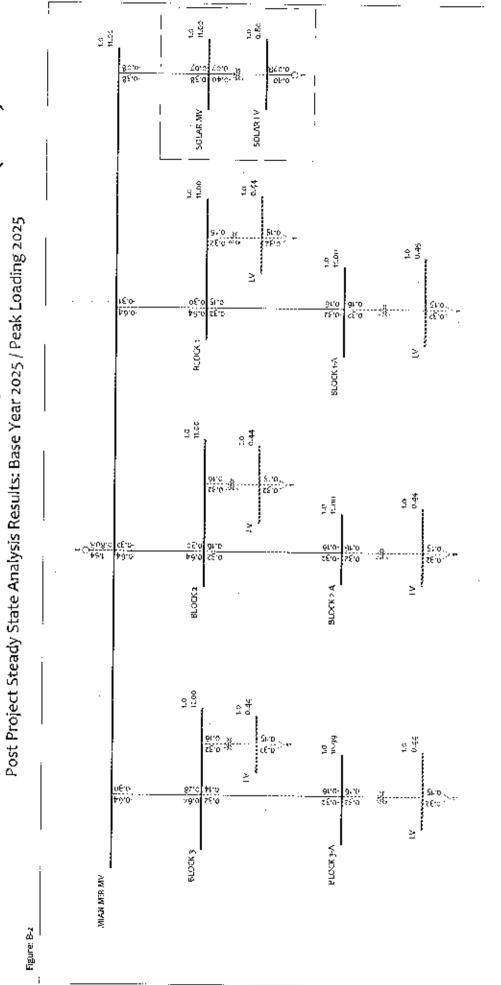
Steady State Analysis Results

Load Flow Analysis of 500kW Solar PV System at Mian Mir (MM)





Load Flow Analysis of 500kW Solar PV System at Mian Mir (MM)



# Annexure-C

. . . .

Assessment of bus voltages

# Annexure-C-1

# Without MML PP and With Sanctioned Load

.

In Service

| <pre>ER SYSTEM SIGUL<br/>LUAD STURT<br/>MW/MVAN MPP/EVAR<br/>6.0 0.0<br/>0.0 0.0<br/>0.3 0.0<br/>0.0 0.0<br/>0.3 0.0<br/>0.0 0.0<br/>0.0 0.0<br/>0.0 0.0<br/>0.0 0.0<br/>0.0 0.0</pre> | C. C | ТИТЬ. ЛАСТТИК РОМЕR SYST<br>FV SYSTEM<br>АКЕЦЕ ММ/КУАЗ ММ/КУАЗ<br>О.0 1.9 С.0<br>0.0 1.9 С.0<br>-0.0 0.0<br>-0.0 0.0<br>-0.6 0.0 0.0<br>-0.0 0.0<br>-0.0 0.0<br>-0.0 0.0<br>-0.0 0.0<br>-0.0 0.0 |  | POWER SYST<br>POWER | MER. SYST<br>LUAD<br>C. D<br>C. D<br>C. D<br>C. D<br>D<br>C. D<br>D<br>C. D<br>D<br>C. D<br>D<br>C. D<br>D<br>C. D<br>D<br>C. D<br>D<br>C. D<br>C<br>C<br>C<br>C<br>D<br>C<br>C<br>D<br>C<br>C<br>D<br>C<br>C<br>D<br>C<br>C<br>D<br>C<br>C<br>D<br>C<br>C<br>D<br>C<br>C<br>D<br>C<br>C<br>D<br>C<br>C<br>D<br>C<br>C<br>D<br>C<br>C<br>D<br>C<br>C<br>D<br>C<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>C<br>D<br>D<br>C<br>D<br>D<br>C<br>D<br>D<br>C<br>D<br>D<br>C<br>D<br>D<br>C<br>D<br>D<br>C<br>D<br>D<br>C<br>D<br>D<br>C<br>D<br>D<br>C<br>D<br>D<br>D<br>D<br>D<br>D<br>D<br>D<br>D<br>D<br>D<br>D<br>D<br>D<br>D<br>D<br>D<br>D<br>D<br>D | ER SYSTE<br>NW/FVAS<br>6.0<br>0.3<br>0.3<br>0.3<br>0.3<br>0.3<br>0.0<br>0.3<br>0.3 | SYSCEM<br>V V V V V V V V V V V V V V V V V V V | 10000000000000000000000000000000000000 |  | 03F53 (B) E<br>BJS: X NV<br>BJS: X NV<br>BJS: X NV<br>BJS: X NV<br>BJS: X NV<br>BJS: ALOCK<br>BJS: ALOCK<br>BJ | 23 23 23 23 23 23 23 23 23 23 23 23 23 2 | <pre>380., Even 15<br/>%EVA FOR 1<br/>% FCR 1<br/>% FCR 1<br/>.* FCR 1<br/>.* ERSKY AXE<br/>11.000<br/>11.000<br/>11.000<br/>11.000<br/>11.000<br/>11.000<br/>11.000<br/>11.000<br/>11.000<br/>0.4400<br/>0.4400</pre> | 3AL, M. N. IS 2025 IVIIT         *EVA FOR THANSHOTMERS         *EVA FOR HOW-TRANSHOTMERS         * FCR BOW-TRANSHOTMERS         * ILLOUS       4         * ILLOUS       4         * ILLOUS       4         * ILLOU       4         * * 4000       5         * * 4000       6         * * 4000       6         * * 4000       6         * * 4000       6         * * 4000       6         * * 4000       0         * * 4000       0 |  | тут.<br>импаза<br>мися симпаза<br>мися симпаза<br>мися симпаза<br>мися симпаза<br>мися симпаза<br>мися симпаза<br>мися симпаза<br>мися симина<br>мися сими |
|--|--|--|--|---|--|--|---|--|--|--|--|--|--|--|---|
|--|--|--|--|---|--|--|---|--|--|--|--|--|--|--|---|

÷

•

.

:

| · | 0.2                   |                   | <<br>1-           |                 | -0.2              | 0.2                 | د.<br>ال:<br>ا      |                  | -0-3                       | 0.2       | C.1              |           | -0.2              |              | -6.2      | 2.2                             | -0.2             |
|---|-----------------------|-------------------|-------------------|-----------------|-------------------|---------------------|---------------------|------------------|----------------------------|-----------|------------------|-----------|-------------------|--------------|-----------|---------------------------------|------------------|
|   |                       |                   | м<br>10-<br>1     |                 | с.<br>0-          | 0.3                 | - 6 - 0 -           |                  | э.<br>-                    | 0.3       | C.3              |           | Р, О-<br>-        |              | 8-0-<br>1 | 0.3                             | -0.J             |
|   | .−<br><del>×</del>    |                   | . 1<br>N          |                 | Т<br>Ŧ            | Ч<br>Т<br>F         | el<br>QI            |                  | 구                          | <br>7     | ы<br>ч           |           | [<br>म            |              | י.<br>יט  | 4 1                             | ∵1<br>10         |
|   | 11,000                |                   | 11.ÅCA            |                 | 11.1000           | C,4400              | 000-Li              |                  | 000-11/                    | 0.4400    | 11.000           |           | 11.000            |              | 11.000    | 0.4460                          | 11,200           |
|   | 4:007 RJOCK 2-A       | 3,0               | 2 X2012 30014 0.0 | 0.0             | 0.0 41005 BLOCE 2 | 410US ZV            | 2.0 41007 3100K 2-8 | C.O              | C.O 1100 MEAN MEER WULLCOO | A1 0:0010 | M-C NOCLE 1.00.0 | 0.0 c.o   | 0.0 42005 BLOCK 3 | 3.0          | OCK 3     | (10312 LV<br>0.0                | 410011 NJOCK 3-3 |
|   | :                     | n. n              | 0.2               | 0.0             | 0.0               | <b>ب</b>            | <br>0.2             | 0.0              | 0.0                        |           |                  | 0.3       | 0.2               | 0-3          | 0.1       | 0.5                             | 6<br>- D         |
|   | c<br>c                | 0.0               | 0.0               | ŋ.c             | 0.0               | . 0.0               | 0.0                 | D.C              | 0.0                        |           |                  | 0.0       | 0.0               | 0.0          | 0.0       | 0.0                             | 0.0              |
|   | ر<br>ن                | а.<br>- О         |                   | -3,6            |                   | 9 .<br>0 -          |                     | -J.C-            |                            |           |                  | -0.6      |                   | 0.0-         |           | <b>F</b> ,0-                    |                  |
|   | 9800 V X              | 0 <b>7</b> 77,0 a | 1 0,4377          | 4 0.9957        | 1 10,997          |                     |                     | 4 J.0306         | 309.AL I                   |           |                  | 4 0.9346  | 1 0.4376          | \$656.0 \$   | C66'), I  | < 1.0089                        | 1 0.4439         |
|   |                       |                   | 2 2%              | : 2-2 11.000    |                   | 22 2<br>0.4460      | 22                  | :<br>-<br>-<br>- |                            | 22 2      |                  | 0.44.30   | 22 2              | 3 A 11.000   |           | 12 3<br>0.2400                  |                  |
|   | 4 - 20<br>A 100 A 100 |                   | N0000.I           | 41207 R.OCK 2-A | £ 1C              | С.9381K<br>01018 ТV |                     | 41009 320CK 3    |                            | . 630     | 3 10             | 410010 TV | 1.0000            | 410011 BLOCK | 4 10      | A. 21001 <del>1</del><br>Aleg.0 |                  |

•

.

•

.

# Annexure-C-2

# With MML PP and With Sanctioned Load In Service

| 2                                  | MIAN NEER | ET LATERACTIVA PORAR SYSTEM SIMILATOR-F53(F)E<br>Solar pu system | SYSTEM | Í      |                  |          |                    | * 1 TOR B | TOR NON-TRANSFORMERS | A ALLA TATAN<br>1 KANSFORMERS<br>HOS-TRANSFORMER ARANCHES | HONELE                                  |
|------------------------------------|-----------|--|--------|--------|------------------|----------|--------------------|-----------|----------------------|---|---|
| X 2ROM RESX<br>MIRANGRAZE PROFINE  | ALLA      | Theorem  | æ      | 662    | LOAD             | SHUAT    | XS                 | 308       | X                    |   |   |
| NVWI<br>E                          |           | 915NA VX/74  |        | N AVVA | ert/nvar mu/aumr | MA/MA/NK | RUSH X XHAN        |           | asea cst             | Sile  | SAVA3                                   |
| 4.00 MIRN REEN RVII.000            | ন্দ       | 1.0000 0.0   |        | ī.5    | 0-0              | 0.0      |                    |           |                      |   |   |
| 10                                 | 1 1.      | 000  | 0      | 0.SK   | 0-0              | 0'0      | ALOGI BLOCK 1      | 111.500   | Ţ ŗ                  | 0.6'  | 0,3                                     |
| 0.7                                |           |  |        |        |                  |          | 2 MD02a 20013      | 300-11    | 7                    | 1919<br>1   | 0.3                                     |
| 10                                 |           |  |        |        |                  |          | 4100% RCCX 3       | 11-000    | 4 J                  | 1.6   | E'C                                     |
|                                    |           |  |        |        |                  |          | 410013 SOLAR MV    | 000101    | 4 1                  | -0.4  | 1.6-                                    |
| 4100. MUCK I 11.000                | ნბტნ ე პ  | 0.0- 699   |        | 0.0    | с.o              | 0°0,     |                    |           |                      |   |   |
|                                    | 10.       | 969  | 0      | 0-0    | 3.6              | J.C      | 4100 MIRA RANG     | 000°17A4  |                      | -U. Ó   | · • • • • • • • • • • • • • • • • • • • |
| 1.0001K 22 2                       |           |  |        |        |                  |          | 41302 LV           | 0.4400    | ب<br>ب               | 0.U   | 0.2                                     |
|                                    |           |  |        |        |                  |          | 41003 BLOCK 1-A    | 0001.1    | Г<br>Ŧ               | 0.9   | 0.2                                     |
| A'002 EV 0.6400                    | 5°0'7     | 3.0- <u>0</u> ∔9   |        | 0.0    | 0.3              | 0<br>0   |                    |           |                      |   |   |
| 1.300UN 22 2                       | 810<br>0  | 820  | 5      | 0.0    | 0.2              | 0.6      | 1 XCOTE 10017      | 1.005     |                      | τ.υ-  | 6- <u>9</u> -                           |
| 41003 BLOCK 1-A 21.000             | 4 0.3     | 933 -0°C   |        | 0.0    | 0.0              | 0.0      |                    |           |                      |   |   |
| -0<br>-                            | FCT T     | 598  | C      | 0.0    | 0.3              | 0.0      | £10018-100K-1      | 21.000    | <b>-</b> ا<br>יקי    | -0.3  | -0.2                                    |
| 0.975LK 22 2400<br>41004 LV 2.4400 | 4 1.32C£  | 2CS -J.6   |        | 0.0    | 0.3              | 0.0      | 41004 LV           | 3, 4403   |                      | 0.3   | G.2                                     |
| 1,8000M 22 2                       | 10;4:01   | 103  | C      | 0.0    | 5.5              | 0.0      | 41003 BUOCK 1-3    | 11.1000   | L<br>Å               | -0.3  | -0.2                                    |
| 41005 NLOCK 2 11.690               | 4 3.9397  | 0.0 <b>.</b> −C.0  |        | 0.0    | 0.3              | 0-0-     |                    |           |                      |   |   |
|                                    | 1 10.397  | 101  | C      | 0.C    | 0.0              | 0.0      | 100 11292 NEW 9015 | 2011-004  |                      |   | :                                       |

·

÷.

.

.

.

ć

.

.

|         | 5.5      | Z'D                  |           | -0.2          |                 | -0.2         | G.7            | -0.2             |      |               | -0.3                   | C.7       | Ú.1                 |            | -0.2          |                  | -0.2          | 0.2                  | -0.2             |                 | 1.5                    |
|---------|----------|----------------------|-----------|---------------|-----------------|--------------|----------------|------------------|------|---------------|------------------------|-----------|---------------------|------------|---------------|------------------|---------------|----------------------|------------------|-----------------|------------------------|
| ·<br>·· | <br>0.3  | C.3                  |           | .0.3          |                 | -0.3         | с Г. С.        |                  |      |               | -D,6                   | £.3       | 510                 |            | с. о-         |                  | -0.3          | 0.3                  | ю <b>.</b> 0-    |                 | 0, ¢                   |
|         |          | -<br>-               |           | ۲<br>ټ        |                 | 7            | . I<br>V       | -<br>-<br>-      |      |               | <br>121                | ר<br>ל    | <del></del>         |            | 4 J           |                  | ۲<br>۲        | 4 1                  | • 1<br>•8*       |                 | 4 I                    |
|         | J. €462  | CD0.LI               |           | 11.030        |                 | 000°1;       | 0.460          | 11.000           |      |               | 11.400                 | 0.7460    | 030.II              |            | 000-11        |                  | 11.0CJ        | 0.4430               | .1.JOC           |                 | CC0.II                 |
|         | 41605 LV | 4100/ 3700K Z-M      |           | 4100% N DOX 3 |                 | 5 NOOLE SUOT | 41008 IV       | 41(0)/ BLCCX 2-A |      |               | 4100 MINN NEER MULLAGO | AT 0100.7 | ALOUN RECONSERVENCE |            | 41003 BLOCK 3 |                  | 41005 BTACK 3 | 419012 _V            | 410011 BLOCK 3-A |                 | COONTRAC MARK AVIL COO |
|         |          | 4<br>- 1             | - 0.0     | c.o           | - 0':           | J.C          | ۰<br>د         |                  |      | c.o           | 0'C                    | 7         |                     | 0'J        | 0.5           | 0.0              | 0.0           | 0.0<br>1             | J.C 42           | - c.0           | 0-0                    |
|         |          | ,<br>(               | 5-0       | 0,0           | 0.0             | 0-C          | n<br>c         | 0.2              |      | 0.0           | 0.0                    |           |                     | 0.3        | U.2           | 0.0              | 0.0           | 6.5                  | 5.2              | 0.0             | 0.0                    |
| :       |          |                      | 5-5       | 0.0           | 0.0             | 0.0          | 0<br>5         | 3 2 5<br>7 6     |      | 0.0           | 0.0                    |           |                     | 0-0        | 0-0           | 0.0              | 0.0           | 0.0                  | 0.0              | J.C             | 0.0                    |
|         |          |                      | 9.7-<br>- |               | 0°0-            |              | بر<br>ح<br>ا   | 2                |      | -0.3          |                        |           |                     | 9.0-       |               | 0-0-             |               | ۳.<br>۱              |                  | 0.0             |                        |
| •       |          |                      | 4 V.Y4X   | 1 0.4377      | 1990.0 2        | 10.937       | 31UJ . K       |                  |      | < 0.9996      | 362,01 1               |           |                     | 4 Ù.3948   | 1 6.4376      | 4 0.9994         | 1 10.993      | <pre>0.0039</pre>    | 1.8.4439         | 4 1.300;        | 100.11 I               |
|         | 5<br>55  |                      |           | 22 2          | -A 11.000       |              | 22 2<br>0.4440 | 1                | 22 2 | 11.300        |                        | 22        |                     | 0,4400<br> | 33            | -7 11.000        |               | 12 3<br>0.4400       | 12 J             | 000111          |                        |
|         | 1,0061.8 | 11<br>11<br>11<br>11 |           | 1.00003       | 41007 BLOCK 2-A | 0.           | - 388<br>410   |                  |      | 42009 BLOOK 3 | 0:<br>-                | 1.0001.K  | 31. E               | 41CJIC 14  | 1, COOCN      | 410011 BLOCK 3-7 | A 10          | U,9885K<br>410012 IV | HD:000 - 1       | AN HW108 210015 | ćI è                   |

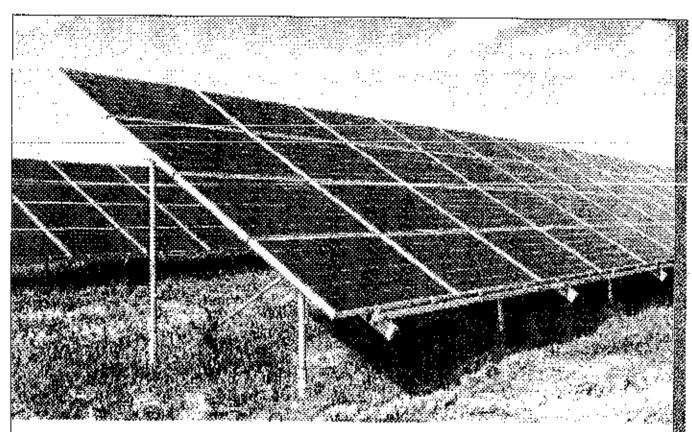
. .

| 5                  |                     |   |     |
|--------------------|---------------------|---|-----|
|                    |                     | - |     |
|                    | 0<br>4              |   |     |
| <br>+              | <del></del> '<br>*  |   |     |
| <br>               | 000                 |   | · . |
| AE SOLAR SULAR     | NR 342-00           |   |     |
| , 410014<br>, 0    | 0.6 4100.3 307AK MV |   |     |
| 0<br>2             | 0.0                 |   |     |
| -<br>-             | ит.о                |   |     |
| °,0                |                     |   |     |
| 97<br>00''<br>1    | 0<br>               |   |     |
| . L<br>. L         | -                   |   |     |
| 1.00016 SOLAR 2V 0 | (<br>ຟີ             |   |     |
| DS FLOCT<br>MINUC  |                     |   |     |

.

.

:





# Mehfooz Shaheed Garrison

# SYSTEM STUDY ANALYSIS OF MEHFOOZ SHAHEED GARRISON (MSG) 500kW SOLAR PV SYSTEM

Report

ARCO Energy

**PAKISTAN** Tel: =92-300-8827101



## CONTENTS

|         | TIVE SUMMARY   |
|---------|--|
| 1 IN.   | TRODUCTION   |
| 1.1     | Project Description  |
| 1.2     | Interconnection Atrangement  |
| 1.3     | Objective of System Study Analysis                                       |
| 1.4     | Study Components   |
| 2 S17   | DY METHODOLOGY   |
| 2.1     | Study Criteria   |
| 2.2     | Steady State Analysis  |
| 2.2.1   | 1 System Intact Analysis   |
| 2.2.2   | 2 Transmission Line Loading Analysis                                     |
| 2.2.3   | 3 Voltage Analysis   |
| 3 STE   | ADY STATE ANALYSIS   |
| 3.1     | Model Development  |
| 3.2     | Power Flow Assessment Without MSG PP and with Sanctioned Load In Service |
| 3.2.3   | Base Year 2025: Peak Loading Summer with Sanctioned Load in Service      |
| 3.3     | Power Flow Assessment with MSG PP  |
| 3.3.3   | Base Year 2025: Peak Loading Summer with Sanctioned Load In Service      |
| 3.4     | Conclusion   |
| 4 CO3   | NCLUSION   |
| 4.1     | Steady State Assessment  |
| LIST OF | ANNEXURES  |



### EXECUTIVE SUMMARY

This report provides the documentation of an assessment that has been performed for the interconnection of a 500kW Solar PV Power Generation project at Mehfooz Shaheed Garrison (MSG) distribution system at 11kV project of "Military Engineering Services" (MES). The project will be a Grid tied 500kW Solar PV based system connected with the power network of MSG. The '500kW MSG solar PV Power Generation project' is located at GCWM+2G5, Aziz Bhatti Town, Lahore, Pakistan.

The integration of solar power generation at the MSG premises necessitates a comprehensive system study analysis to ensure optimal operation of the electrical network. MSG currently receives a single point supply from LESCO with a sanctioned load of 2.690MW. The introduction of solar power generation will influence the flow of electricity within the premises, impacting both consumption and injection dynamics.

The existing setup includes transformers, switchgcar, and distribution panels to distribute electricity throughout the premises. The sanctioned load of 2.690MW is the maximum load that can be drawn from LESCO's grid.

The entire solar generation within the MSG premises will be consumed internally without exporting any power to the grid. To ensure the safe and efficient integration of solar power, a load flow study is required to analyze the impact of this interconnection on the existing electrical network. This study will assist in obtaining solar generation concurrence and ensuring compliance with relevant technical and regulatory requirements.

The analyses have been carried out in following scenarios;

- Without 500kW MSG solar PV with sanctioned load in service.
- With 500kW MSG solar PV with sanctioned load in service.

Steady state power flow assessment has been performed using the network data of MSG. Power flow study was conducted without Solar Project with sanctioned load in service to analyze the magnitude and phase angles of bus voltages, line loadings and power flows under steady-state conditions. Power flow analysis was also conducted with sanctioned load in service after the interconnection of the Solar project with the MSG distribution system. The power flow results for the system intact shows that

1



the power flows on all the MSG transmission and distribution line branches are within their normal line loading limit. There is no capacity constraint in terms of power flow or voltage ratings within the study area.

This systems study is a critical step in obtaining solar generation concurrence for MSG. By ensuring the stability and reliability of the electrical system, the study facilitates scencless solar power integration while maintaining compliance with MSG and regulatory requirements.

Based on the study results, it is concluded that proposed generation interconnection assessment for 500kW MSG solar PV Power Generation project meets the NEPRA grid code planning criteria.



## **1** INTRODUCTION

#### 1.1 Project Description

This report provides the documentation of an assessment that has been performed by ARCO Energy in response to a request made by Mehfooz Shaheed Gatrison (MSG) ("Project Owner" or "PO") for the interconnection of a 500kWp Solar PV Power Generation project ("Project") to the MSG power System at 11kV.

The '500kW MSG solar PV Power Generation project' is located at GCWM+2G5, Aziz Bhatti Town, Labore, Pakistan. Figure 1.1 shows Google site map of the project.

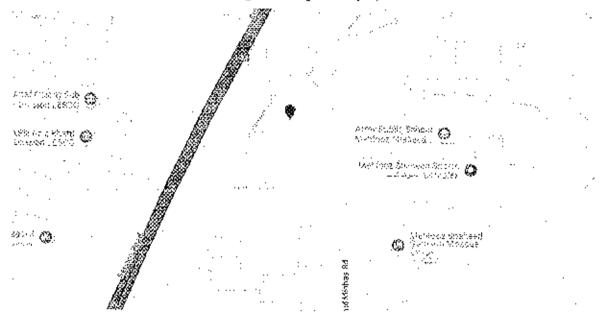


Figure 1.1: Google Site Map of the Solar PV Power Generation Project.



#### 1.2 Interconnection Arrangement

MSG aims to integrate solar power generation into its existing electrical infrastructure. MSG cuttently receives a single point power supply from LESCO with a sanctioned load of 2.690MW. The entire solar generation within the MSG premises will be consumed internally without exporting any power to the grid. The objective of the analyses is to evaluate the impact of the solar power plant on the MSG transmission and distribution system.

### 1.3 Objective of System Study Analysis

The primary objectives of the load flow study are:

- To evaluate the impact of solar power injection on the voltage levels and power distribution within MSG premises.
- To determine the changes in power flow patterns resulting from the integration of solar generation.
- To cosure that the existing electrical infrastructure can support the additional solar power without causing instability or operational issues.
- To verify compliance with regulatory requirements for solar power interconnection and obtain concurrence for solar generation.

#### 1.4 Study Components

500kW solar PV system is modelled into the MSG distribution system by ARCO Energy. Technical analysis includes:

- i) Data gathering and modelling
- it) Steady state analysis
- iii) Conclusion

The above scope of work involved in the technical analysis has been carried to demonstrate that connection assessment of this PV system meets the National Electric Power Regulatory Authority (NEPRA) distribution code.

The analyses have been carried out in following scenarios;

- Without 500kW MSG solar PV with sanctioned load in service.
- With 500kW MSG solar PV with sanctioned load in service.



This report documents the results of the steady state analyses. The principal objective of these analyses is to evaluate the impact of 500kW solar PV system to the distribution system of MSG and vice versa.



### 2 STUDY METHODOLOGY

#### 2.1 Study Criteria

The study has been carried out based on the National Electric Power Regulatory Authority (NEPRA) Grid Code planning criteria. Key parameters and their corresponding limits have been summarized in table below.

| Par            | ameter           | Range   |
|----------------|------------------|---|
| Voltage Level  | Normal Condition | ±5 % p.u at 1.32kV and below<br>+8%, 5% p.u at 220kVand above |
|                | Contingency      | 10 % p.u  |
| T/Line Loading | Normal Condition | 100%  |
| Capacity       | Contingency      |   |
|                | Nominal          | 50 112  |
| Frequency      | Normal Variation | 49.8 Hz - 50.2 Hz   |
|                | Contingency Band | 49.4 Hz - 50.5 Hz   |
| Power Factor   | Lagging          | 0.95  |
| Tower Pactor   | Leading          | 0.95  |

#### 2.2 Steady State Analysis

The purpose of steady-state analysis is to analyse the impact of the proposed solar power plant on distribution system facilities under steady-state conditions. It involves two distinct analyses: line loading analysis and voltage analysis. Power flow solutions using the PSS/E® program (Version 33.4) has been performed.

A "study atea" was defined to represent the areas of interest within MSG.

#### 2.2.1 System Intact Analysis

The incremental impact of the project on substations and transmission line loading under normal conditions was evaluated by comparing transmission and distribution system power flows through different scenarios for the project.

#### 2.2.2 Transmission Line Loading Analysis

11kV and 0.4kV rated transmission and distribution facilities in the study area have been monitored for line loadings.



### 2.2.3 Voltage Analysis

Voltages at buses inside the study area have been monitored for possible for voltage violations in accordance with NEPRA Grid Code guidelines.

• · · · • · · · ·



### **3 STEADY STATE ANALYSIS**

#### 3.1 Model Development

Project specific data was provided by the plant owner and it has been compiled and presented in **Annexure-A**. The steady state model of the power plant is presented in table below:

|  | Generator                  |
|--|----------------------------|
| No. of Collector Units                       | <u> </u>                   |
| Generation size of each<br>collector (kVA)   | 421                        |
| Active Power of cach<br>collector Pgen. (kW) | 400                        |
| Power Factor                                 | 0.95 lagging, 0.95 leading |
| Qinin, Qinax (kVAR)                          | 0.1315, 0.1315             |
| Rated Frequency                              | 50 Hz                      |
| Generation Voltage                           | 0.8V                       |
| Xsource                                      |                            |
| Genera                                       | tion Step Up Transformer   |
| No of Transformet                            | 1                          |
| kVA Capacity of each<br>GSU                  | 630                        |
| % Reactance (X)                              | 5%                         |
| Mehf   | fooz Shahced Garrison      |
| Sanctioned Load (LESCO)                      | 2690 kW                    |

Steady state power flow assessment has been performed using the network data of MSG.

## 3.2 Power Flow Assessment Without MSG PP and with Sanctioned Load In Service

Power flow study without MSG solar and with sanctioned load in service, was conducted to analyze the magnitude and phase angles of bus voltages, line loadings and power flows under steady-state conditions.

The result of this power flow analysis is in Annexure-B.



### 3.2.1 Base Year 2025: Peak Loading Summer with Sanctioned Load in Service

Power flow analysis has been performed on the peak loading summer (June) 2025 case of MSG network. This base case included a detailed representation of the MSG transmission and distribution system in the study area.

The steady state results, depicts that the power flows on all the MSG distribution line branches are within their normal loading limits. There is no capacity constraint in terms of load flow or voltage tatings around the study area. Result of the power flow analysis is attached in Figure B-1.

#### 3.3 Power Flow Assessment with MSG PP

Power flow study of MSG solar project was conducted with sanctioned load (in service and out of service) to determine the reliability impact of the 500kW MSG solar project on the MSG distribution system. This includes the performance of load flow analysis to identify any facility overload or voltage condition that violates the NEPRA planning criteria. Any such violation that is either directly attributable to this project or for which it will have a shared responsibility is included in this report.

The results of the project power flow analysis are plotted in Annexure-B.

### 3.3.1 Base Year 2025: Peak Loading Summer with Sanctioned Load In Service

A base case has been developed with sanctioned load in service at MSG solar for peak loading summer (June) 2025 that allow us to judge the impact of MSG solar project on the MSG network.

Project power flow analysis has been performed after the connection of the project with the MSG distribution system. This includes the detailed representation of the power plant.

The steady state result, with sanctioned load in service at MSG solar depicts that the power flows on all the transmission line branches are within their normal loading limits. There is no capacity constraint in terms of load flow or voltage ratings around the study area.

Result of the power flow analysis is attached in Figure B-2.

The results of the project bus voltages analysis are attached in Annexure-C.

#### 3.4 Conclusion

Steady state power flow assessment has been performed. Power flow study was conducted without solar Project with sanctioned load in service to analyze the magnitude and phase angles of bus voltages, line loadings and power flows under steady state conditions. Power flow analysis was also conducted



## Mehfooz Shaheed Garrison

with sanctioned load in service after the interconnection of the Solar project with the MSG distribution system. The power flow results for the system intact shows that the power flows on all the MSG distribution line branches are within their normal line loading limit. There is no capacity constraint in terms of power flow or voltage ratings within the study area.

Sector Contractor

10



### 4 CONCLUSION

### 4.1 Steady State Assessment

Steady state power flow assessment has been performed. Power flow study was conducted without MSG solar with sanctioned load in service, to analyze the magnitude and phase angles of bus voltages, line loadings, and power flows under steady-state conditions. Power flow analysis was also conducted with MSG solar and with sanctioned load in service with MSG distribution system. Power flow results showed that the power flows on all the MSG distribution branches are within their normal loading limit. There is no capacity constraint in terms of power flow of voltage ratings within the study area.

The steady state results found no capacity constraint in terms of power flow and voltage ranges.

Hence, it is concluded that based on the study results the Interconnection Assessment for 500kW Mehfooz Shaheed Garrison solar PV system with MSG Transmission and Distribution Network, meets the NEPRA grid code planning criteria.



### LIST OF ANNEXURES

Annex A: Project Specific Data.

Annex A-1: Project Site Map

Annex A-2: Power Plant Data.

Annex B: Power Flow Steady State Analysis Result.

Figure B-1: Base Year 2025 - Peak loading summer without MSG solar and Sanctioned load in service.

Figure B-2: Base Year 2025 - Peak loading summer with MSG solar and Sanctioned load in service.

Annex C: Assessment of Bus Voltages.

Annex C-1: Without MSG solar and with Sanctioned Load In Service.

Annex C-2; With MSG solar and with Sanctioned Load In Service.

## Annexure-A

Project Specific Data

## Annexure-A-1

. .

Project Site Map

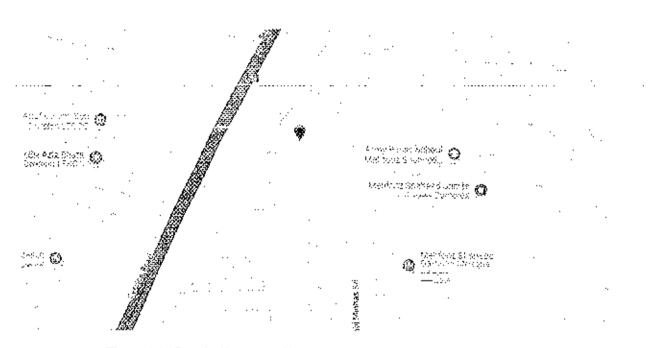


Figure 1.1: Google Site Map of the Solar PV Power Generation Project.

•

## Annexure-A-2

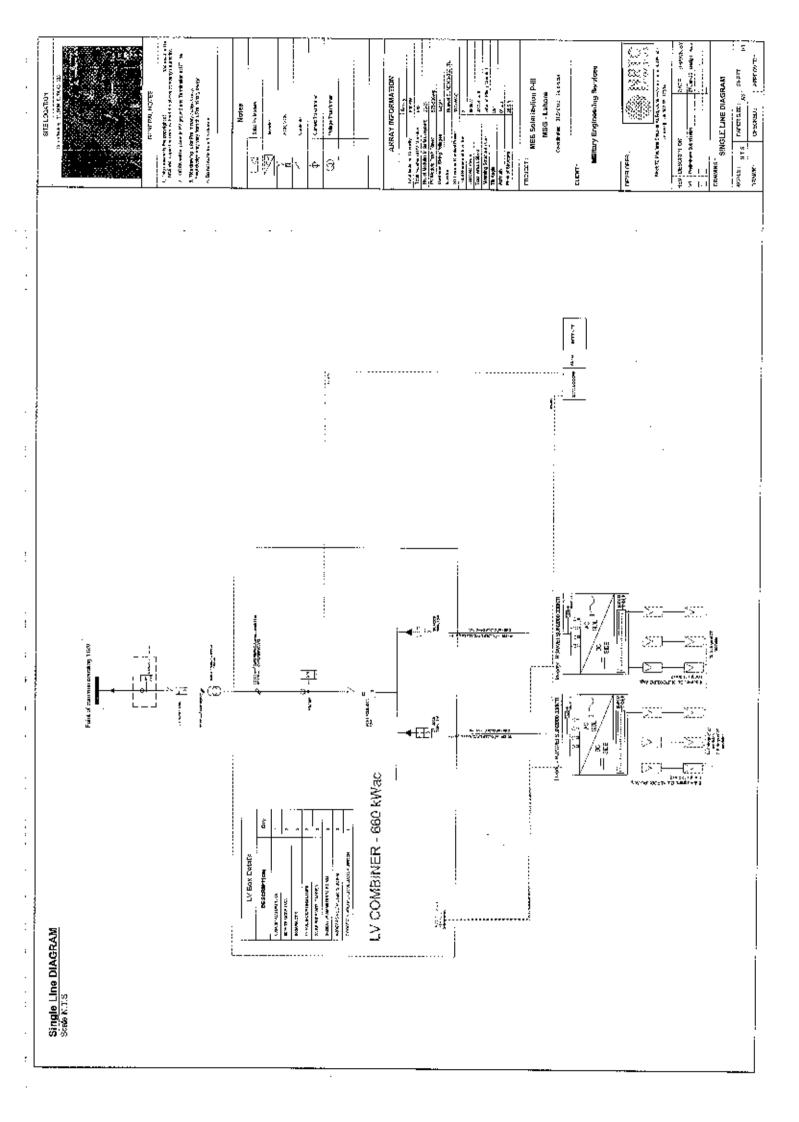
-

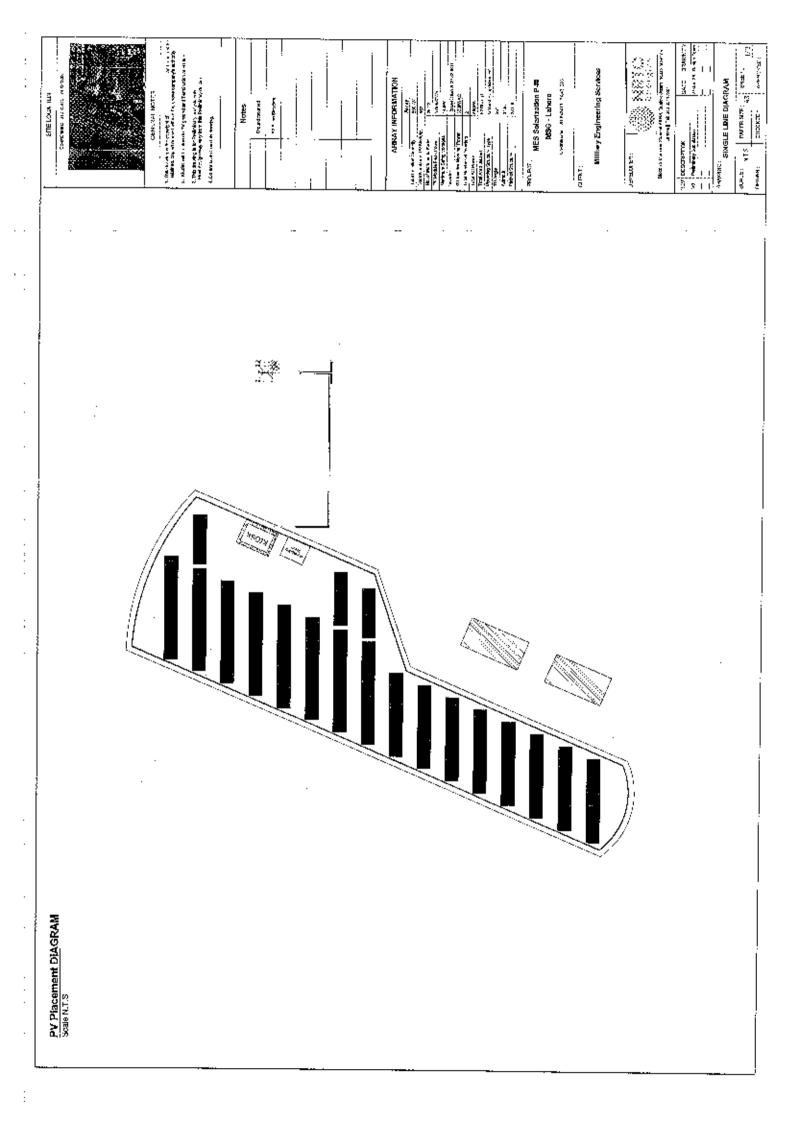
-

i

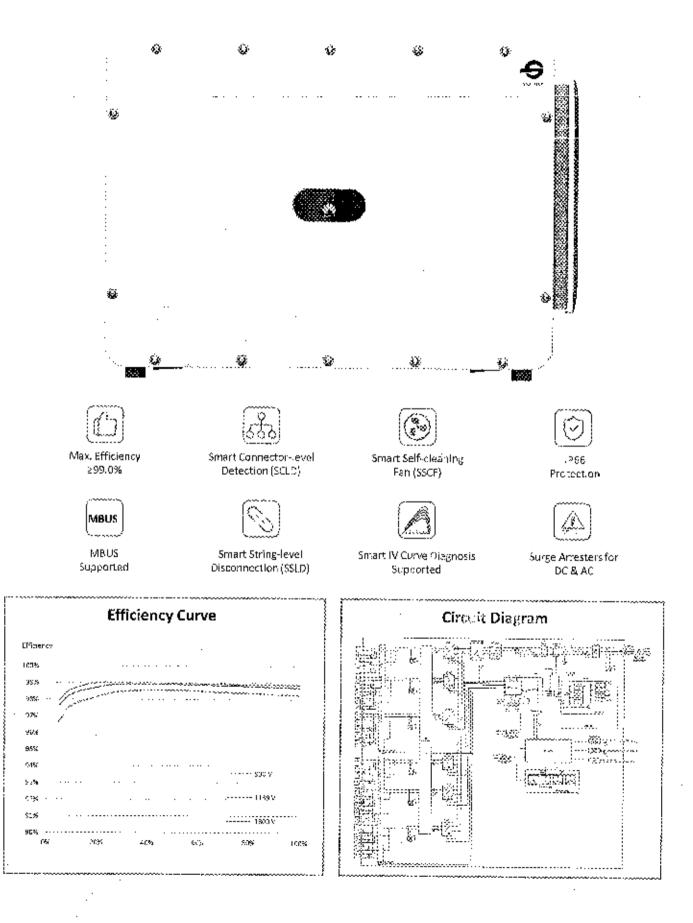
. .

Power Plant Data





### SUN2000-330KTL-H1 Smart String Inverter



SOLAR HUAWS LCOV

### sun2000-ззоктьна Technical Specifications

|  | Efficiency                            |                           |                                       |
|--|---------------------------------------|---------------------------|---------------------------------------|
| Max. Efficiency                                      | · · · · · · · · · · · · · · · · · · · | 3\$9.0%                   |                                       |
| European Hiffolondy                                  |                                       | 253.8%                    | • •                                   |
| ······   | Input                                 |                           | ···· • ·                              |
| Mox, Inpu: Voltage                                   |                                       | 1.500 V                   |                                       |
| Number of MPP Trackers                               |                                       |                           |                                       |
| Мах Сиггелт рег МРР"                                 |                                       | • •• • •••                | •••                                   |
| · · · · · · · · · · · · · · · · · · ·                |                                       | - 65 /                    |                                       |
| Miss, Short Certair Carren, per MPPT                 |                                       | : 15 A                    |                                       |
| Msx. PV inputs per MPPT                              |                                       | 4/5/3/4/%/2               |                                       |
| Start Voltage  |                                       | 550 Y                     |                                       |
| MPPT Operating Voltage Range                         |                                       | 500 V ~ 1,500 V           |                                       |
| Vominal riput Vollage                                |                                       | 1.080 V                   |                                       |
| •  | Oulput                                |                           |                                       |
| Nominal AC Active Power                              |                                       | 300,000 W                 | •••••••••••                           |
| Max, AC Apparent Power                               |                                       | 330,000 VA                |                                       |
| Max. AC Active Power (content)                       |                                       | 530,000 W                 | · · · · · · · · ·                     |
| Nominal Output Vollage                               |                                       | 300 V, 3W ÷ PE            |                                       |
| Rated AL Grid Frequency                              |                                       |                           |                                       |
| Nomina: Output Current                               |                                       | 50 - x / 60 Hz            | · · · · · · · ·                       |
|  |                                       | 216.6 A                   |                                       |
| Max. Output Current                                  |                                       | 238-2 A                   |                                       |
| Acjustable Power Factor Range                        |                                       | 08LG 08LD                 |                                       |
| Total Hardronic Distortion                           |                                       | <1%                       |                                       |
|  | Protection                            |                           | · · · · · ·                           |
| Smart String-Level Disconnector(SSLD)                |                                       | Yes                       |                                       |
| Anti-Islanding Protection                            |                                       | Yes                       |                                       |
| AC Overcorrent Protection                            |                                       | <sup>9</sup> ся           |                                       |
| DC Reverse polarity Protection                       |                                       | Yes                       | · ····· ···· ··· ···                  |
| PV-array String , ault Monitoring                    |                                       | Yes                       | ····· · · · · · · · · · · · · · · · · |
| DC Surge Arrestor                                    |                                       | Type I'                   |                                       |
| AC Surge Arrester                                    |                                       |                           | · · · · · ·                           |
| DC Insulation Resistance Detection                   |                                       | Type II                   |                                       |
| AC Grounding Fault Protection                        |                                       | ¥25                       |                                       |
| · ··· · · · · · · · · · · · · · · · ·                |                                       | Yes                       |                                       |
| Residual Current Monitoring Unit                     |                                       | Yes                       |                                       |
|  | Communication                         | ·                         |                                       |
| С ярау   |                                       | ED Indicators, WIAN + AP; | s<br>· · · · · · · · · · · ·          |
|  |                                       | Yes                       |                                       |
| MBUS   |                                       | ¥cs                       |                                       |
| K\$485   |                                       | Yes                       |                                       |
|  | General                               |                           |                                       |
| Dimensions (Wix Hix #)                               |                                       | 1.048 × 732 × 395 mm      |                                       |
| Weight (with mounting plate)                         |                                       | 5112 kg                   |                                       |
| Operating Temperature Range                          |                                       | -25 °C ~ 60 °C            |                                       |
| Cooling Method                                       |                                       |                           |                                       |
| në e nënë e e sa |                                       | Smart Air Cooling         |                                       |
| Mox. Operating Altitude without Derating             |                                       | 4,000 m (13,123 ft.)      | <b>.</b>                              |
| Relative Humidity                                    |                                       | C ~ 100%                  |                                       |
| AC Connector   | Walerp                                | toof Connector + CT/DT Te |                                       |
| Protection Degree                                    |                                       | IP 65                     |                                       |
| · · · · · · · · · · · · · · · · · · ·                |                                       |                           |                                       |

:

• :--

.

:

:

:

i

### Harvest the Sunshine

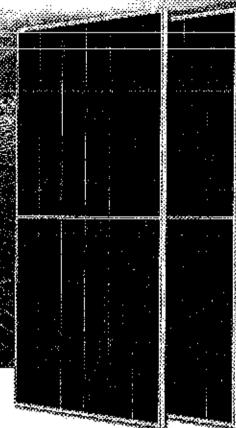
## DEEP BLUE 4.0

Nono

80W n-type Bifacial Double Glass High Efficiency Mono Module JAM72D40 555-580/GB

### Introduction

Power by the lastest SMBG n-type solar cell, heli-cell configuration and hapless ubbah connocativitechnology, these control have higher cellput power, lower EHD botte: waak illuminetion response? and better temparature preficient.





Higher power generation better £COE



n-type with very Lower LID.



Better weak illumination response



Better Temperature Coefficient

### Superior Warranty

- 12-year product wasterity.
- 30-year linear power cuppt warrany.



- n-type Briecial Double Glass Module 25 Under Performance Warrapty
- Standard Module Lines; Pedomatics Wairanty

### Comprehensive Certificates

- (ED 81245, ED 61793)
- ISO 9001; 2015 Quality management systems.
- ISO 14001: 2015 Etw)commental management systems.
- ISO 45001: 3018 Occupational health and satety management eystems
- #EC 62943: 2018 Terrestriel photovolfals (PV) motivies -Quality system for PV module manufacturing





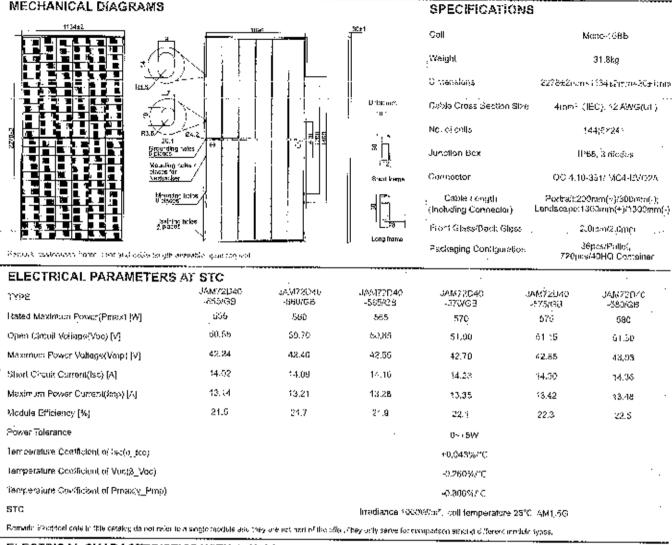
WWW. asolation



### **JA** SOLAR

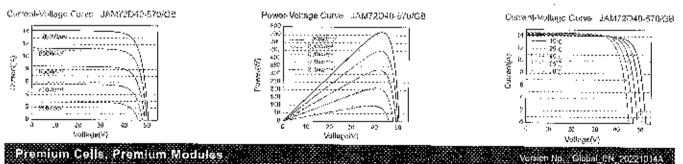
#### **MECHANICAL DIAGRAMS**

JAM72D40 555-580/GB



| ELECTRICAL CHARAC  | TERISTICS                  | S WITH 10           | 1% SOLA             | R IRRADI            | ATION R/           | атю                  | OPERATING COND  | ITIONS                              |
|--|----------------------------|---------------------|---------------------|---------------------|--------------------|----------------------|---|-------------------------------------|
| TYPE   | JAW872540<br>-555/GB       | 34M/2D40<br>-860/68 | ↓AM72つ40<br>+665/GB | JAM72D40<br>-570/GB | JAM72D40<br>575/33 | JAN(72040<br>-580/GB | Maximum System Voltage                                  | 1500V DC                            |
| Rated Max Power(Perax) [W]   | 509                        | 805                 | e10                 | 616                 | 621                | 628 -                | Operating Temporature                                   | -40°C~+85°C                         |
| Open Circuit Voltage(Ves) (V)  | 50.58                      | 30.75               | 50,68               | 51.03               | 51.16              | 51,80                | Maximum Sories Fusa Rating                              | ACK.                                |
| Max Power Vollage(Vorpi (V)  | 42.24                      | 42.3\$              | 42.55               | 42.70               | 42.88              | 53.0Z                | Maximum Static Losd, Fresh<br>Maximum Static Coad, Back | 5400Pe(112 lb(9)<br>2400Pe(50 lb(9) |
| Sheri Ginad Garen((so) [A]   | 5.14                       | 16,23               | 15.29               | 15.37               | 15 44              | 15.51                | NOOT  | 46-300                              |
| Max Power Correns(Imc) [A]   | 14.19                      | 14.27               | 54.86               | 14/42               | 14.42              | \$4.56               | Séarciali(y**   | 80%±10%                             |
| Interligition Ratio (rear/front)   |                            |                     | 10%                 |                     |                    |                      | Fite Performance  | UL 1990-29                          |
| "For Nexima or Instatelions, costic un<br>""Difecicily: "Pous, cost-Reicel Proce, ac | i susko koad pierrok<br>XI | lavo serges (d      | išy opulova lato    | e between JA S      | Soliar qha Nextr.  | seker für jofenen.   |   | ore yar ga                          |

#### **CHARACTERISTICS**



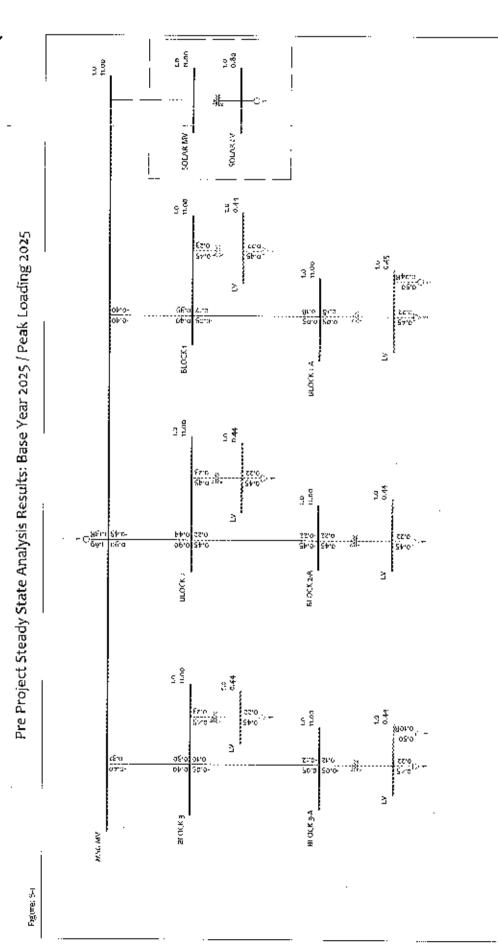
### Annexure-B

. .

.

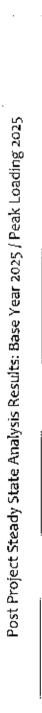
Steady State Analysis Results

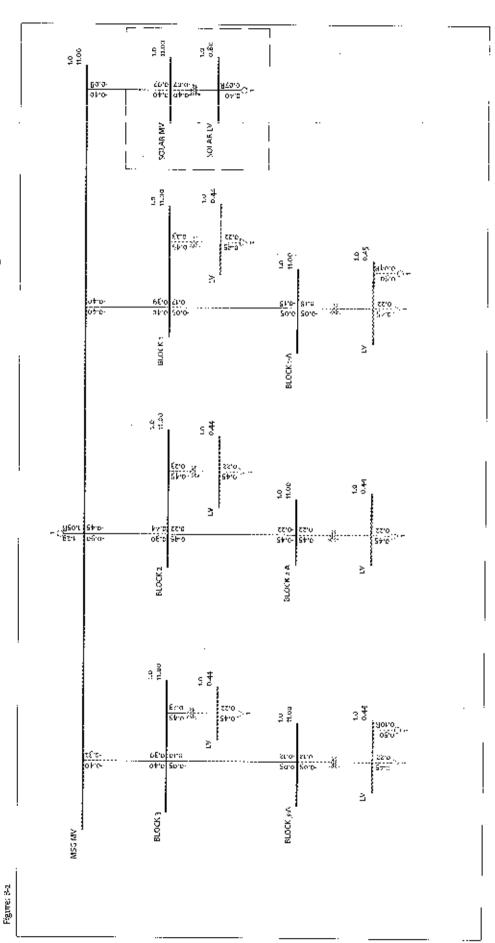
Load Flow Analysis of 500kW Solar PV System at Mehfooz Shaheed Garrison (MSG)



-

Load Flow Analysis of 500kW Solar PV System at Mehfooz Shaheed Garison (MSG)





F

## Annexure-C

Assessment of bus voltages

### Annexure-C-1

. .

\_.

.

.

-

..

.

## Without MSG PP and With Sanctioned Load In Service

2

SAT, FEATE 2025 17:20 SMVN FOR TRANSFORMERS % I FOL NOA-TRANSTORMER' BRANCHES 9 ° ¢ J. 4 0.0 0.2 7.5 9 C.2 --0.13 -0.2 9 0.2 -0,2 NVAR 9°6 6.6 9°€ 0,4 4.0--0.1 0.5 ¥-0. -0° 0.4 -0.1 5 h OKT - -1 ÷ н . \_ . × NRME --- X RANNA ARAN <del>st</del> ÷ ÷ ъ. ., . T শ ., ÷ - . . 42  $\sim$ 000.11 11.000 11.600 11.1000 0.4400 000111 11.000 0.6460 11.000 11.030 11,300 3.4400 İ 202,02 ¢1003 3DOCK 1-A 0.0 42003 81.00% .-8 ıH 41005 BLCCX 2 75 . . н 4100 NSG MV 4100 PSG W PTI INTERACTIVE PONEM SYNTHM SIMULATOR--PSS(R)E NSO SOLAR IV SYSYEN 0.0 41001 BLCCK 4.003 PROCX MOCIE (CUT) BLOCX | |×| 41032 IV AI \$COLY 41000 I.V 3U3# 41001 į × 1 i ł 0.0 0.0 MW/NYAR MW/WAR MW/MVAR. 0.J 3 0.0 0.0 о.с 0.0 0.0 0.0 SERVIT 0.0 0.0 0.0 0.0 0.2 0. 0 ۲. 0 ې 0 0.0 с С 0.0 4.0 0.000 JII. I 10.04 1.7 0.5 0.0 0'0 0.0 9-12 0-12 0.0 0.0 0.0 0.0 GEN. ENERG 0 0 0.0 9'U-1.5 с. Р 0.0-BUS# X-- NAMM --X NASKV ZONE PU/XV 4 0.9999 4 1.0000 4 0.9329 00011.1 9856.0 5 4 0,9596 1 10.998 L 0.4369 4610.1 b 10.596 VCLT 10.990 1 0.4483 ·····X AREA 11.600 0,4400 21,300 11.000 0,4430 11.003 с (  $\sim$ ¢? (N οı A 1120 M CNITAR 3 넑 r-i Fri 엌 ģ Z----- 2ROM 2D2 55 41003 NLOCK 1-A . 41001 NUCCE 1 οı 4100 KSC MV FIGLE 41005 BLOCK TTEMNSPORMUR 41002 LV 41004 LV R Н, e, Ц Э 0 X100011 S 1.00.00% 0.9751.K 1,00001 1.00CLK ! RATIO 3 Ê φ ŝ ى N \$

:

:-

. 1

| ¢.               | ų      |              | 9                 |                  | 5                 | 0.2              |          | ц.                  |             | en<br>en        | 7         | г                |           | N.                |                  |                   | -                    | ÷                       |
|------------------|--------|--------------|-------------------|------------------|-------------------|------------------|----------|---------------------|-------------|-----------------|-----------|------------------|-----------|-------------------|------------------|-------------------|----------------------|-------------------------|
|                  | •      |              | č.0-              |                  | -0.2              | õ                |          | 13<br>12<br>1       |             | e.0-            | 0.2       | 0.1              |           | -0.2              |                  | 0-1               | 1.0                  | 1-0-                    |
| 5<br>1           |        |              | ў.С-              |                  | -0.4              | •••              |          | -0.4                |             | 0. ć            | 0.4       | -0.1             |           | -0,4              |                  | 0.7               | 0 -                  | 0.1                     |
| -<br>-           |        |              | 4 I               |                  | ד                 | ľ<br>V           |          | ~                   |             | 4 I             | і<br>т    | <br>घ            |           | •                 |                  | 4                 | 4 J                  | . I<br>V                |
| 000 11           | 000-11 |              | 11.000            |                  | 0001.1            | 0.4400           |          | 100.11              |             | 000.11          | 0.47.00   | 11.600           |           | 1.300             |                  | 11,030            | 0,440                | 00011.                  |
| 47 (AT BLOCK 2-2 |        |              | 6.0 4'005 RUDCY 2 | ι.,Ω             | U.O 410U3 BLOCK 2 | VI 80019         | J.C      | 0.0 41007 3300K 2-A | 0.3         | VA 250 00.7 0.0 | 410010 IV | 410011 BLOCK 3-A | n.0       | 0.0 41039 PIOCK 3 | 0.8              | 0.0 41105 BLCCK 3 | 413012 JV<br>5.6     | 0.6 410011 BIOCK 3-A    |
|                  |        | 0.4          | 0.2               | 0°0              | 0.0               |                  | 3.6      | a. 2                | 0.3         | 0.0             |           |                  | C.J       | 2.5               | 0.0              | 0.0               | С. З                 | 0.2                     |
|                  |        | 0.1          | 0.3               | 0.0              | 0.0               |                  | 0.0      | 0-0                 | 0°0         | 3.5             |           |                  | 0.0       | 0.0               | 0.0              | 0.0               | 0.5                  | U, IR                   |
|                  |        | -0.9         |                   | 0.0-             |                   |                  | -0.8     |                     | -6. C       |                 |           |                  | -0.8      |                   | -6.0             |                   | 0.1                  |                         |
|                  |        | 4 0,3926     | 1 0,4367          | 4 0.399 <i>8</i> | 1 1C.506          |                  | £ 1.0033 | ÷                   | 4 3.5996    | 1 10.39£        |           |                  | 0.9627    | : C.1368          | 4 3.9996         | 1 10.995          | é 1.0099             | 에<br>역<br>역<br>10<br>20 |
|                  |        | ח. קוסה.<br> | er<br>Tř          | 0.2-A 11-000     |                   | r<br>Tr          | () ¢4    | 31 2                | 3 12,030    |                 |           | 5 T              | 0.4400    |                   | 3~5 12.000       |                   | 4 3<br>0.4463        |                         |
|                  | 5 10   | 41006 LV     | 1.00007           | 41007 BLOOK 2-A  | 5 10              | 0.998 <u>5</u> 8 | 41033 LV | NL-30C.1            | 41009 3LOCN |                 |           | 1, 100 March     | ر 10014 v | NF005'T           | ALOCIL ALOCK 344 | 1 10              | 6,988_K<br>410012 5V | 1. 300 UR               |

.

. .

.

•

### Annexure-C-2

## With MSG PP and With Sanctioned Load In Service

:

|   |                           |  |             |               |               |               |                 | İ             |             |          |                 |             |               |                   |              |                |                 |               |             |
|---|---------------------------|--|-------------|---------------|---------------|---------------|-----------------|---------------|-------------|----------|-----------------|-------------|---------------|-------------------|--------------|----------------|-----------------|---------------|-------------|
| 2HONFE  |                           | M/AR   |             | C. A          | 6.4           | 0.3           |                 |               | 1.0         | 0.2      | 0.2             |             | 2'R           |                   | -0-2         | 0.2            | -0.2            |               | -0.5        |
| -<br>   |                           | 1915   |             | 0.4           | 6-0           | 0.A           | ÿ°C-            |               | -0.4        | ٥.٦      | -0.1            |             | 5.0.          |                   | 0            | -0.1           | C. 1            | !             | 0°C-        |
| 2025<br>24757<br>(84-1167                       | ×X                        | EN CKT   |             | . 7           | en<br>su      | ÷.            | 4<br>1          |               | Ц<br>т      | Г<br>Ŧ   | 1-1<br>121      |             | ŕ             |                   | Ч<br>Т       |                | ا ،<br>ال       |               | 4<br>1      |
| АА <i>Р, -</i> КА 15<br>КАР, - КА 15<br>КОМ - Т |                           | NAKK HEX BASAV AREA CKT                          |             | :T.000        | 11,000        | C00'II        | 11,000          |               | 11,000      | 0,4400   | 00C'L.          |             | 11.0CD        |                   | 11, 000      | C.440C         | 11.000          |               | 11.030      |
| NECSAHOLWICKIS WELSAS ENGOD ANLLOVMART FLA      | S09 05                    | EUS# X NAMK ···                                  |             | [ 300 € 10017 | 41005 RIGOK 2 | 41000 3TOOK 3 | 410013 SOLAR MV |               | VM 400 COLV | 4:002 FW | 41003 BLOCK 1-7 |             | 410(4 300CK 1 |                   | 1001 BLOCK ; | ¢1.004 i.V     | 41003 BLOCK 1-0 |               | VM 82M 0019 |
| LYTICIS (                                       | SHUNT X-                  | R/MVBR   | 0'C         | 0.0           | ~             | ~             | 12              | 0,0           | 0.0         | ~        | 4               | 0.0         | 0.1 4         | 0,0               | C.O 4        | 0.0<br>        | 0.J 4           | 0.0           | 0.0         |
| ABTEVE ST                                       | LORD                      | ai/nurr n  | 0.C         | 3.5           |               |               |                 | 0.0           | 0.0         |          |                 | j.t         | 0.2           | 0.0               | 0-0          | 2.4            | 0.2             | Û-Û           | 0.0         |
|   | (ULL)                     | ra/war ra/wer ra/wer                             | 1.3         | 1.1R          |               |               |                 | 0.0           | 0.0         |          |                 | 0.0         | 0.0           | 0.0               | 0.0          | 5' J           | U, GR           | 0.0           | 0.0         |
| MELSAS AL<br>OVERLAT TLA                        |                           | A' ĐKV   | 0.0         |               |               |               |                 | -0.0          |             |          |                 | 8-0-<br>-0- |               | -0,1              |              | 1.'U           |                 | 0.0-          |             |
| S AL ACIOS SSN<br>Tha                           | SAOV AE                   | NE PO/KV   | 4 1.000C    | 1, 11,000     |               |               |                 | 6068.0 F      | 1 IC.998    |          |                 | 4 8,9920    | 1 J.4369      | 4 0.3958          | 1 IC.998     | 4 1.0139       | 1 J.(483        | € 0.3958      | 556'JI [    |
| 595   | 1308X AKSA<br>RATING      | NUSL Y NAMEX BASKY CONE<br>210 ANGLEX BASKY CONE | 11,003      |               |               |               |                 | 1, 300        |             | Ŀ.       |                 | 0.4450      | ž:<br>2       | I-A 21,500        |              | 12 2<br>0.4400 | 12 2            | 1.300         |             |
|   | X FROM 2US<br>TRANSFORMEN | NUS, Y NM<br>RATIO ANGLE                         | 4130 KSS MV | -<br>-<br>-   | c             | -             | 0 T C           | 41201 BLCCK 1 |             | 000      | · · ·           | 10          | MU200.1       | 41003 Bu(XCK 1-3. | 2 10         | 27.5           | 1.000Uk         | 41005 BIOCK 2 | 0T Q.       |

. .

.

: .

. .

|     | 0.2                         | с.<br>Ц                         | -0.2                           | 2                                    | 0<br>9              |               | 6.0-            | 0.2       | 0.1               | -0.2              |                   | -0.1              | [.]                  | 0.5                    |                 | 0.1              |
|-----|-----------------------------|---------------------------------|--------------------------------|--------------------------------------|---------------------|---------------|-----------------|-----------|-------------------|-------------------|-------------------|-------------------|----------------------|------------------------|-----------------|------------------|
| · · | . <b>4</b> .<br>. 4         | י.<br>דייק -<br>דייק -          | <br>                           |                                      | 0.1                 | -             | F-0-            | 5.4       | • n. 1            | . <b>テ</b> ゙i)-   |                   | 0.1               | -0.1                 | J.J                    |                 | 0.4              |
|     | ાન પ્<br>ચાર્યો             | rei<br>VI                       | <br>                           |                                      | 1 1                 |               | <br>7           | . 1<br>21 | يد<br>            | -<br>~            |                   | 21<br>24          | . ا.<br>الا          | 4<br>1                 |                 | <del></del><br>च |
|     | 0.4400<br>11.300            | 21.003                          | 011.050<br>0440                |                                      | 11,000              |               | 11.000          | 0.€403    | 11.000            | 12.600            |                   | 11.300            | n. 4460<br>          | 11,000                 |                 | 11.000           |
|     | 41635 LV<br>41637 Alock 2-A | 0.0 41605 3200K 2               | 0.3 41305 BLCCX 2<br>47609 577 |                                      | 0.0 40007 BLOCK 2-R | 3.6           | 0.C 4100 MSG MV | A1 000.5  | (1001) TOOTK 3-A  | 0.0 41008 BLOCK 3 | G.C               | J.C 41039 BLOCK 3 | ¢.0                  | . v-£ ⊁0079 IL001€ 0°0 | C.Ū             | n.o 4100 NGC MV  |
|     |                             | د.<br>م.م<br>م.م                | 0.0                            | 0.4                                  | 0.2                 | 0.0           | 0°C             |           | 0.4               | 0.2               | 0.0               | 0'C               | 0.4                  | 0.2                    | 0.0             | 0.0              |
| !   | 0                           | 0.0<br>0.0                      | J.C                            | 0.0                                  | 0.0                 | 0.0           | 0.0             |           | 3.6               | 0.0               | 0.0               | 0.0               | 3,5                  | 0.14                   | 0.0             | 0.0              |
|     | e                           | ບ ລັ<br>ວິດ<br>                 |                                | -0 <b>.</b> 8                        |                     | 0.0-          |                 |           | -3.0              |                   | 0.0               |                   | 0.1                  |                        | 0.0             |                  |
| :   |                             | 1 0.436/<br>1 0.436/<br>4 0.496 | 1 10.396                       | 4 1.0053                             | 1 (.4424            | 4 C.9996      | 10.096          |           | 4 0.937           | 1 0.4368          | < 0.9996          | 10, 995           | 4 I.3099             | 1 0.44/4               | 1.00J1 4        | 100,11 2         |
| -   | 7 500 0<br>15               | 17                              |                                | 31 2<br>0.4400                       | 31. 2               | × 3 11.000    |                 | 31 2      | 00,4400           | 31 2              | К 3-№ 11.00С      |                   | € 3<br>C,4€00        | (1                     | NV 11.000       |                  |
|     | 1.000TX<br>50               | 1.0000N 3400K 2-A               | 0F<br>. u:                     | л.9881.К<br>VI BOUL <del>A</del><br> | 1.00001             | 41003 NLOCX 3 | ې<br>:<br>د     | . JOC -   | 1 10<br>€10010 LV | 1.000UX           | 410011 Nr.CCK 3-A | 0:                | 0.3881K<br>410U12 LV |                        | 412013 SOLAR MV | ा<br>. ।<br>स    |

.

.

:

.

!

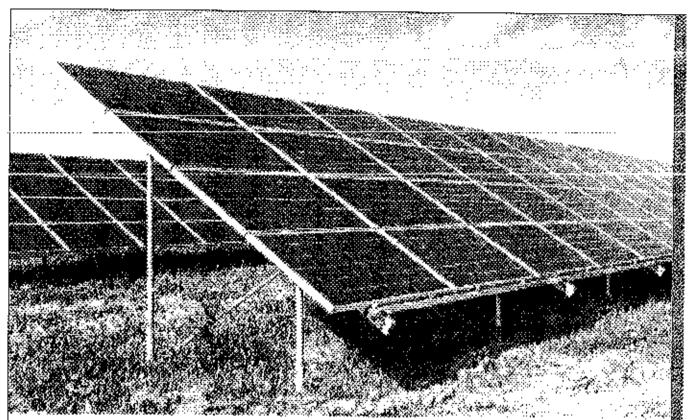
|   | · · · · · · · · · · · · · · · · · · · |
|---|---------------------------------------|
|   | न<br>र                                |
| C.308.0                                 |                                       |
|   | VA 1.912 SC101 0.0                    |
| 0.0                                     |                                       |
| 9.<br>D                                 | 0 T K                                 |
| 0.5                                     |                                       |
| ¢ 1,0015                                | 1 G. SF '2                            |
| . <u>64</u> 1<br>V 8000                 | ت.<br>ت                               |
| יאי איז איז איז איז איז איז איז איז איז | NDOUU"                                |
|   | ·                                     |

.

.

÷

Annex - J





## **Okara Cantt**

## SYSTEM STUDY ANALYSIS OF OKARA CANTT (OC) 999kW SOLAR PV SYSTEM

Report

ARCO Energy

PAKISTAN Tel: +92-300-8827101



### CONTENTS

| EXECUTIVE SUMMARY   |
|---|
| 1 INTRODUCTION  |
| 1.1 Project Description   |
| 1.2 Interconnection Arrangement   |
| 1.3 Objective of System Study Analysis  |
| 1.4 Study Components  |
| 2 STUDY METHODOLOGY   |
| 2.1 Study Criteria  |
| 2.2 Steady State Analysis   |
| 2.2.1 System Intact Analysis  |
| 2.2.2 Transmission Line Loading Analysis  |
| 2.2.3 Voltage Analysis  |
| 3 STEADY STATE ANALYSIS 8   |
| 3.1 Model Development   |
| 3.2 Power Flow Assessment Without Okara Cantt PP and with Sanctioned Load In Service8 |
| 3.2.1 Base Year 2025: Peak Loading Summer with Sanctioned Load in Service             |
| 3.3 Power Flow Assessment with Okara Caott PP   |
| 3.3.1 Base Year 2025: Peak Loading Summer with Saoctioned Load In Service             |
| 3.4 Conclusion  |
| 4 CONCLUSION  |
| 4.1 Steady State Assessment   |
| LIST OF ANNEXURES   |





### EXECUTIVE SUMMARY

This report provides the documentation of an assessment that has been performed for the inverconnection of a 999kW Solar PV Tower Generation project at Okara Canit (OC) distribution system at 11kV project of "Military Engineering Services" (MES). The project will be a Grid fied 999kW Solar PV based system connected with the power network of OC. The '999kW OC solar PV Power Generation project' is located at Q943+J56, Okara Cantonment, Okara, Pakistan.

The integration of solar power generation at the Okara Cantt premises necessitates a comprehensive system study analysis to ensure optimal operation of the electrical network. Okara Cantt currently receives a single point supply from LESCO with a sanctioned load of 4.5MW. The introduction of solar power generation will influence the flow of electricity within the premises, impacting both consumption and injection dynamics.

The existing scup includes transformers, switchgear, and distribution panels to distribute electricity throughout the premises. The sanctioned load of 4.5MW is the maximum load that can be drawn from LESCO's grid.

The entire solar generation within the Okara Caritt premises will be consumed internally without exporting any power to the grid. To ensure the safe and efficient integration of solar power, a load flow study is required to analyze the impact of this interconnection on the existing electrical network. This study will assist in obtaining solar generation concurrence and ensuring compliance with relevant technical and regulatory requirements.

The analyses have been carried out in following scenarios;

- Without 999kW Okara Cantt solar PV with sanctioned load in service.
- With 999kW Okara Cantt solar PV with sanctioned load in service.

Steady state power flow assessment has been performed using the network data of Okara Cantt. Power flow study was conducted without Solar Project with sanctioned load in service to analyze the magnitude and phase angles of bus voltages, line loadings and power flows under steady-state conditions. Power flow analysis was also conducted with sanctioned load in service after the interconnection of the Solar project with the Okara Cantt distribution system. The power flow results for the system intact shows that the power flows on all the Okara Cantt transmission and distribution



line branches are within their normal line loading limit. There is no capacity constraint in terms of power flow or voltage ratings within the study area.

This systems study is a critical step in obtaining solar generation concurrence for Okara-Cantt. By ensuring the stability and reliability of the electrical system, the study facilitates scamless solar power integration while maintaining compliance with Okara Cantt and regulatory requirements.

Based on the study results, it is concluded that proposed generation interconnection assessment for 999kW Okara Cantt solar PV Power Generation project meets the NEPRA grid code planning criteria.



### **1** INTRODUCTION

#### 1.1 **Project Description**

This report provides the documentation of an assessment that has been performed by ARCO Energy in response to a request made by Okara Cantt (OC) ("Project Owner" or "PO") for the interconnection of a 999kWp Solar PV Power Generation project ("Project") to the OC power System at 11kV.

The '999kW Okara Cantt solar PV Power Generation project' is located at Q943+J56, Okara Cantonment, Okara, Pakistan. Figure 1.1 shows Google site map of the project.

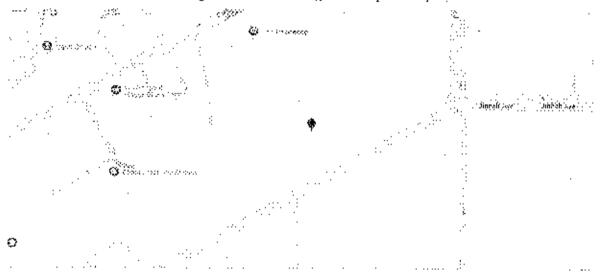


Figure 1.1: Google Site Map of the Solar PV Power Generation Project.



### 1.2 Interconnection Arrangement

Okara Cantt aims to integrate solar power generation into its existing electrical infrastructure. Okara Cantt currently receives a single-point power supply from LESCO with a sanctioned load of 4.5MW. The entite solar generation within the Okara Cantt premises will be consumed internally without exporting any power to the grid. The objective of the analyses is to evaluate the impact of the solar power plant on the Okara Cantt transmission and distribution system.

### 1.3 Objective of System Study Analysis

The primary objectives of the load flow study are:

- To evaluate the impact of solar power injection on the voltage levels and power distribution within Okara Cantt premises.
- To determine the changes in power flow patterns resulting from the integration of solar generation.
- To ensure that the existing electrical infrastructure can support the additional solar power without causing instability or operational issues.
- To verify compliance with regulatory requirements for solar power interconnection and obtain concurrence for solar generation.

### 1.4 Study Components

999kW solar PV system is modelled into the Okara Cant distribution system by ARCO Energy. Technical analysis includes:

- i) Data gathering and modelling
- ii) Steady state analysis
- iii) Conclusion

The above scope of work involved in the technical analysis has been carried to demonstrate that connection assessment of this PV system meets the National Electric Power Regulatory Authority (NEPRA) distribution code.

The analyses have been carried out in following scenarios;

- Without 999kW Okara Cantt solar PV with sanctioned load in service.
- With 999kW Okara Cantt solar PV with sanctioned load in service.



This report documents the results of the steady state analyses. The principal objective of these analyses is to evaluate the impact of 999kW solar UV system to the distribution system of Okara Cantt and vice versa.

...

and the second second

5

.



### 2 STUDY METHODOLOGY

### 2.1 Study Criteria

The study has been carried out based on the National Electric Power Regulatory Authority (NEPRA) Grid Code planning criteria. Key parameters and their corresponding limits have been summarized in table below.

| Patz           | aineter          | Range  |  |  |  |  |  |
|----------------|------------------|--|--|--|--|--|--|
| Voltage Level  | Normal Condition | ±5 % p.u at 132kV and below<br>+8%,-5% p.u at 220kVand above |  |  |  |  |  |
|                | Contingency      | ±10 % p.u  |  |  |  |  |  |
| T/Line Loading | Normal Condition | 100%   |  |  |  |  |  |
| Capacity       | Contingency      | 100%   |  |  |  |  |  |
|                | Nominal          | 50 IIz   |  |  |  |  |  |
| Frequency      | Normal Variation | 49.8 Hz - 50.2 Hz  |  |  |  |  |  |
|                | Contingency Band | 49.4 Hz - 50.5 Hz  |  |  |  |  |  |
| Power Factor   | Lagging          | 0.95   |  |  |  |  |  |
| Tower Pacifin  | Leading          | 0.95   |  |  |  |  |  |

#### 2.2 Steady State Analysis

The purpose of steady-state analysis is to analyse the impact of the proposed solar power plant on distribution system facilities under steady-state conditions. It involves two distinct analyses: line loading analysis and voltage analysis. Power flow solutions using the PSS/E® program (Version 33.4) has been performed.

A "study area" was defined to represent the areas of interest within Okara Cantt.

#### 2.2.1 System Intact Analysis

The incremental impact of the project on substations and transmission line loading under normal conditions was evaluated by comparing transmission and distribution system power flows through different scenarios for the project.

#### 2.2.2 Transmission Line Loading Analysis

11kV and 0.4kV rated transmission and distribution facilities in the study area have been monitored for line loadings.



### 2.2.3 Voltage Analysis

Voltages at buses inside the study area have been monitored for possible for voltage violations in accordance with NEPRA Grid Code guidelines.

7



### 3 STEADY STATE ANALYSIS

### 3.1 Model Development

Project specific data was provided by the plant owner and it has been compiled and presented in **Annexure-A**. The steady state model of the power plant is presented in table below:

|  | Generator                  |
|--|----------------------------|
| No. of Collector Units                       | <u> </u>                   |
| Generation size of each<br>collector (kVA)   | . 841                      |
| Active Power of each<br>collector Pgen. (kW) | 799                        |
| Power Factor                                 | 0.95 lagging, 0.95 leading |
| Qmin, Qmax (kVAR)                            | - 0.2626, 0.2626           |
| Rated Frequency                              | 50 Hz                      |
| Generation Voltage                           | 0.8V                       |
| Xsource                                      | <u> </u>                   |
| Genetati                                     | ion Step Up Transformer    |
| No of Transformer                            | 1                          |
| kVA Capacity of each<br>GSU                  | 1250                       |
| % Reactance (X)                              | 5 %                        |
|  | Okara Cantt                |
| Sanctioned Load (LESCO)                      | 4500 kW                    |

Steady state power flow assessment has been performed using the network data of OC.

### 3.2 Power Flow Assessment Without Okara Cantt PP and with Sanctioned Load In Service

Power flow study without Okara Cantt solar and with sanctioned load in service, was conducted to analyze the magnitude and phase angles of bus voltages, line loadings and power flows under steady-state conditions.

The result of this power flow analysis is in Annexure-B.



#### 3.2.1 Base Year 2025: Peak Loading Summer with Sanctioned Load in Service

Power flow analysis has been performed on the peak loading summer (June) 2025 case of Okara Cantt network. This base case included a detailed representation of the Okara Cantt transmission and distribution system in the study area.

The steady state results, depicts that the power flows on all the Okara Cantt distribution line branches are within their normal loading limits. There is no capacity constraint in tenns of load flow or voltage ratings around the study area. Result of the power flow analysis is attached in **Figure B-1**.

#### 3.3 Power Flow Assessment with Okara Cantt PP

Power flow study of Okara Cantt solar project was conducted with sanctioned load (in service and our of service) to determine the reliability impact of the 999kW Okara Cantt solar project on the Okara Cantt distribution system. This includes the performance of load flow analysis to identify any facility overload or voltage condition that violates the NEPRA planning criteria. Any such violation that is either directly attributable to this project or for which it will have a shared responsibility is included in this report.

The results of the project power flow analysis are plotted in Annexure-B.

#### 3.3.1 Base Year 2025: Peak Loading Summer with Sanctioned Load In Service

A base case has been developed with sanctioned load in service at Okara Cantt solar for peak loading summer (June) 2025 that allow us to judge the impact of Okara Cantt solar project on the Okara Cantt network.

Project power flow analysis has been performed after the connection of the project with the Okara Cantt distribution system. This includes the detailed representation of the power plant.

The steady state result, with sanctioned load in service at Okara Cantt solar depicts that the power flows on all the transmission line branches are within their normal loading limits. There is no capacity constraint in terms of load flow or voltage ratings around the study area. Result of the power flow analysis is attached in **Figure B-2**.

The results of the project bus voltages analysis are attached in Annexure-C.



### 3.4 Conclusion

Steady state power flow assessment has been performed. Power flow study was conducted without solar Project with sanctioned load in service to analyze the magnitude and phase angles of bus voltages, line loadings and power flows under steady state conditions. Power flow analysis was also conducted with sanctioned load in service after the interconnection of the Solar project with the Okara Cantt distribution system. The power flow results for the system intact shows that the power flows on all the Okara Cantt distribution line branches are within their normal line loading limit. There is no capacity constraint in terms of power flow or voltage ratings within the study area.

10



## **Okara** Cantt

#### 4 CONCLUSION

#### 4.1 Steady State Assessment

Steady state power flow assessment has been performed. Power flow study was conducted without Okara Cantt solar with sanctioned load in service, to analyze the magnitude and phase angles of bus voltages, line loadings, and power flows under steady-state conditions. Power flow analysis was also conducted with Okara Cantt solar and with sanctioned load in service with Okara Cantt distribution system. Power flow results showed that the power flows on all the Okara Cantt distribution branches are within their normal loading limit. There is no capacity constraint in terms of power flow or voltage ratings within the study area.

The steady state results found no capacity constraint in terms of power flow and voltage ranges.

Hence, it is concluded that based on the study results the Interconnection Assessment for 999kW Okara Cantt solar PV system with Okara Cantt Transmission and Distribution Network, meets the NEPRA grid code planning criteria.



## **Okara Cantt**

#### LIST OF ANNEXURES

Annex A: Project Specific Data.

... Annex A-1: Project Site Map.

Annex A-2: Power Plant Data.

Annex B: Power Flow Steady State Analysis Result

Figure B-1: Base Year 2025 - Peak loading summer without Okara Cantt solar and Sanctioned load in service.

Figure B-2: Base Year 2025 - Peak loading summer with Okara Centt solar and Sanctioned load in service.

Annex C: Assessment of Bus Voltages.

Annex C-1: Without Okara Cantt solar and with Sanctioned Load In Service.

Annex C-2: With Okara Cantt solar and with Sanctioned Load In Service.

## Annexure-A

Project Specific Data

## Annexure-A-1

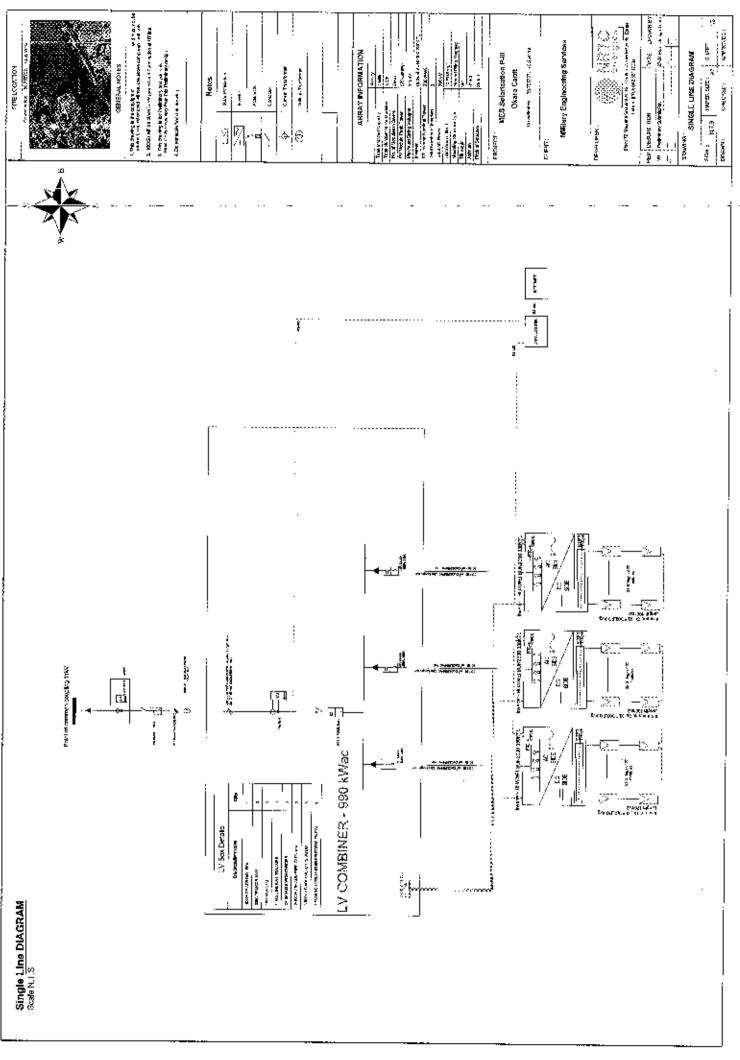
Project Site Map





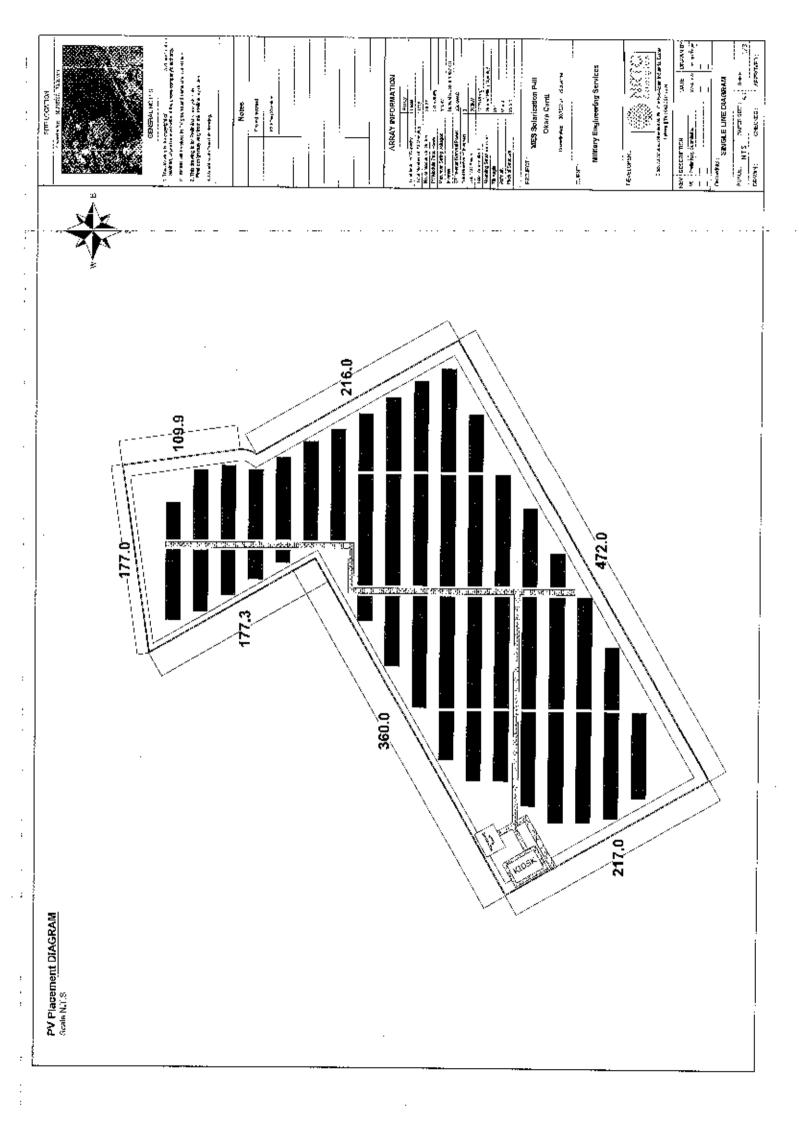
## Annexure-A-2

Power Plant Data

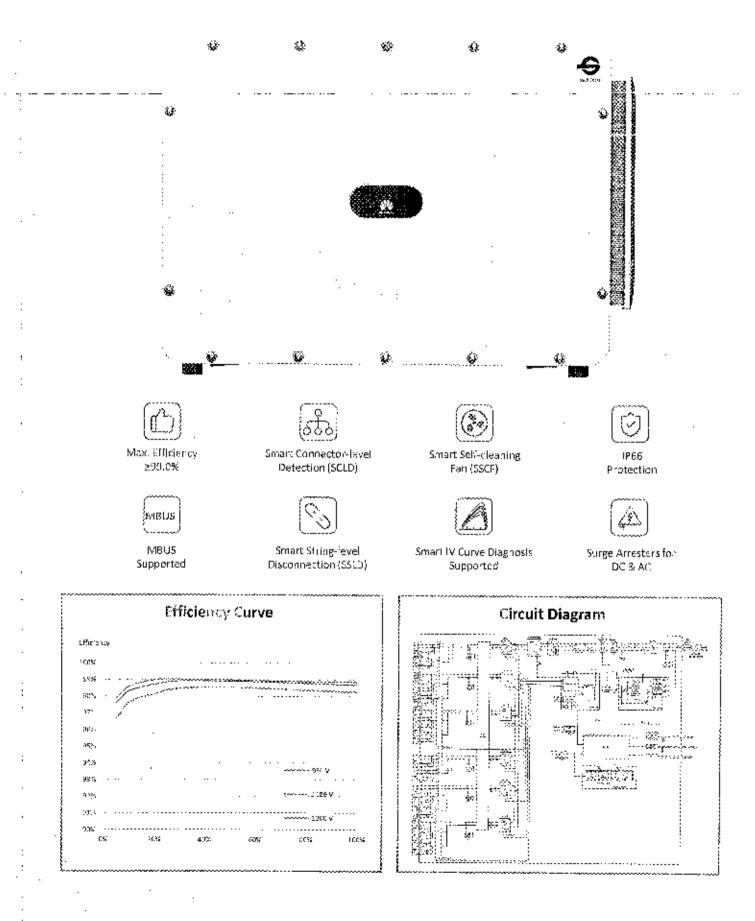


i

:



### SUN2000-330KTL-H1 Smart String Inverter



SOLAR HUAWELCOM

#### SUN2000-330KTL-H1

## **Technical Specifications**

| 299.0%   |
|--|
| ×98.8%   |
| but  |
| 1,500 V  |
|  |
| 55 A   |
| 135A   |
| 4/5/5/4/3/5  |
|  |
| 500 V ~ 1,500 V  |
| 1.080 V  |
| put  |
|  |
| 330,000 VA   |
|  |
| 800 V, 3W - PE   |
| 50 · · 2 / 60 /- 2   |
| 236.EA   |
| 238.2 A  |
| en en la servició de la servició de la servició de la servició de la servició de la servició de la servició de |
| 0.8LS 0 BIC  |
| <1%  |
| sticn  |
| ¥25  |
| Yes  |
|  |
| Yes  |
| Yes  |
| Τγρο ΙΙ  |
| Type I   |
| Yes  |
| Yes  |
| Yes  |
| ication  |
| LED Indicators, WLAN + A2P   |
| Yus  |
| Yes  |
|  |
| ral  |
| 1.048 x 732 x 395 mm   |
|  |
| <11.2 kg<br>-25°C ~66°C  |
|  |
| Smart Air Cooling  |
| 4.000 m (13,123 ft.)   |
| ··· ··· ··· ·· · · · · · · · · · · · ·   |
| G ~ 1:00%  |
| ··· ··· ··· ·· · · · · · · · · · · · ·   |
|  |

## Harvest the Sunshme

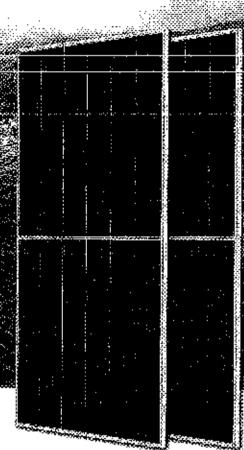
### and a second DEEP BLUE 4.0

Mono

580W n-type Bifacial Double Glass High Efficiency Mono Module JAM72D40 555-580/GB

#### Introduction

Power by the basicst SivEB n-type solar cell, holf-coll configuration and gopless dbbm connuction technology, these modules have higher subput power, lower LHD, better week illumination responde and batter temperature section in .





#### Eligher power generation better LCOE



n-type with very Lower LID







Better weak illumination response



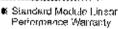
Better Temperature Coefficient

#### Superior Warranty

- 12-year product warranty
- 30-year linear power output warranty.



in-type Bitadial Ocuble Glass Modulo × Linsar Performance Warranty



#### Comprehensive Certificates

- IEC 81215, IEC 81739.
- ISO 9001: 2015 Quality management systems.
- ISO 14691; 2016 Environmental management systems.
- ISO 45001; 2018 Occupational health and safety manugement svetavns
- 85.0 62241: 2019 Terrestrial photovoltaio (PV) modulos -Quality system for PV modulo menufacturing



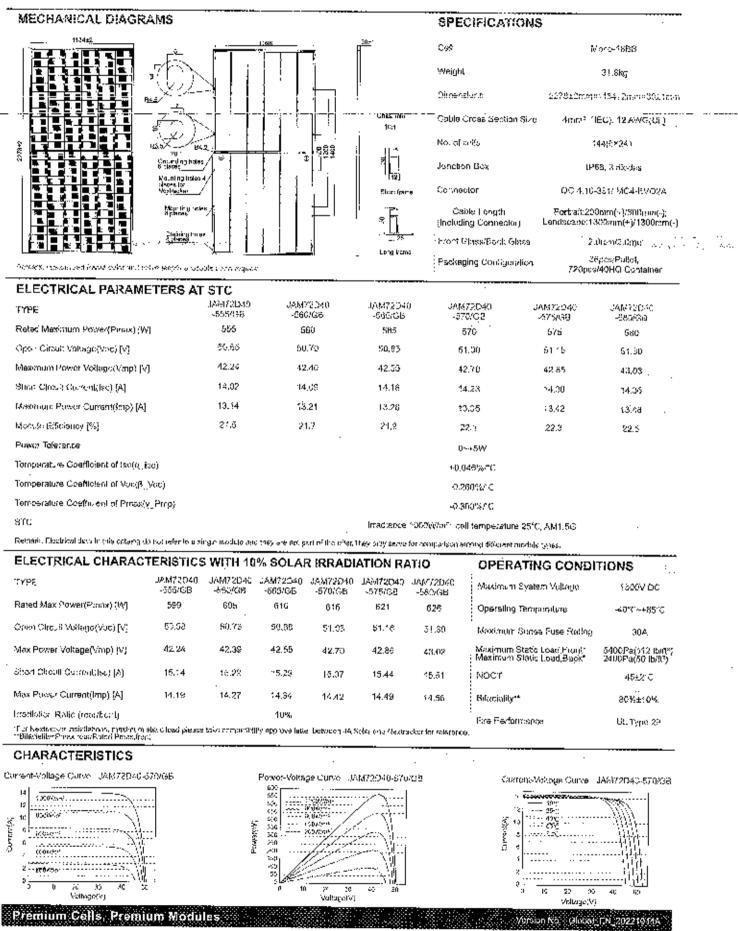
WWW.Jazolat.com





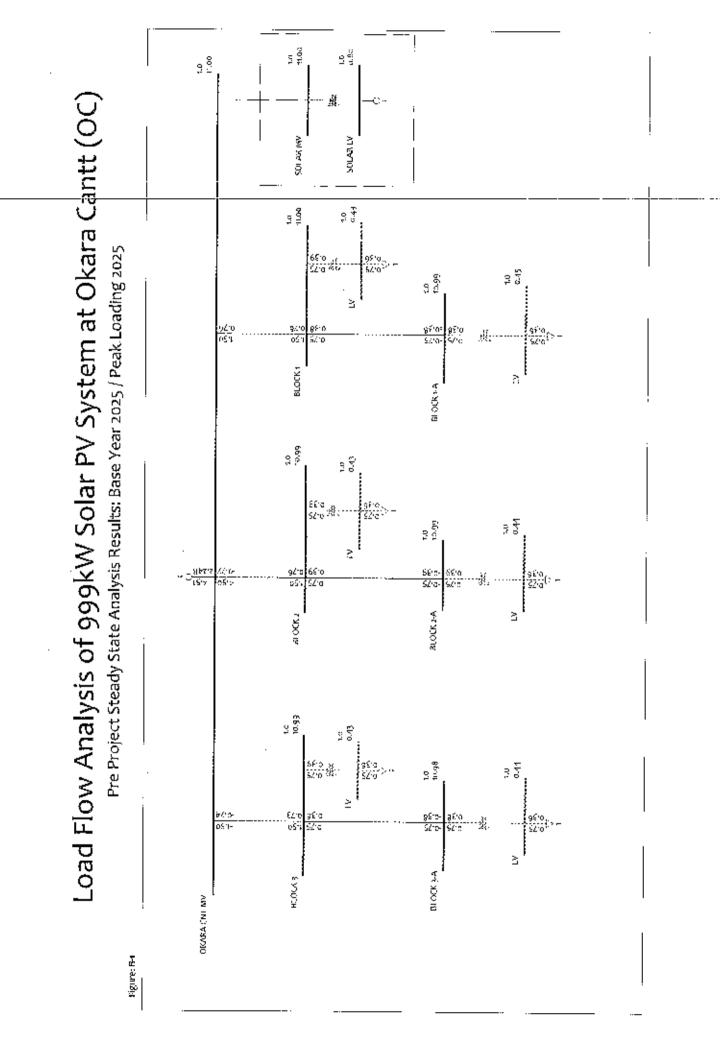


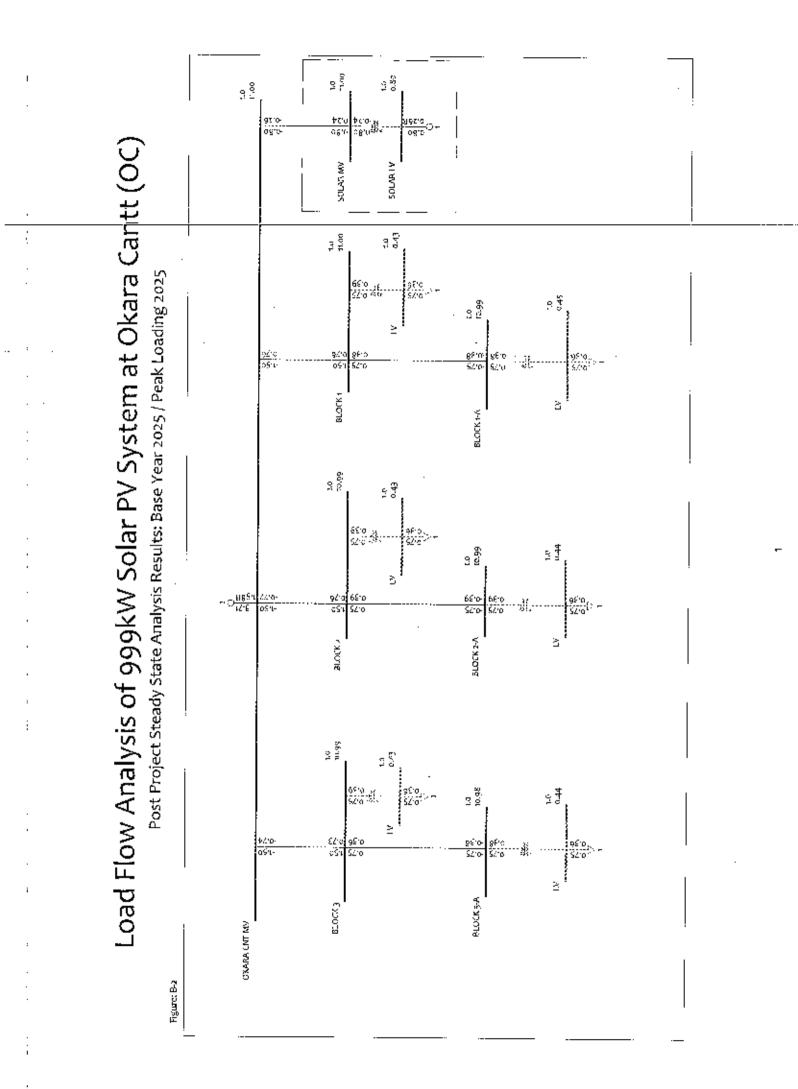
#### JAM72D40 555-580/GB



## Annexure-B

Steady State Analysis Results





## Annexure-C

. ..

Assessment of bus voltages

## Annexure-C-1

## Without Okara Cantt PP and With Sanctioned Load In Service

| X 5000 NUSX RRAA<br>URABORARR 220160 | 1.10V A.45 |      | 950        | 1.0/1                   | INTHS          | X TO 3US                |              | X              |        | _                 |
|--------------------------------------|------------|------|------------|-------------------------|----------------|-------------------------|--------------|----------------|--------|-------------------|
| LAMA                                 | AN/UG ENCE | NGLE | MA/MULK    | NW/MVAR OW/OVAR OW/MVAR | antal/me       | BUSÉ XAH ARAN H         | X BASKV A    | BASKV AREA CAF | NIC.   | VEAM              |
| 4100 OKARA CMT MVC1.000              | é 1.0630   | 0.0  | 4.5        | 0.0                     | Ú°)            |                         |              |                |        |                   |
| 10                                   | 2 II.600   |      | 2.2R       | 0.0                     | 0.0            | CIOCI BLOCK 1           | 11,000       | L<br>Ŀ         | 1.5    | 0.8               |
| 10                                   |            |      |            |                         |                | 41005 3000K 5           | 1.300        |                | 1.5    | 0.S               |
| . [                                  |            |      |            |                         |                | 41005 BL00K 3           | 11.060       |                | 1.5    | 6-3               |
| 41301 BLOCK 1 11,300                 | 4 0.9997   | -0.0 | 0.0        | 0.0                     | 0.0            |                         |              |                |        |                   |
| 0.                                   | 1 IC.596   |      | 0.0        | 0.0                     | 0.0            | ALDA OTARA CNT          | CNE NATI COO | 4<br>1         | -1-2   | -0.8              |
| 1.300LS 53 7                         |            |      |            |                         |                | V1 20015                | 0.4400       | i I<br>V       | 0.7    | 0,4               |
| 2                                    |            |      |            |                         |                | 41003 PJOCK 1-A         | 11.060       | . I<br>N       | 0.1    | Ç.4               |
| 41202 LV C.4600                      | 4 0.9873   | ÷.   | <b>D.C</b> | 0.8                     | . C.O          |                         |              |                |        |                   |
| 1-03003 52 2                         | 1 0.4348   |      | 0.0        | <b>6</b> .0             | C.O            | 4:00, PLOCX :           | 11.CAÚ       | 4<br>7         | C.0-   | <b>+</b> 0 -      |
| (1003 BLOCK 1-A 11,000               | 4606°D \$  | -0.0 | 0.0        | J.C                     | . ງ <b>ໍ</b> ເ |                         |              |                |        |                   |
| 10                                   | 1 10.394   |      | 0-0        | 0.3                     | 0.0            | 41301 3JCCK 1           | 1,000        | <br>7          | -0.1   | й <sup>н</sup> 0- |
| 6.9755K 53 2<br>41064 TV 514400      | 6 1,0136   | -1.3 | 0.0        | 8.0                     | . 0. J         | 41004 V4 20014          | 0.4400       | 4 1            | Ľ.     | 0.4               |
| 1.00000 52 2                         | 1 01446    |      | 0.0        | 5.6                     | 0°C            | 4-1 NOOLE 20015         | 11.200       | -1<br>V        | -0.7   | -i),4             |
| 41005 BLOCK 2 11.000                 | 4 0.0393   | -3.0 | J.C        | 0.0                     | 0.1-           |                         |              |                |        |                   |
| 0.                                   | 1 1C.992   |      | 0.0        | 0.0                     | 0.0            | 4100 DKNFR CNT MV11.000 | 000.11vE     | 4 l            | ил<br> | B.U               |
| 1.3007.7 53 2                        |            |      |            |                         |                | AT 30016                | 6.4400       | 4 J            | 0.7    | ų.4               |

:

:

•

.

: .

;

:

;

. .

;

:

i

· . · · · · -

.....

.

.

.

.

|     |   |                 |          |                   | -               |                   |                       |                 |               |                           |             |                     | .         |                     | ł                |                     | i                        |                        |  |  |
|-----|---|-----------------|----------|-------------------|-----------------|-------------------|-----------------------|-----------------|---------------|---------------------------|-------------|---------------------|-----------|---------------------|------------------|---------------------|--------------------------|------------------------|--|--|
|     |   | 0.4             |          | ÷-0               |                 | ₽'Û-              | 9.6                   | -0.4            |               | -0.7                      | 0.4         | 6,4                 |           | -Ú.4                |                  | <b>F</b> .0-        | 0.4                      | .ŭ.                    |  |  |
| : . | • | . ສຸ<br>ດ       |          | . r.c-            | · 4-            | ອີງ<br>-          | с.<br>С.С.            |                 |               | -1,5                      | 0.7         | C.7                 | . !       | · É'0-              |                  | -0.7                | <br>8''0                 | <br>6.0-               |  |  |
| •   |   | с.<br>519       |          | -                 |                 | : 5               | 4 I                   |                 |               | -<br>5                    |             |                     |           | .T.<br>72           |                  | 4 I                 |                          | н<br>ъ                 |  |  |
|     |   | 1, JOC          |          | CCO.II            |                 | 11.000            | 0.4400                | JOC'T:          |               | 1010                      | C.440C      | 11.003              |           | 000,111             |                  | 11.000              | c_4100                   | 11,000                 |  |  |
|     |   | 21037 BIOCK 2-A | 0.3      | 0.0 41005 BLOCK 2 | ü.ü             | 0.0 41005 3100K 3 | 42008 I.V             | 0.0             | c.o           | 0.0 4100 OX3RA CMC AV1000 | 410010 LV 0 | I W-£ XDOTE IIC(),Y | 0.0       | 0.0 41009 BLOCH 3 1 | 0.0 C.O          | 0.0 41009 BLOCK 3 1 | 450012 LV 3<br>0.0       | C.O 113011 BLOCK 3-A 1 |  |  |
|     |   |                 | 0.8      | 0.4               | 0.0             | 0.1               | 4                     | 8 ~<br>6 6      | 0 U           | 0.0                       |             |                     | ŋ.8       | C.4                 | 0.0              | 0.0                 | 0.8                      | 0.4                    |  |  |
|     |   |                 | 0.0      | 0.0               | 0.0             | 0-D               | :                     | 0,0             | <u>р.с</u>    | 0.0                       |             |                     | 0.0       | 0.0                 | 3.6              | 0.0                 | 0-U                      | 0.1                    |  |  |
| i   |   |                 |          |                   | -0.0            |                   | -                     | +<br>_<br>      | -3.1          |                           |             |                     | -1.4      |                     | -0.1             |                     | 6.0-                     |                        |  |  |
| •   | · |                 | 4 0.9874 | 1 0.4345          | 0699.0 s        | 1 10.932          | 2000 F 10             | - C.4401        | 4 J.5360      | EU0,01 I                  |             |                     | 4 0.387L  | 1 0,4343            | 4 0.985          | 1 10-983            | 4 1,0038                 | 1 0.4427               |  |  |
|     |   |                 | 0.4400   | 52 2              | 2-A 11.000      |                   | 53 2                  | <br>2<br>2<br>2 | ) II.000      |                           | 53 2        |                     | C.4400    | 52 2                | 3-A 11.000       |                     | 28 J<br>0.4400           | . 28                   |  |  |
| :   |   | а<br>10         | 41006 LV | 1,000X            | 41037 BLOCK 2-A | 6 IC .            | С.9894К<br>АГООТ - 27 | MC00C-1         | 41009 BLOCK 3 | 17 20                     | 1001        | 8 10                | 41CAIC JA | ND000.;             | V-S NOOLE IIOOLE | B 1.1               | 0.5381.5 LV<br>410015 LV | 1,00013                |  |  |

: .

i .

.

. .

.

.

.

## Annexure-C-2

. .

.

.

. . . . . . .

: -

. .

## With Okara Cantt PP and With Sanctioned Load In Service

| $K^{*}_{1000}$ $K^{*}_{1000}$ $K^{*}_{10000}$ $K^{*}_{1000000000000000000000000000000000000$   | ž   | FTT INTERACTIVE P<br>UKARAR CANTI SULAR PV SYSTEM | FTI INTER<br>UT SCHAR P | ACTIVE POO | TR SYSTE | ALUMLS X | INTERACTIVE POWIR SYSTEM SIMULATORFS3(F)E<br>Mar PV SYSTEM | 341, F7F 15<br>1873 202<br>18 I. FOR 1 | ZU25<br>FRANSEC<br>VON-FRANSEC | 17:33<br>BRERS<br>MSFORMER                | BILANCING |
|--|---|---|-------------------------|------------|----------|----------|--|--|--------------------------------|---|-----------|
|  | FROM BUSX   |   | •                       | GEN        | d.vo.t   | SHUNT    | OL   |  | Х                              |   |           |
| $ \begin{array}{ c c c c c c c c c c c c c c c c c c c$  | BJS# X XAMEX BASK<br>BJS# X XAMEX BASK<br>TTO ANGLE & RET A |   |                         |            | NK/W/M   | AM/MUAR  | CMARX  | X BASKV A                              | ANA CKI                        | NIN.                                      | EVA4      |
| $ \begin{array}{ c c c c c c c c c c c c c c c c c c c$  | 4100 OKARA CNT NVIL.000                                     | ÷   |                         |            | 0.0      | 0.0      |  |  |                                |   |           |
| $ \begin{array}{c ccccccccccccccccccccccccccccccccccc$   | IC  |   | ų<br>v                  | 7.0R       | J.C      | J.C      | 41001 BLOCK 1  | 1,300                                  |                                | 1.5 <sup>.</sup>                          | 0.8       |
|  | 1   |   |                         |            |          |          | BLOCK  | C)0.II                                 |                                | - 5 - T                                   | 0.8       |
| $ \begin{array}{ c c c c c c c c c c c c c c c c c c c$  | 9   |   |                         |            |          |          | BLOCK  | 000.11                                 |                                | 5.5                                       | 0.7       |
| $ \begin{array}{ c c c c c c c c c c c c c c c c c c c$  | Ų.,   |   |                         |            |          |          | 41.0013 SCLAR PV   | 11.000                                 |                                | :<br>:::::::::::::::::::::::::::::::::::: | -0.3      |
| $n_{10}$ $1$ $10.996$ $3.0$ $0.1$ $u.3$ $3.06$ $3.06$ $3.06$ $3.10$ $1.0$ $0.0$ $1.0$ $1.0$ $0.0$ $1.0$ $0.0$ $1.0$ $0.0$ $1.0$ $0.0$ $1.0$ $0.0$ $1.0$ $0.0$ $1.0$ $0.0$ $1.0$ $0.0$ $1.0$ $0.0$ $1.0$ $0.0$ $1000$ $1.0$ $0.0$ $0.0$ $0.0$ $0.0$ $1.0$ $1.0$ $1.0$ $1.0$ $1.0$ $1.0$ $1.0$ $1.0$ $1.0$ $1.0$ $1.0$ $1.0$ $1.0$   |   |   |                         |            | 9.6      | 0.0      |  |  |                                |   |           |
| $ \begin{array}{ c c c c c c c c c c c c c c c c c c c$  | 13  |   | U                       | 0.0        | 0.0      | 0.0      | ADDE CRARA CMT   | 000-117M                               |                                | - 5° ].                                   | 9°C-      |
| $ \frac{110}{52} = \frac{110}{52} + \frac{1100}{52} + \frac{11000}{52} + \frac{1100}{52} + \frac{11000}{52} + \frac{11000}{52} + \frac{11000}{52} +$ | 53  |   |                         |            |          |          | AT 200.4   | 0.4430                                 | 1                              | 0.7                                       | 0.4       |
| $\frac{1V}{52} = \frac{0.4230}{52} + \frac{3.8378}{10.4326} -1.4 + \frac{0.0}{0.0} + \frac{0.0}{4.300} + \frac{0.0}{10.000} + \frac{10.030}{4} + \frac{10.03}{4} + \frac{10.030}{4} + \frac{10.03}{4} + \frac{10.030}{4} + \frac{10.030}{$                     |   |   |                         |            |          |          | 41003 BLOCK 1-A  | 11.000                                 |                                | 0.7                                       | 0.4       |
| $ \begin{array}{cccccccccccccccccccccccccccccccccccc$  |   | é   |                         | 0.0        | Ó.R      | 0.0      |  |  |                                |   |           |
| DIJOCK 1-A       11.060       1 6.993       -0.0       0.0       0.1       0.1       -1.1       -1.5       -1.1       -1.5       -1.5       -1.5 <td>52</td> <td>0</td> <td>ve</td> <td>0.1</td> <td>0.4</td> <td>0.0</td> <td>REGER</td> <td>11-030</td> <td></td> <td>- 1, 1, -</td> <td>÷-0-</td>   | 52  | 0   | ve                      | 0.1        | 0.4      | 0.0      | REGER  | 11-030                                 |                                | - 1, 1, -                                 | ÷-0-      |
| 1       1       0.1994       0.0       0.0       41001 BLCCK 1       11.000       4       -0.7         LV       53       2       41.0°36       -1.3       0.0       6.8       41064 IV       0.4930       4       1       0.7         LV       53       2       1       1.0°36       -1.3       0.0       6.8       3.0       41064 IV       0.4930       4       1       0.7         52       2       1       1.450       6.0       0.8       3.0       4103 BLCCK 1       1.003       4       1       0.7         52       2       1       1.450       0.0       0.0       0.0       6.0       4100       4       1       0.7         51       2       1       0.0       0.0       0.0       6.0       4100       4       1       -0.7         51       2       10.592       0.0       0.0       6.0       4100       0.0       2       -0.7         51       2       10.2       0.0       6.0       6.0       4100       2       -0.7       -1.5       -0.7         51       2       0.0       6.0       6.0       4100       0.1   |   |   |                         | 0.0        | 3.6      | С.С.     |  |  |                                |   |           |
| 53       2       41064 :/v       0.4930       4 1       0.7         LV       0.4403       41.0°36       -1.3       0.0       0.8       9.0          50       1.0.450       0.0       0.8       9.0            50       2       1.0.450       0.0       0.6       0.6       0.0       4103 ±-000       4.1       -0.7         6LOCK 2       11.000       4       0.3       0.0       0.0       0.0       4100       4.1       -0.7         0       2       10.9       0.0       0.0       0.0       4.1       -1.5       -0.7         0       2       10.992       -0.0       0.0       0.0       4.1       -1.5       -0.7   | 10  | 0.  | ᆌ                       | 0.0        | 0.0      | 0.0      | BLOCK  | 11.0CD                                 |                                | -<br>-<br>-<br>-                          | ÷.5       |
| 50     2     1.0.450     0.0     0.0     41003 ±0000 ± 1.000     2     -0.7       BLOCK 2     11.000     € 0.3993     -0.0     0.0     0.0     6.0     -0.7       0     0     0     0     0     0     4100 02460 CMT 1.000     4     1     -1.5  | 53<br>TA  |   |                         | 0.0        | 0.8      | 0.5      |  | 0.4430                                 |                                | 0.7                                       | 0.4       |
| 2 11.000 € 0.3993 -0.0 0.0 0.0 6.0   |   | 3.6   | _                       | 0'0        | 0.£      | 0.0      |  | 000'II                                 |                                | -0.7                                      | -0.4      |
| 2 10.892 0.0 0.0 0.0 4100 03340 CWZ AVILLOO 4 1 -1.5 -   | C.  | 6.0   |                         | 0.3        | 0.0      | · 0· 0   |  |  |                                |   |           |
|  | 10  | 10,992  | ~                       | 0.0        | 0.0      | 0.0      | 4100 0338A CBT   | WTL.COO                                |                                | - 1-2                                     | -0.3      |

-

-

.

.

!

•

:

:

. . ;

i

.

| 1, JOGLA 52 3                      |           |      |      |        | 41008 TW                    |                     | 004400  | ר<br>ד   | 0.7       | 0.4  |
|------------------------------------|-----------|------|------|--------|-----------------------------|---------------------|---------|----------|-----------|------|
|                                    |           |      |      |        | 41007 BLOOK 2-A             |                     | 1, 1000 | ų l      | . 8.0     | 0.4  |
| 1005 LV 0.44U                      | 4 C.9374  | -1.4 | 0.0  | 9'B    | J.C                         |                     |         |          |           |      |
| 1.000mu 52 2                       | 1 3,4345  |      | 0.0  | 0.≰    | 0.6 410.05 3.00K            | c.                  |         | . 1<br>7 | 1-4-      | -0.4 |
| 41307 BIOCK 2-A 11.030             | 4 (1,9993 | -3,6 | J.C  | 0.0    | ú.J                         |                     |         |          |           |      |
| 15                                 | 1 10,992  |      | 0.0  | 0.0    | 0.0 41005 8LOCK             | Ň                   | 11,000  | 4 1      | . 8'C-    | -0.4 |
| 0.988.4K 53 2<br>2.009 - 27 0 7400 |           | -    |      | 6      | 41.008 TV                   | ċ                   | 0.4430  | 1 1      | . 7.0     | 0.4  |
|                                    | 5 T.UCUA  | -T-J | 0.0  | 8<br>5 |                             |                     |         |          |           |      |
| 1,300'IN 52 2                      | 1090'N .  |      | 0.0  | 9 C    | D.C. CICCT BLOCK            | 2-3                 | :1.300  | <br>     | <br>()−   | -0,4 |
| 41009 BLOOK 3 11.000               | 4 D.996A  | -0.1 | 0.0  | 0.0    | 0.0                         |                     |         |          |           |      |
| 10                                 | 1 10.989  |      | 3,6  | 0.0    | 0.0 4100 OKAR               | CKARA ONT WVLL (000 | , 000   | 4 L      |           | -0.7 |
| 1.0001K 53 2                       |           |      |      |        | AT CIONTR                   | Û.                  | Ú-443Ú  | 4 T      | 0.7       | 0.6  |
|                                    |           |      |      |        | 410011 BLOCK 3-A            |                     | 0001.1  | μ        | 6.0       | 0.4  |
| 4010 EV 0.4400                     | é C.9871  | -1,4 | 0.0  | 63     | 3.C                         |                     |         |          |           |      |
| 1.0000N \$2 2                      | 1 3,4343  |      | 0'0  | 2°4    | 0.0 41039 3400K             | 10                  | 30011.  | . 1<br>7 | -0-7      | -0,4 |
| 410311 BLOCK 3-A 11,000            | 4 0.3965  | -0,1 | 0.0  | 0.0    | 0.00.0                      |                     |         |          |           |      |
| 07                                 | 1 10,983  |      | 0.0  | 0.0    | 0.0 4',009 BLOCX            | m                   | 000-11  | 4<br>1   |           | -0.4 |
| 36<br>76                           |           |      |      |        | A10012 W                    | с<br>С              | 00%F.0  |          | 0.8       | 0.4  |
| 0.44                               | 4 1.0033  | e'0- | 0°0  | 0.0    | 0.0                         |                     |         |          |           |      |
| 1.00005 28 3                       | 1 0.4415  |      | J.C  | 0.4    | 0.0 VICTL BLOCK             | .स.<br>             | 1,000   | .।<br>च  | 8-0-<br>- | 6-j  |
| 412013 SOLAR WV 1.30C              | € 1.0033  | 0.0  | 0.0  | 0.0    | 0.0                         |                     |         |          |           |      |
| -0                                 | 800°.E E  |      | 0.0. | 0.0    | C.O 4103 OSERA CN2 NV11.030 | CNP NV13.           | 000-    | 4 1      | 0.8       | 0.2  |

.

.

÷ į

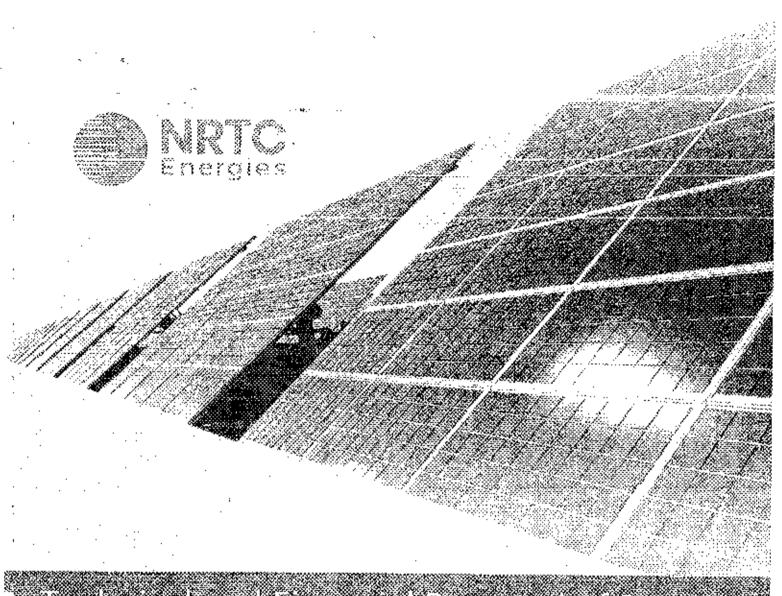
.

| : | -0.2                                   |  |  |
|---|--|--|--|
|   | 8°.0-                                  | <br>ع<br>ب                               |  |
|   | -                                      | า<br>                                    |  |
|   | 3.800C                                 | 2007 T                                   |  |
|   | 40014 SOLAR LV<br>0.0                  | 0.0 £10012 SOLAR MV                      |  |
|   |  | 0 .<br>0                                 |  |
|   | ш<br>г)                                |  |  |
| 1 | 5'U                                    | · .                                      |  |
|   | A 1.0053                               |  |  |
|   | 1.0001K 57 5<br>410014 SOLAR LV 0.8020 | ۲. ۲. ۲. ۲. ۲. ۲. ۲. ۲. ۲. ۲. ۲. ۲. ۲. ۲ |  |

.

• ;

,



## Technical and Financial Proposal of Stativity

Head Office:

72 Block, PECO Road, Lahore – Pakistan

**Regional Offices:** 

Islamabad i Karachi i Peshawar i Quetta i Multan

#### TECHNICAL PROPOSAL

#### Project Rationale:

The Military Engineering Services (MES) in Pakistan has a rich history dating back to the British colonial era. After the independence of Pakistan in 1947, the MES was reconstituted to serve the Pakistan Army. The MES is responsible for providing engineering support to the Pakistan Armed Forces, including construction, maintenance, and repair of military infrastructure.

Apart from the strategic importance of activities carried out by MES and their requirement of reliable electric power, MES is committed to play a notable role in reducing carbon footprints of Pakistan. To achieve the endeavor, MES is determined to meet their electric power demand through Solar energy. For aforementioned purpose, MES engaged NRTC Energies ("The Applicant Company") and their team conducted surveys to the sites of Military Engineering Services (MES) Pakistan and keeping in view their annual energy consumption, a 3.5 MWp Solar PV Solution at five sites (CM11 Lahore, MM Lines Lahore, Akram Lines Lahore, Mahfooz Shaheed Garrison – MSG Lahore and Okara Cantt) in Punjab is proposed. It is anticipated that the project will serve a projected annual production of 5,110,000 kWh/year.

#### Business Model:

The Applicant Company intends to sell electricity to Military Engineering Services (MES) that utilizes electricity for a wide range of functions, primarily powering their operations and infrastructure. This includes tasks like construction, maintenance, and support for military installations, as well as the design and development of electrical and electronic equipment for military use. NRTC Energies ("The Applicant Company") will provide electricity to MES through its own complete on-grid solution of electricity based on solar power (Generating Facilities) under the long-term Energy Purchase Agreements (EPAs).

In this regard, the Applicant Company has conducted financial analysis and found this model to be financially workable if there are long term contracts involved. The Company will therefore, plan, design, procure material, construct, install, operate and maintain Generating l'acilities at sites of the MES Pakistan ("the Buyer"). The NRTC Energies and MES shall be collectively referred as "Parties" herein after.

The Applicant Company shall provide product of the Generation Facilities to the Buyer on terms and conditions as agreed between the Parties so as to recover the cost of investment, working capital, operation and maintenance cost with reasonable rate of return on basis of actual delivery of electricity while taking the risk of shortfall in generation on account of reduction in solar irradiation at its own.

The Applicant Company will install various Generation Facilities at the sites of the Buyer and understands that the activity of generation and sale of electricity shall take place within the same premises (for each site) without crossing any other property or requiring the use of transmission or distribution lines.

The electricity generated through the Generation Facilities of the Applicant Company shall be fed directly into the distribution panel of the Buyer and in no case shall be fed or exported to the distribution system of utility company.

The electricity generated through the Generation Facilities of the Applicant Company shall be less than the total demand of the Buyer, hence, it will not be a replacement for the relevant utility company but only a partial augmentation.

#### Technical Overview:

#### Technology:

2

and the straight of the state

The electricity shall be generated by use of PV Panels to be installed at the premises of the Buyer and will be supplied directly to the Distribution Panel of the Buyer (s). The Solar PV system will operate in grid interactive / grid tied mode. The grid-tie inverter will be used that will convert direct current (TX electricity into alternating current (AC with built in ability to synchronize with a utility line to supplement the electricity required by the buyer from the distribution company.

Grid-tie inverters are also designed to quickly disconnect from the grid if the utility grid will go down and it will ensure that in the event of interruption of electricity from utility, the grid tie inverter will shut down to prevent the energy flow back in the distribution system of the utility. Grid interactive system will supplement utility supplied energy to building or facility. The PV System output will be designed in a manner that it will always be less than the premises load and there will be no export to the utility company's grid.

In case the Buyer subject to NEPRA's permission and agreement with the utility company, opts to export excess electricity to the distribution system through net metering arrangement, then the Applicant Company, on behalf of the Buyer, may provide requisite services.

The PV Panels shall convert the solar irradiation into DC electricity and by using inverters, DC supply will be converted into 3-Phase AC supply of 400/11,000 Volts. In the process, the Applicant will use equipment including:

- PV Modules
- DC, AC Cables

- Mounting structure
- Meters
- Invertors
- Data loggers for Monitoring;
- Surge arrestors
- Internet devices
- Junction Boxes
- Water Network
- Transformer
- Steel Structure
- LV, MV Switchgear
- Screws, Nuts/Bolts

Technical details, Single Line Diagram and flow diagram for each site is attached herewith.

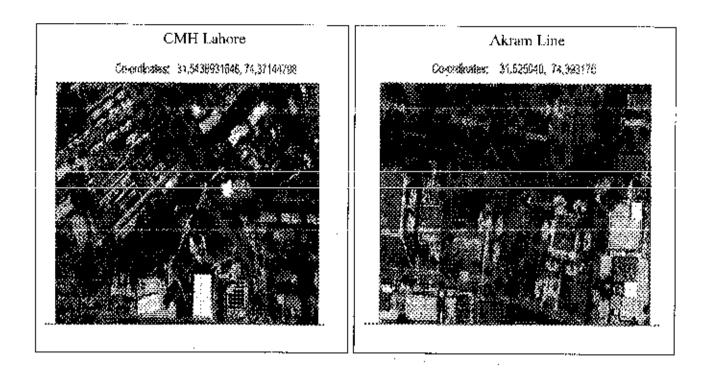
Before the Distribution Panel and after the PV AC Electrical Board there shall be installed the Meter for reading of the actual energy delivered through Generation Facilities of the Applicant Company to the Buyer. DC PV Generation from Modules will be converted to both Single and three Phase AC supply (220V and 400V) by specified inverters. Single and Three phase AC supply will further be transformed to MV system (II kV) by using specified Transformer. The whole capacity of PV plant will fully be utilized by the facility, so there is no need of Net-Metering and export of power to national grid studies and regulations. Further, standardized PV-DG operational technology along with IEC standardized protection schemes will be adopted to control the flow of power towards the national grid system.

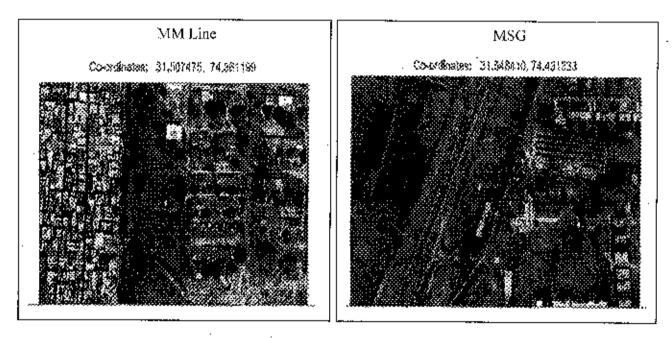
#### Capacity:

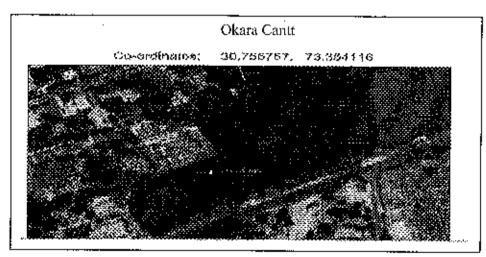
The Applicant Company will deploy Solar PV facilities totaling 3.5 MWp at Buyer sites.

#### Site:

The Generation Facilities to be offered by the Applicant Company shall be at the site premises of the Buyer and therefore the Applicant Company does not require purchasing or acquiring a particular site / land. Moreover, since the electricity generated by the Generation Facilities of the Applicant will not be sold to any electricity utility i.e., DISCO hence it would not require any evacuation by the National Grid Company (NTDC) therefore the mentioning of a particular site is not relevant in this case. However, details of sites are as under;







#### Interconnection:

Since the Generation Facilities of the Applicant Company shall be installed at the sites of the Buyer and shall provide electricity to that premises in order to supplement the electricity requirement of the Buyer therefore, the interconnection point shall also be within the premises of the Buyer at the point as identified by the Buyer. The Applicant Company shall deliver electricity to the Buyer's distribution box/panel at 11 kV level.

#### Commissioning & Expected Life:

The terms as to commissioning shall be as per terms of EPA. However, the average expected life of the Generation Facilities shall be 25 Years.

#### **Operation & Maintenance:**

The Applicant Company shall also provide the operation and maintenance, including periodical washing of the PV modules, of the Generation Facilities installed at the site of the Buyer. Detailed O&M Manual is attached herewith.

#### Monitoring Facilities:

The Applicant Company shall develop, install and maintain a remote monitoring facility at its premises for overall monitoring of the Generation Facilities to be installed at various sites of the Buyer. The Applicant will hire trained staff to carry out maintenance activities on the installed facilities at the Buyer's sites. The Applicant also has a team of qualified engineers to plan and supervise the routine / regular maintenance needs.

#### Eligible Site / Buyer:

The Applicant Company declares the following eligibility criteria for the site / buyer for whom Generation License is required.

- i. Generation Facility to be setup should be within the site of the buyer.
- ii. Electricity generated through the Generation Facility should not be provided to any premises other than the buyer's premises / site where the Generation Facility is installed.
- iii. Electricity from the Generation Facility should be in addition and supplemental to the electricity being obtained from the electric utility company.
- iv. Interconnection point should be within the premises / site where the Generation Facility is installed.
- v. Generation Facility installed should ensure no back flow of electricity to the distribution system of the utility.
- vi. The delivery of electricity from the PV Modules to the distribution Switchgears of the buyer should not require crossing of any public road / area and the distribution network

of the electric company.

÷

.

vii. The buyer should not be a defaulter of dues of electricity obtained from electric utility company.

.

#### Capital Cost:

The Capital cost shall include the cost borne by the Applicant Company on completion of feasibility, planning, designing, material, construction and installation of the Generation Facilities.

The cost of switchgear protection and interconnection with distribution system of utility is included in this case.

The Applicant Company aims to provide the Generation Facilities up to 3.5 MWp in a period of about 04 months, with an estimated cost on per Watt basis is worked out by the Applicant Company as below. The expected cost of the installations under has been estimated to be USS 0.513/Wp. This cost does not include the cost of land as facilities shall be installed at the premises of the Buyer.

| Sr. No. | Description                              | US\$/Wp |
|---------|--|---------|
| 1       | Civil Work                               | 0.095   |
| 2       | EPC                                      | 0.413   |
| 3       | Others<br>(including approvals<br>costs) | 0.005   |
|         | Total                                    | 0.513   |

Item wise break up of project cost is attached herewith.

#### Source of funding:

The applicant company will install a total of 3.5 MWp at stated sites of MES Pakistan in parallel (at once) and will be equity financed with 80:20 ratio.

### Details of Annexure

| Sr. No. | Annexure | Description                    |
|---------|----------|--------------------------------|
| 1       | A1       | MM Line MES 0.5MW Site         |
| 2       | A1.1     | Simulation Report of 0.5MW     |
| 3       | A1.2     | PV Modules Layout              |
| 4       | A1.3     | Single Line Diagram            |
| 5       | A1.4     | BOQ for 0.5MW Site             |
| 6       | A2       | MSG MES 0.5MW Site             |
| 7       | A2.1     | Simulation Report of 0.5MW     |
| 8       | A2.2     | PV Modules Layout              |
| 9       | A2.3     | Single Line Diagram            |
| 10      | A2.4     | BOQ for 0.5MW Site             |
| 11      | A3       | CMH MES 1MW Site               |
| 12      | A3.1     | Simulation Report of 1MW       |
| 13      | A3.2     | PV Modules Layout              |
| .14     | A3.3     | Single Line Diagram            |
| 15      | A3.4     | BOQ for 1MW Site               |
| 16      | A4       | New Akram Lines MES 0.5MW Site |
| 17      | A4.1     | Simulation Report of 0.5MW     |
| 18      | A4.2     | PV Modules Layout              |
| 19      | A4.3     | Single Line Diagram            |
| 20      | A4.4     | BOQ for 0.5MW Site             |
| 21      | A5       | Okara MES 1MW Site             |
| 22      | A5.1     | Simulation Report of 1MW       |
| 23      | A5.2     | PV Modules Layout              |
| 24      | A5.3     | Single Line Diagram            |
| 25      | A5.4     | BOQ for 1MW Site               |
| 26      | B1       | Technical Data Sheets          |
| 27      | B1.1     | PV modules Datasheet           |
| 28      | B12      | Inverter Datasheet             |
| 29      | B1.3     | DC Cable Datasheet             |
| 30      | B1.4     | Protection Modules Datasheet   |
| 31      | B1.5     | Lightening Arrestor Datasheet  |
| 32      | B1.6     | Weather Station Datasheet      |
| 33      | B1.7     | Financial Breakup              |
| 34      | B1.8     | O & M Manual                   |

# Annex A-1



:

## **PVsyst - Simulation report**

Grid-Connected System

Project: MES Lahore (MM Line)

Variant: New simulation variant No 3D scene defined, no shadings System power: 501 kWp Lahore MES (MM Line) - Pakistan



.

I

#### Project: MES Lahore (MM Line)

Variant: New simulation variant

#### PVsyst V7.3.1 VC6, Simulation date: 08/01/24 10:48 wth v7.3.1

| •   |                         | Project s                             | ummary            |                       |  |
|---|-------------------------|---------------------------------------|-------------------|-----------------------|--|
| Geographical Site                             |                         | Situation                             |                   | Project settings      |  |
| Lahore MES (MM Line                           | e)                      | Letitude                              | 31.51 °N          | Albodo                | 0.20                                   |
| Pakisten                                      |                         | 'Longitude                            | 74.36 °E          |                       |  |
|   |                         | Altitude                              | 207 m             |                       |  |
|   |                         | Time zone                             | UTC+5             |                       |  |
| Meteo data                                    |                         |                                       |                   |                       |  |
| Lahore MES (MM Line)                          |                         |                                       |                   |                       |  |
| Meleono <del>m</del> 8.1 (1996-2              | 2015), Sat=100% - Syi   | nthelic                               |                   |                       |  |
|   |                         | System s                              | summary —···      |                       |  |
| Grid-Connected Sy<br>Simulation for year no 1 |                         | No 3D scana defir                     | ned, no shadings  |                       |  |
| PV Field Orientatio:                          | n                       | Near Shadings                         |                   | User's needs          |  |
| Fixed plane                                   |                         | No Shadings                           |                   | Unlimited load (grid) | 1                                      |
| TIIVAzimuth                                   | 26/0°                   |                                       |                   |                       |  |
| System information                            | 1                       |                                       |                   |                       |  |
| PV Array                                      |                         |                                       | Inverters         |                       |  |
| Nb. of modules                                |                         | BĠ4 unite                             | Nb. of units      |                       | 2 units                                |
| Phom total                                    |                         | 501 kWp                               | Pnom total        |                       | 600 kWac                               |
|   |                         |                                       | Phom ratio        |                       | 0,835                                  |
|   |                         | Results s                             | ummary            |                       | ··                                     |
| Produced Energy                               | 593959 kWh/year         | Specific production                   | 1185 kWh/kWp/year | Perf. Ratio PR        | 72.74 %                                |
|   |                         | Table of a                            | contents          | · •                   |  |
| Project and results sum                       | imary                   |                                       |                   |                       |  |
| General parameters, P                         | V Array Characteristic: | s, System losses                      |                   |                       | ·                                      |
| Main results                                  | -                       | · · · · · · · · · · · · · · · · · · · |                   |                       | ×                                      |
| Loss diagram                                  |                         |                                       |                   |                       | ``                                     |
| Predef. graphs                                |                         |                                       |                   |                       |  |
|   |                         |                                       |                   |                       | ······································ |

j

.



#### Project: MES Lahore (MM Line)

#### Variant: Now simulation variant

| PVsyst V7.3,1         |
|-----------------------|
| VC0, Simulation date: |
| 08/01/24 10:48        |
| with v7.3.1           |
|                       |

#### **General parameters Grid-Connected System** No 3D scene defined, no shadings **PV** Field Orientation Orientation Sheds configuration Models used Fixed plane No 3D scene dofined Transposition Perez Tilt/Azlmuth 28/0° Diffuse Perez, Meteororm Circumsolar separate Horizon Near Shadings User's needs Free Horizon No Shadings Untimited load (grid) **PV Array Characteristics** PV module Invertor Manufacturer CSI Solar Menufacturer Huawei Technologios Model CS7L-580MB-AG 1500V Model SUN2000-330KTL-H2 (Original PVsyst database) (Custom parameters definition) Unit Nom, Power 580 Wp Unit Nom, Powor 300 kWac Number of PV modules 864 unite Number of invertors 2 units Nominal (STC) 501 kWp Total power 600 kWac Modules 32 Strings x 27 in series Operating voltage 500-1500 V At operating cond. (50°C) Max. power (=>30°C) 330 kWac Prapp 460 kWp Phom ratio (DC:AC) 0.84 U трр 823 V Power sharing within this inverter I mpp 559 A **Total PV power** Total inverter power Nominal (STC) 501 kWp Total power 600 kWac Total 864 modules Number of inverters 2 units Modulo area 2445 m² Phom ratio 0.84 Array losses Array Solling Losses Thermal Loss factor DC wiring losses Loss Fraction 4.0 % Module temperature according to Irradiance Global arrey res. 24 m·Ω. Uc (const) 29.0 W/m²K Loss Fraction 1.5 % at STC Uv (wind) 0.0 W/m<sup>s</sup>K/m/s Serie Diode Loss LID - Light Induced Degradation Module Quality Loss Voltago drop < 0.7 V Loss Fraction 2.0 % Loss Fraction -0.4 % Loss Fraction 0.1 % at STC Module mismatch losses Strings Mismatch loss Module average degradation Loss Fraction 2.0 % at MPP Loss Fraction 0.1 % Year no 10 Loss factor 0.4 %/year Mismatch due to degradation Imp RMS dispersion 0.4 %/year Vmp RMS dispersion 0.4 %/year IAM loss factor Incidence effect (IAM): User defined profile **1**0° 20° 30° 46° 50° 60° 70° 80° 90° 0.998 0.998 0.995 0.992 0.986 0.970 0.917 0.763 0.000



# Project: MES Lahore (MM Line)

## Variant: New simulation variant

· .. \_ \_

---- .

#### PVsyst V7.3.1 VC0, Simulation dete: 08/01/24 10:48 with v7.3.1

|                            |             | System los               | ises     |   |
|----------------------------|-------------|--------------------------|----------|---|
| Unavailability of the :    | system      | Auxillaries loss         |          |   |
| Time fraction              | 3.4 %       | Proportionnal to Power   | 5.0 W/kW |   |
|                            | 12.4 deys,  | 0.0 kW from Power threst |          |   |
|                            | 3 periods   | Night aux. cons.         | 500 W    |   |
| <b></b> _                  |             | AC wiring lo             | sses     | u |
| Inv. output line up to     | MV transfo  |                          |          |   |
| Inverter voltage           |             | 800 Vac tri              |          |   |
| Loss Fraction              |             | 0.10 % at STC            |          |   |
| Inverter: SUN2000-330M     | TL-H2       |                          |          |   |
| Wire section (2 Inv.)      | - Alu 2 x 3 | x 240 mm²                |          |   |
| Average wires length       |             | 20 m                     |          |   |
| MV line up to injectio     | n           |                          |          |   |
| MV Voltage                 |             | 11 kV                    |          |   |
| Wires                      | Alu 3       | 3 x 95 n1 m²             |          |   |
| Length                     |             | 100 m                    |          |   |
| Loss Fraction              |             | 0.01 % at STC            |          |   |
|                            | ••          | AC losses in tran        | sformers |   |
| MV transfo                 |             |                          |          |   |
| Medium voltege             |             | 11 KV                    |          |   |
| Transformer from Datas     | heets       |                          |          |   |
| Nominel power              |             | 630 kVA                  |          |   |
| Iran Loss (24/24 Connex    | (noi        | 1.00 kVA                 |          |   |
| Iron lose frection         |             | 0.16 % of PNorn          |          |   |
| Copper loss                | :           | 20.00 kVA                |          |   |
| Copper loss fraction       |             | 3.17 % at PNom           |          |   |
| Colfe equivalent resistand | e 3x3       | 32.25 mΩ                 |          |   |

÷



# Project: MES Lahore (MM Line)

#### Variant: New simulation variant

#### PVsyst V7.3.1 VC0, Simulation date: 08/01/24 10:48 with v7.3.1

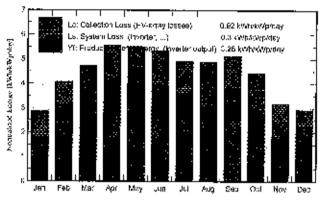
#### Main results

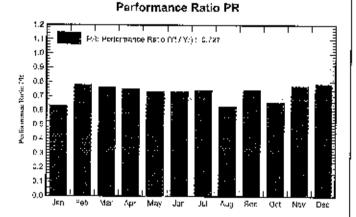
### System Production

Produced Energy (P50) 593959 kWh/yeer Produced Energy (P90) 556330 kWh/yeer Produced Energy (P99) 525662 kWh/yeer Specific production (P50) Produced Energy (P90) Produced Energy (P99)

1185 kWh/kWp/year 1110 kWh/kWp/year 1049 kWh/kWp/year

#### Normalized productions (per installed kWp)





#### Balances and main results

|           | GlobHor                    | DiffHor         | T_Amb    | Globine              | GlobEff     | EArray           | E_Grid            | PR    |
|-----------|----------------------------|-----------------|----------|----------------------|-------------|------------------|-------------------|-------|
|           | kWh/m²                     | kWh/m²          | <b>.</b> | k\\\\\\\\\           | kWh/m²      | kWh              | kWh               | ratio |
| anuary    | 69.8                       | 43.7            | 11.88    | 89,2                 | 84.1        | 37531            | 28331             | 0.634 |
| ebruary   | 92,3                       | 46.7            | 16.09    | 114.0                | 107.7       | 46962            | 44484             | 0.779 |
| March     | 131.6                      | 77.3            | 22.10    | 148,8                | 138.3       | 59265            | 56348             | 0.768 |
| April     | 161.0                      | 87.3            | 27.05    | 186.8                | 157.0       | 65711            | 62574             | 0.749 |
| May       | 176.7                      | . 96.9          | 32.91    | 170.8                | 160.7       | 65704            | 62568             | 0.731 |
| June      | 169.5                      | 100.5           | 32.80    | 160.2                | 150.8       | 61926            | 58956             | 0.735 |
| fuly      | 160.5                      | . 102.3         | 31.45    | 152.3                | 143.1       | 59594            | 56715             | 0.743 |
| August    | 151.5                      | 98.0            | 30.72    | 151.7                | 142.8       | 59490            | 48077             | 0.633 |
| September | 141.8                      | 76,6            | 29.06    | 154.1                | 145.1       | 60591            | 57635             | 0.746 |
| October   | 116.4                      | 68,0            | 25.94    | 136.8                | 129.1       | 54602            | 45298             | 0.661 |
| November  | 77.4                       | 49.9            | 19.09    | \$ <del>8</del> .0 ' | 99.5        | 39361            | 37144             | Q.772 |
| December  | 68.6                       | 41.9            | 13.95    |                      | 85.7        | 38037            | 35830             | 0.786 |
| féar      | 1517.1                     | 887.0           | 24.46    | 1629.4               | 1535,0      | 648681           | 593959            | 0.727 |
| Légends   |                            |                 |          |                      |             |                  |                   |       |
|           | Global horizontal irradia  | ation           |          | EArray               | Effective e | enorav at the pu | tput of the array |       |
| DiffHor   | Horizontal diffuse Irradi  | ation           |          | E_Grid               |             | ected into grid  |                   |       |
| í_Amb /   | Ambient Temperature        |                 |          | PR                   | Performar   |                  |                   |       |
| 3labina   | Global incident In coll. p | lane            |          |                      |             |                  |                   |       |
| SlobEff i | Effective Global, corr. fo | or IAM and shad | lings    |                      |             |                  |                   |       |



-40

- .....

# Project: MES Lahore (MM Line)

Variant: New simulation variant

PVsyst V7.3.1 VC0, Simulation date: 08/01/24 10:48 with v7.3.1

|   |                         | Loss dia        | gram   |   |
|---|-------------------------|-----------------|--|---|
| ſ | 1517 kWh/m²             |                 | Global horizontal irradiation<br>Global incident in coll. plane                  |   |
|   |                         | -1.87%          | IAM factor on global   |   |
|   |                         | \ac%            | Sailing loss fector  |   |
|   | 1535 kWh/m² ^ 2445 m    | ° cail.         | Effective irradiation on collectors  |   |
|   | officiency at STC = 20. | 58%             | PV conversion  |   |
|   | 772638 kWh              |                 | Array nominal energy (at STC effic.)   |   |
|   |                         | -3.80%          | Module Degrectation Loss ( for year #10)   |   |
|   |                         | (+-0.27%        | PV loss due to Imadiance level   |   |
|   |                         | -6.47%          | PV loss due to temperature   |   |
|   |                         | (+0.43%         | Module quality loss  |   |
|   |                         | -2.00%          | LID - Light induced degredation  |   |
|   |                         | V) -4.00%       | Mismatch loss, modules and strings<br>(including 1.9% for degradation dispersion |   |
|   |                         | 4-0.98%         | Ohmle widing loss  |   |
|   | 648681 kWh              |                 | Array virtual energy at MPP  |   |
|   |                         | 9-1.69%         | Inverter Loss during operation (efficiency)                                      |   |
|   |                         | 9 0.00%         | Inverter Loss over nominal lov, power  |   |
|   |                         | 9 0.00%         | Inverter Loss due to max. Input current  |   |
|   |                         | + 0.00%         | leverter Loss over nominal inv. voltage  |   |
|   |                         | ₩ 0.00%         | Inverter Loss due to power threshold   |   |
|   |                         | ¥ 0.00%         | Inverter Loss due to voltage threshold   |   |
|   |                         | 9-0.01%         | Night consumption  |   |
|   | 637660 kWh              |                 | Available Energy at Inverter Output  |   |
|   |                         | 9-0.84%         | Auxiliaries (fans, other)  |   |
|   |                         | <b>∀</b> -0.04% | AC ohmic loss  | 1 |
|   |                         | 9-2.46%         | Medium voltage transfo loss  |   |
|   |                         | 9-0.01%         | MV line ohmic loss   |   |
|   |                         | 13-3.64%        | System unavailability  |   |
|   | 593959 kWh              |                 | Energy injected into grid  |   |

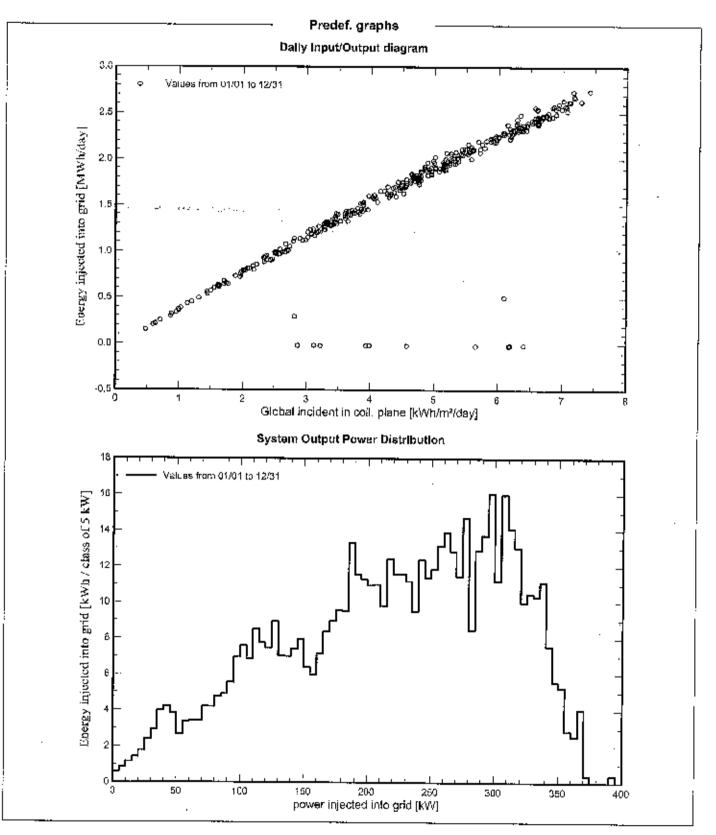
!



# Project: MES Lahore (MM Line)

Variant: New simulation variant

**PVsyst V7.3.1** VC0, Simulation date: 08/01/24 10:48 with v7.3.1





# Project: MES Lahore (MM Line)

#### Variant: New simulation variant

#### PVsyst V7.3.1 VCD, Simulation date: 08/01/24 10:48 with v7.3.1

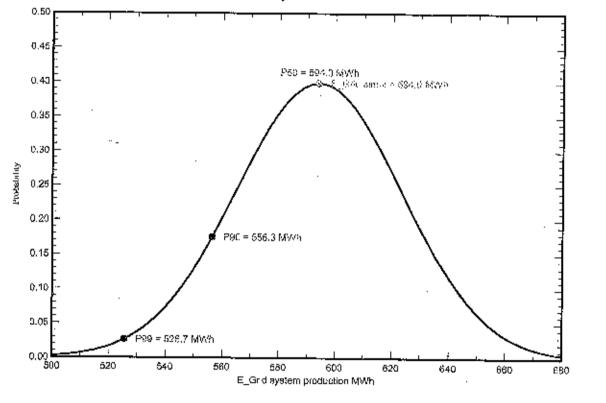
|           |                             |              | P50 - P90 ev |
|-----------|-----------------------------|--------------|--------------|
| Meteo d   | lata                        |              |              |
| Source    | Meteonorm 6.1 (1996-2016)   | ), Set=100%  |              |
| Kind      |                             | ily averages |              |
| Synthetic | - Multi-year average        | -            |              |
| Year-to-y | ear variability(Variance)   | 4.6 %        |              |
| Specified | d Deviation                 |              |              |
| Climate o | hango                       | 0.0 %        |              |
| Global v  | /ariability (meteo + syster | n)           |              |
|           | (Quadratic sum)             | 4,9 %        |              |
|           |                             |              |              |

en langer in the

# P50 - P90 evaluation

| Simulation and parameters uncer    | tainties  |
|------------------------------------|-----------|
| PV module modelling/parameters     | 1.0 %     |
| Inverter efficiency uncertainty    | 0.5 %     |
| Solling and mismatch uncertainties | 1.0 %     |
| Degradation uncertainty            | 1.0 %     |
| Annual production probability      |           |
| Varlability                        | 29.3 MWh  |
| P50                                | 594,0 MWh |
| P90                                | 556,3 MWh |

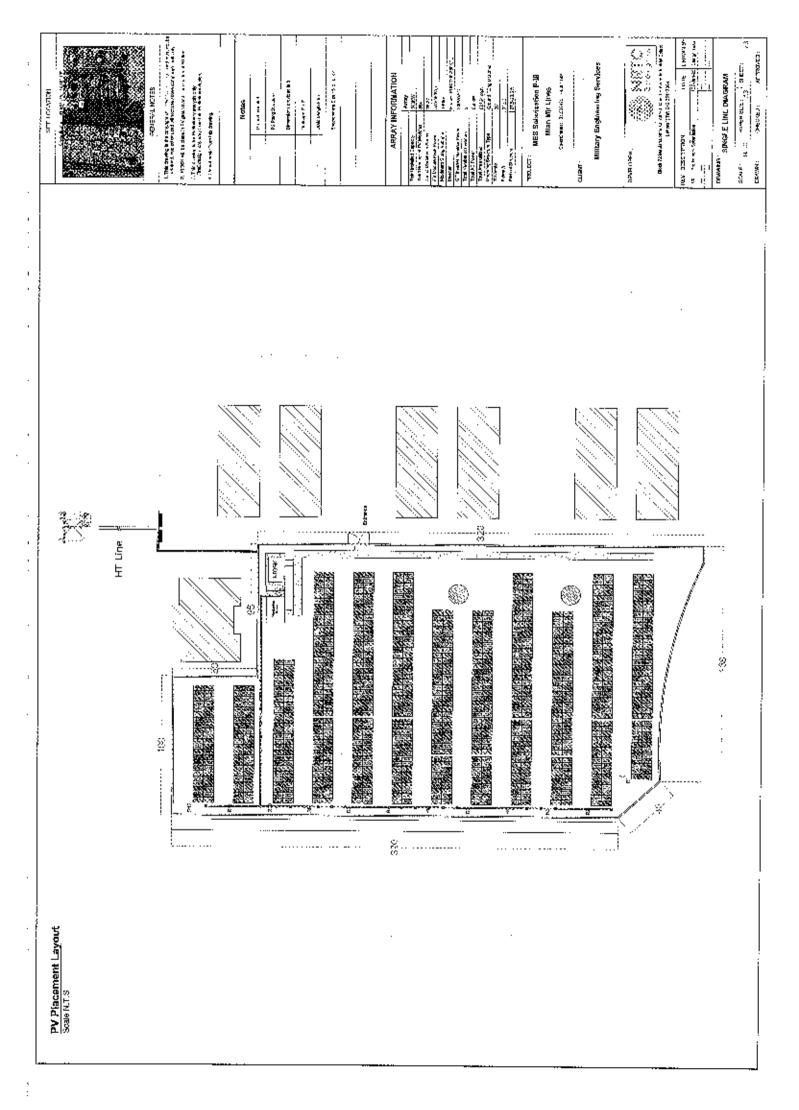
525,7 MWh

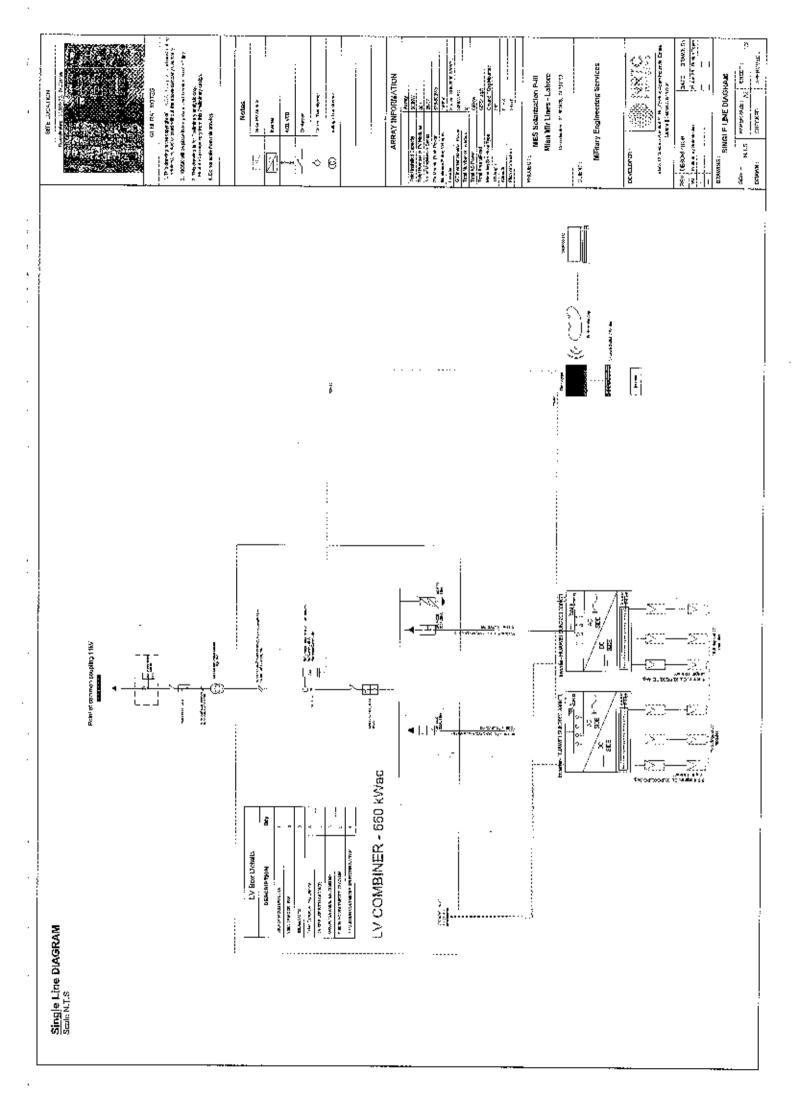


# Probability distribution

P99

#### 08/01/24





| SP 14 | jing .  | Specifications   | ្រំណា  | Q.         | e Att de and make   | LOCALIMAORTED | Con 10051-0010-50  |
|-------|---|--|--------|------------|---|---------------|--------------------|
|       |   |  |        |            |   |               | Cooling 3, 50 rank |
| - 67  |   | SOL  | AR SY  | STEM CO    | MPONENTS  |               |                    |
|       | <u></u>   | 590Ws Tier-1 Difacial  |        | <u></u>    | ·····   |               |                    |
|       | Solar PV Modules<br>(*2 years product & 25 years<br>performance warranty)   | Meno Milypa<br>Technology raving<br>efficiency_22.5%   | ٩г     | 954        | N-lypa Bifadal 680 w - JA; China  | Imported      | China              |
|       | Solar PV hyertene (S  | 330KVA heving  |        | 1          |   |               |                    |
| 2     | years warany)<br>w/// W/ Dongle   | efficiency of 99,03% wch :<br>bult⊧in SPC at DC ace<br>AC Side   | Nr     | 2          | Huswel 350 kT., ; China   | , mpuried     | Colha              |
| з     | Cate ogger (Five<br>yvers werranty)   | Dataloggenfor<br>communication   | N-     | 1          | Husiwe Smart Logger 2000A ;<br>China  | Іперлас       | Chris              |
| .4    | Weather sonsors set   | Whether sensers set<br>(temp, wind, irrediation<br>etc) compatible with the<br>system as per RFP   | Set    | 1          | ;7 Sensors ; Huawa  | Imported      | Chira              |
| 5     | Salar PV mounting<br>structure as non RH <sup>a</sup>   | Solar PV mounting<br>structure as per REF<br>complete with CMI and<br>Mechanics work as per<br>crawing approved by<br>jeansuitant                                  | doL    | <br>,      | Concrete Pile Structure - 150cm/r<br>  PAX STAN - General<br>Construction Mechanics | Lazzi         | Pêkiêları          |
| ð     | Splet PV Celles<br>as per IHC stendard 50618 OR<br>IEC 62560 (10 years warranly<br>.0<br>case of Locel Cable)                               | Singe to 6 4nnnsqrpv<br>Cable tested at 1.5KV<br>withstanding at 120<br>Degree X, PE/XLPO<br>msdalider must be<br>compliant went BC<br>standard IEC<br>Eventschitz | m      | 1          | , Panstan Cables  | Lecal         | ¶Pa∢slan           |
| 7     | AC Cables from (rearbors to<br>K OSK and liten from KOAK to<br>point of concest vity  | Thrue Core 1 20 mm/8q<br>Cu, AC cable(Inverter Ic<br>I V)<br>Three Core MV 95<br>.mm/8q A0, AC cable<br>(KIC66K to point of<br>.commetions)                        | . ac.  | 1          | Pakiston Ceb/ee   | Local         |                    |
| Ē     | KIOSK compact station   | I.V & de Fenel 2 x 320A<br>MCC3 800Vote and<br>1 x 630A<br>AC3.Transformet 630<br>XVA, HT Side Panel<br>630A VC5   | Sei    | 1          | l'ieriq Electric  | .aca'         |                    |
| â     | Serthing Sytem at DC and AC<br>side separate with material<br>drilling upto water level, and<br>lebour sa per BOQ approved by<br>consultant | Complete Earthing whiti<br>pure depaier roe, pappar<br>electrodes having less<br>than 3 Ohm earth<br>rosistance  |        | 1          | NRTC FNERGIES   | Local         | <br>Pacsian        |
| -0    | 'Lightaning Arrestors   | ESE (Early Stroamer<br>Enticeion) Lightening<br>Protection System as<br>per RFP.   | h.r    | 1          | CONTRASO CESE LIGHTEN NG<br>TERMINAL  | Imported      | l'uskey            |
| 11    | Feroing for protection of Plant   | Fonding wall for<br>protection from animals<br>and theft,  | , locu | <i>4</i> . | NRTO ENERGIES   | Local         | Fakistan           |
| 12    | Control Room  | Well-equipped Contro<br>room with LED and<br>Furniture   | Job    | 1          | Signatura Arch test   | _008          | Pekielan           |
| 13    | SCADA   | Scada system for<br>Monifering and Control<br>as per RFP<br>Spocifications   | Jak    | 1          | licss   | Lecal I       | -akistan           |
| 14    | Land preparation  | Dealis removal,<br>desning, leveling,<br>psving, wakweys,<br>roundstionel making land<br>mady tor SPP.   |        | ;          | NRTO E NERCORES   |               | Pakisten           |
| 15    | Frongy Maler  | 29207  | -03    | 1          | WicroStar   | mportest (    | hlua               |
| 18    | Sludies, approvals and permits  | All studies approvats and<br>pomnts required as per<br>authoritios in Pakistanise  |        | 1          |   |               | okizten            |

# Schedule-II - BOQ FOR\_0.5\_MWp for SITE Name\_Lahore Site-3 (MM Line)\_

٦

.

:

# Annex A-2

.

.

. •

.

.

ì

.

÷

:

· .



# **PVsyst - Simulation report**

Grid-Connected System

Project: Lahore MES (MSG) Variant: New simulation variant No 3D scene defined, no shadings System power: 501 kWp Lahore MES (MSG) - Pakistan



.

I

# Project: Lahore MES (MSG)

Variant: New simulation variant

- -----

#### PVsyst V7.3.1 VC0, Simulation date: 08/01/24 10:33 with v7.3.1

|  |                       | Project s           | summary —            |                       |          |
|--|-----------------------|---------------------|----------------------|-----------------------|----------|
| Geographical Site                              |                       | Situation           |                      | Project sattings      |          |
| Lahore MES (MSG)                               |                       | Latitude            | 31.55 °N             | Alberto               | 0.20     |
| Pakistan                                       |                       | Longitude           | 74.43 <sup>°</sup> E |                       |          |
|  |                       | Altitude            | 210 m                |                       |          |
|  |                       | Time zone           | UTC+5                |                       |          |
| Meteo data                                     |                       |                     |                      |                       |          |
| Lahore MES (MSG)                               |                       |                     |                      |                       |          |
| Meteonorm 8.1 (2016-2                          | 021), 5at≃100% - Syr  | nthetic             |                      |                       |          |
|  |                       | System s            | ummary —             |                       |          |
| Grid-Connected Sys<br>Simulation for year no 1 |                       | No 3D scene defin   | ed, no shadings      |                       |          |
| <b>PV Field Orlentation</b>                    | 1                     | Near Shadings       |                      | User's neods          |          |
| Fixed plano                                    |                       | No Shadings         |                      | Unlimited load (grid) |          |
| Till/Azimuth                                   | 26/0°                 | _                   |                      |                       |          |
| System Information                             |                       |                     |                      |                       |          |
| PV Array                                       |                       |                     | Inverters            |                       |          |
| Nb. of modules                                 |                       | 864 units           | Nb. of units         |                       | 2 units  |
| Pnom total                                     |                       | 501 kWp             | Pnom total           |                       | 600 kWac |
|  |                       |                     | Pnom ratio           |                       | 0.835    |
|  |                       |                     | ummary —             |                       | ·        |
| Produced Energy                                | 589756 kWh/year       | Specific production | 1177 kWh/kWp/year    | Parl. Ratio PR        | 72.60 %  |
|  | · · · •               | Table of c          | contents             |                       |          |
| Project and results sum                        | mary                  |                     |                      |                       |          |
| General parameters, PV                         | Array Characteristics | a, System losses    |                      |                       |          |
| Main results                                   | -                     |                     |                      |                       |          |
| .oss diagrem                                   |                       |                     |                      |                       |          |
| Predel, crautis                                |                       |                     |                      |                       |          |
| a  |                       |                     |                      |                       | ·····    |

:



PVsyst V7.3.1 VC0. Simulation date: 08/01/24 10:33 with v7.3.1

# Project: Lahore MES (MSG)

### Variant: New simulation variant

....

|   |                     | General                          | parameters —             | ~ ~                         |       |
|---|---------------------|----------------------------------|--------------------------|-----------------------------|-------|
| Grid-Connected Sys                                | stem                | No 3D scene de                   | fined, no shadings       |                             |       |
| PV Field Orientation                              | 1                   |                                  |                          |                             |       |
| Orientation                                       |                     | Sheds configurati                | ion                      | Models used                 |       |
| Fixed plane                                       |                     | No 3D scene defin                | ed                       | Transposition Perez         |       |
| Till/Azimuth                                      | 26/0 *              |                                  |                          | Diffuse Perez, Meleonorm    |       |
|   |                     |                                  |                          | Circumaotar separate        |       |
| Horizon   |                     | Near Shadings                    |                          | User's needs                |       |
| Free Horizon                                      |                     | No Shadings                      |                          | Unlimited load (grid)       |       |
| ·   |                     | PV Array C                       | haracteristics –         |                             |       |
| PV module   |                     | PV Allay Q                       |                          |                             |       |
| Manufacturar                                      |                     | 001.0.1                          | Inverter                 |                             |       |
| Model   | (107) 5             | CSI Solar                        | Manufacturer             | Huawel Technologie:         |       |
|   |                     | 80MB-AG 1500V                    | leboM                    | SUN2000-330KTL-H            | 2     |
| (Original PVsyst dat                              | aoasoj              | 500.146                          | (Custom paramete         | •                           |       |
| Unit Norr, Power                                  |                     | 580 Wp                           | Unit Nom, Power          | 300 kWac                    |       |
| Number of PV modules.                             |                     | 864 units                        | Number of inverters      | 2 units                     |       |
| Naminel (STC)<br>Madulus                          |                     | 501 kWp                          | Total power              | 600 kWac                    |       |
| Modules   | -                   | х 27 Iл series                   | Operating voltage        | 500-1600 V                  |       |
| At operating cond. (50<br>Price                   | "CJ                 |                                  | Max. power (=>30°C)      | 330 kWao                    |       |
| Ρηφρ<br>1   |                     | 460 kWp                          | Pnom ratio (DC:AC)       | 0.84                        |       |
| U mpp   |                     | 823 V                            | Power sharing within t   | his inverter                |       |
| Ι πρα   |                     | 559 A                            |                          |                             |       |
| Total PV power                                    |                     |                                  | Total Inverter powe      | er                          |       |
| Nominel (STC)                                     |                     | 501 kWp                          | Total power              | 600 KWac                    |       |
| Total   |                     | 864 modules                      | Number of inverters      | 2 units                     |       |
| Module area                                       |                     | 2445 m²                          | Pnom retio               | 0.84                        |       |
|   | • <b></b>           | Array                            | losses                   |                             |       |
| Array Solling Losse                               |                     | Thermal Loss fa                  |                          | DC wiring losses            |       |
| Loss Fraction                                     | 4.0 %               |                                  | e according to imadiance | Global array res. 24 mΩ     |       |
|   |                     | Uc (const)                       | 29,0 W/m²K               | Loss Fraction 1.5 % at      | I STC |
|   |                     | Uv (wind)                        | 0.0 W/m²K/m/s            |                             |       |
| Serie Diode Loss                                  |                     | LID - Light Induc                | ed Decradation           | Module Quality Loss         |       |
| Valtage drop                                      | 0.7 V               | Loss Fraction                    | 2.0 %                    | Loss Fraction: -0,4 %       |       |
| LORS Fraction                                     | 0.1 % at STC        |                                  |                          |                             |       |
| Module mismatch lo                                | •                   | Strings Line-t-                  | h 1                      |                             |       |
| loss Fraction                                     | 2.0 % at MPP        | Strings Mismatc<br>Loss Fraction |                          | Module average degradation  |       |
| -coa i neomati                                    | 2-0 70 GUWH 1       | сова повеција                    | 0.1 %                    | Yearno 10                   |       |
|   |                     |                                  |                          | l.oss factor 0.4 %/ye       | aar   |
|   |                     |                                  |                          | Mismatch due to degradation |       |
|   |                     |                                  |                          | Imp RMS dispersion 0.4 %/ye |       |
|   |                     |                                  |                          | Vmp RMS dispersion 0.4 %/ye | аг    |
| <b>AM loss factor</b><br>noidence effect (IAM); U | ser defined profile |                                  |                          |                             |       |
|   |                     |                                  | ·                        |                             | _     |
| 10" 20'   | ° 30°               | 40" !                            | 59° 60°                  | 70° 80°   90°               |       |
| 0.998 0.99  | 0.995               | 0.992 Q                          | .986 0.970               |                             |       |



# Project: Lahore MES (MSG)

## Variant: New simulation variant

#### PVsyst V7.3.1 VC0, Simulation date: 08/01/24 10:33 with v7.3.1

|                            |            |                          | ses —    |                                       |  |
|----------------------------|------------|--------------------------|----------|---------------------------------------|--|
| Unavailability of the      | system     | Auxiliarías loss         |          |                                       |  |
| Time fraction              | 3.4 %      | Proportionnal to Power   | 5.0 W/kW |                                       |  |
|                            | 12.4 days, | 0.0 kW from Power thresh | ۱,       |                                       |  |
| -81                        | 3 parioria | Night eux, cons.         | 500 W    |                                       |  |
|                            |            | AC wiring la             |          | · · · · · · · · · · · · · · · · · · · | ······································ |
| Inv. output line up to     | MV transfo |                          |          |                                       |  |
| Inverter voltage           |            | 800 Vac tri              |          |                                       |  |
| Loss Fraction              |            | 0.10 % at STC            |          |                                       |  |
| Inverter: SUN2000-330k     | TL-H2      |                          |          |                                       |  |
| Wire section (2 Inv.)      | Alu 2 x 3  | x 240 mm²                |          |                                       |  |
| Average wires length       |            | 20 m                     |          |                                       |  |
| MV line up to injectio     | m          |                          |          |                                       |  |
| MV Voltage                 |            | 11 KV                    |          |                                       |  |
| Wires                      | Copper 3   | 3 x 95 mm²               |          |                                       |  |
| Length                     |            | 100 m                    |          |                                       |  |
| Loss Fraction              |            | 0.01 % at \$TC           |          |                                       |  |
|                            |            | AC losses in tran        | sformers |                                       | ··                                     |
| MV transfo                 |            |                          |          |                                       |  |
| Medium voltaga             |            | 11 KV                    |          |                                       |  |
| Transformer from Datas     | heets      |                          |          |                                       |  |
| Nominal power              |            | 630 kVA                  |          |                                       |  |
| Iron Lass (24/24 Connex    | ion)       | 1.00 kVA                 |          |                                       |  |
| from loss fraction         |            | 0.16 % of PNom           |          |                                       |  |
| Copper loss                | 2          | 20.00 RVA                |          |                                       |  |
| Copper loss fraction       |            | 3.17 % et PNom           |          |                                       |  |
| Colls equivelent resistanc | æ 3x3      | 32.25 mΩ                 |          |                                       |  |



# Project: Lahore MES (MSG)

## Variant: New simulation variant

PVsyst V7.3.1 VC0, Simulation date: 08/01/24 10:33 with v7.3.\$

#### Main results

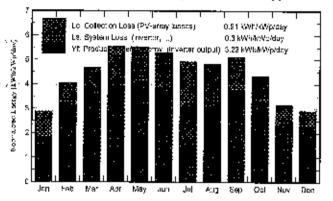
#### System Production

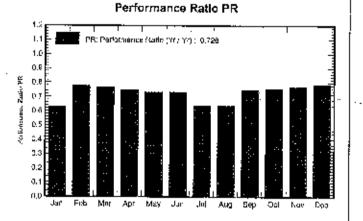
Produced Energy (P50) 589756 kWh/vear Produced Energy (P90) 541853 kWh/year Produced Energy (P99) 502448 kWh/year

Specific production (P60) Produced Energy (P90) Produced Energy (P99)

1177 kWh/kWp/year Performance Ratio PR 72.60 % 7081 kWh/kWp/year 1003 kWh/kWp/year

#### Normalized productions (per installed kWp)





|                | GlobHor               | DiffHor           | T_Amb  | Glabine  | GlobEff                         | EArray           | E_Grid j           | PR    |
|----------------|-----------------------|-------------------|--------|--|---------------------------------|------------------|--------------------|-------|
|                | kWh/m²                | kVVh/m²           | °C     | ; <wh m²<="" th=""><th>kWh/m²</th><th>kWh</th><th>kW/h</th><th>retio</th></wh> | kWh/m²                          | kWh              | kW/h               | retio |
| January        | 69.8                  | 42.4              | 11.54  | 89.6   | 84.5                            | 37686            | 28413              | 0.63  |
| February       | 91.8                  | 46.6              | 15.8B  | 113.2  | 107.0                           | 46619            | 44159              | Q.77  |
| March          | 130.8                 | 79.4              | 21.92  | 145.3  | 137.0                           | 58713            | 55820              | D.76  |
| April          | 160.4                 | 87.8              | 26,96  | 166.0  | 156.3                           | 65390            | 62279              | 0.749 |
| May            | · 176.0               | 100.0             | 33,05  | 171.4  | 161.3                           | 66009            | 62669              | 0.732 |
| Juno           | 168.2                 | 101.7             | \$2.90 | 158.7  | 149.3                           | 61304            | 58385 I            | 0.734 |
| July           | 160,4                 | 100.6             | 31.45  | 152.9  | 143.9                           | 59650            | 48865              | 0.63  |
| August         | 150.4                 | 97.5              | 30,68  | 150.0  | 141.2                           | 58865            | 47968              | 0.63  |
| September      | 141.1                 | 7 <del>9</del> .3 | 28.86  | j 153.9  | 144.5                           | 50336            | 57400              | 0.741 |
| October        | 115.5                 | 72.9              | 25.81  | 134.3  | 126.7                           | 53619            | 50928              | 0.75  |
| November       | 76.7                  | 49.6              | 18.79  | 95.6   | 90.1                            | 39211            | 97010              | 0.772 |
| December       | 68.8                  | 42.1              | 1,3.61 | 90.6   | 85.5                            | 37888            | 35679              | 0.786 |
| Year           | 1509.6                | 900.0             | 24.33  | 1620,9   | 1527.1                          | 645291           | 589756             | 0.726 |
|                |                       |                   |        | !  |                                 |                  |                    |       |
| Legends        |                       |                   |        |  |                                 |                  |                    |       |
|                | al horizontal irvadia |                   |        | EArray   | <ul> <li>Effoctive e</li> </ul> | anergy at the ou | ulput of the array | ,     |
| Diffutor Horiz | contal diffuse irrada | ation             |        | E_Grid   | l Energy inj                    | ected into grid  |                    |       |

PR.

Performance Ratio

# Balances and main results

T, Amb

Globine

GIODEIT

Ambient Temperaturo

Global incident in coll. plane

Effective Global, corr. for IAM and shadings

Page 5/8



;

# Project: Lahore MES (MSG)

### Variant: Now simulation variant

**PVsyst V7.3.1** VC0, Simulation date: 08/01/24 10:33 with v7.3.1

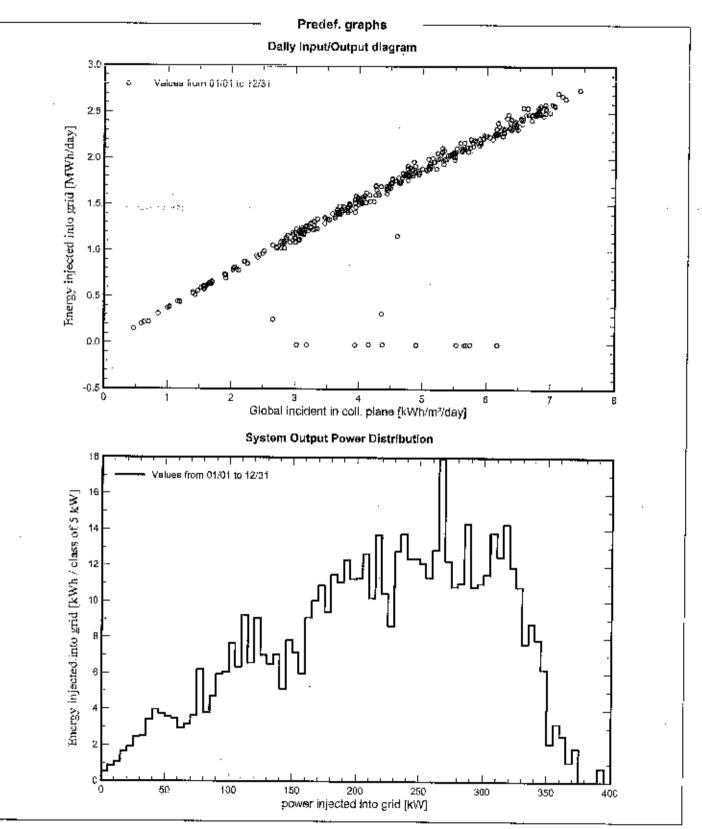
| 1510 kWh/m²                            | Global horizontal irradiation  |
|--|--|
|  | .4% Global Incident in coll. plane   |
| 14-1.8                                 | 16% IAM factor on global   |
| 4.0                                    | 0% Soiling loss factor   |
| 1527 kW0/m² * 2445 m² coll.            | Effective irradiation on collectors  |
| efficiency at STC = 20.58%             | PV conversion  |
| ······································ | Array nominal enorgy (at STC effic.)   |
| -3.809                                 |  |
| 9-0.28%                                | PV loss due to irradiance level  |
| 5.39%                                  | PV loss due to temperature   |
|  | Module quality loss  |
| -2.00%                                 | LID - Light induced degradation  |
| 4.10%                                  | Mismutch loss, modules and strings<br>(including 2% for degradation dispersion |
| Å+-0.97%                               | Ohmic wiring loss  |
| 845291 kWh                             | Array virtual energy at MPP  |
| 9-1.69%                                | Inverter Loss during operation (efficiency)                                    |
| ₩ 0.00%                                | inverter Lose over nominal inv. power  |
| N 0.00%                                | Inverter Loss due to max. Input current  |
| ₩ 0.00%                                | Inverter Loss over nominal inv. voltage  |
| ₩ D.DB%                                | Inverter Loss due to power threshold   |
| ¥ 0.00%                                | Inverter Loss due to voltage threshold   |
| 9-0.01%                                | Night consumption  |
| 634331 kWh                             | Available Enorgy at Inverter Output  |
| 9 -0.84%                               | Auxilíaries (fans, other)  |
| N-0.04%                                | AC ohmic loss  |
| -2.48%                                 | Medium voltago transfo loss  |
| ¥ 0.00%                                | MV line of mic loss  |
| 3-3.83%                                |  |
| 589756 kWh                             | System unavailability<br>Energy injected into grid                             |



Project: Lahore MES (MSG)

Variant: New simulation variant

PVsyst V7.3.1 VC0. Simulation dete: 08/01/24 10:33 with v7.3.1





# Project: Labore MES (MSG)

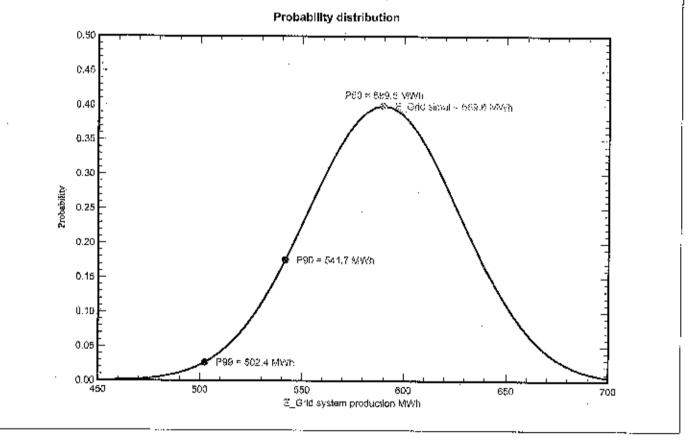
#### Variant: New simulation variant

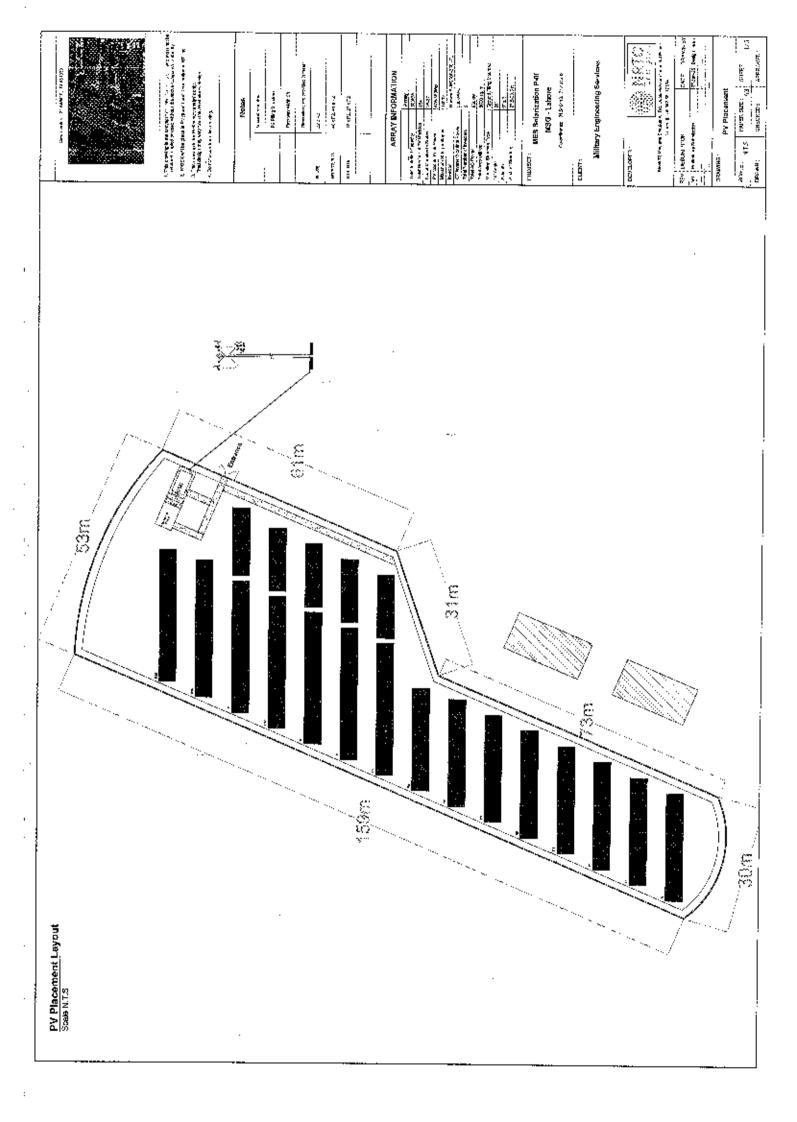
**PVsyst V7.3.1** VC0, Simulation dete: 06/01/24 10:33 with v7.3.1

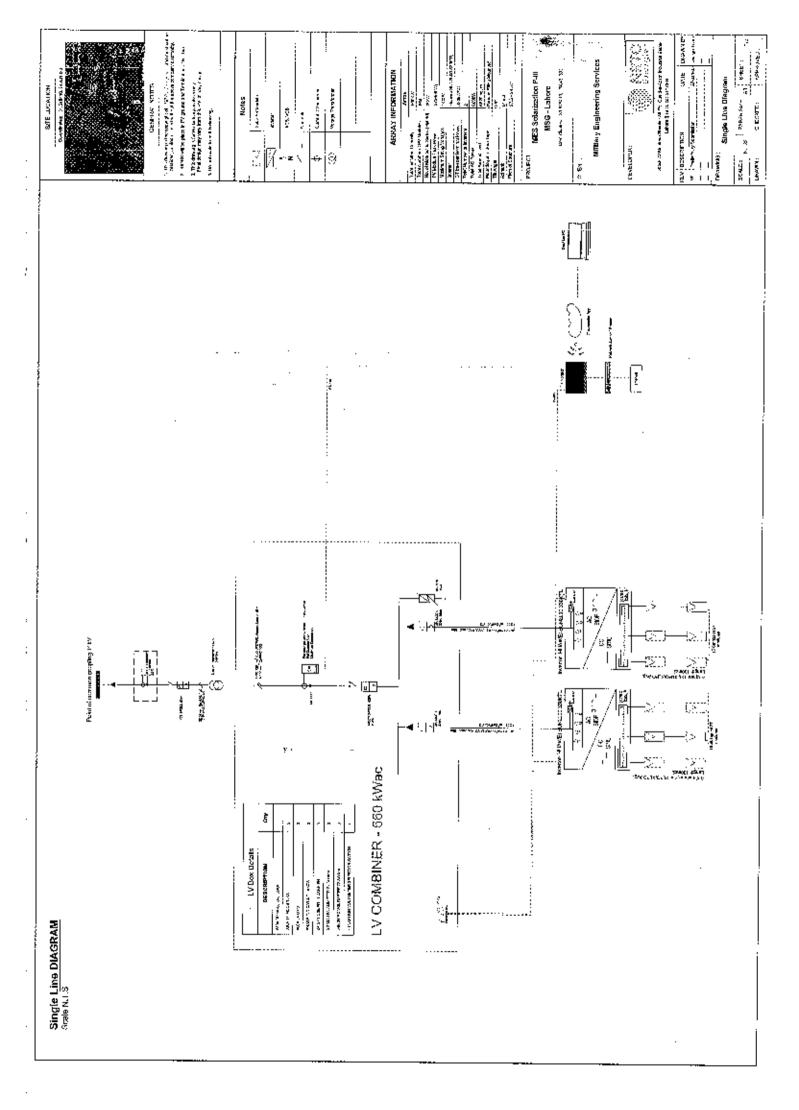
| Source    | Meteonorm 8.1 (2016-2021),             | Sat=100%    |
|-----------|--|-------------|
| Kind      |  | everages    |
| Synthetic | <ul> <li>Multi-year average</li> </ul> |             |
| Year-to-y | ear variability(Variance)              | 6.1 %       |
| Specifica | Deviation                              |             |
| Climate d | hange                                  | D.D %       |
| Globaí v  | /ariability (mateo + system)           | 1           |
|           | (Quedratic sum)                        | ,<br>17.4 % |

#### P50 - P90 evaluation

| Simulation and parameters unce<br>PV module modelling/parameters  | 1.0 %                           |
|---|---------------------------------|
| Inverter efficiency uncertainty                                   | 0,5 %                           |
| Soiling and mismatch uncertainties                                | 1.0 %                           |
| Degradation uncerteinty   | 1.0 %                           |
|   |                                 |
| Annual production probability                                     |                                 |
|   | 37.5 MW                         |
| Variability   |                                 |
| <b>Annual production probability</b><br>Variability<br>P50<br>P90 | 37.5 MW<br>589.8 MW<br>541.7 MW |







| Sy Ne      | lleri   | Specifications   | Umb            | (Jh)    | Moreat and apples  | LOCALITMPORTE | Country of Or |
|------------|---|--|----------------|---------|--|---------------|---------------|
|            |   | so   | lar sy         | STEM CO | MPONENTS:  |               |               |
| ı          | Solar 2V Koduces<br>(172 years product & 2b years<br>partomishice wairenty)   | S80V(): Tier-1 DPacial<br>Mont N Type Technolog<br>having officiality_22 5%  | y Nr           | 881     | h-lype B facat 590 w-vA. China   | mporter       | Chine         |
| 2          | Sular FV Inventers (3 years<br>warranty)<br>with With Dongle  | <ul> <li>330KVA heVirg efficiency</li> <li>c) 93.63% with built-or</li> <li>SPD al DC and AC Side</li> </ul>   | y<br>Nr        | 2       | HUSING SJC KTL ; CMIR  | Importation   |               |
| 3          | Datalogger (Flye<br>years warranty)   | Datalogger for<br>communication  | N <sup>r</sup> | 1 1     | Husiyel Smart Logger SCEOA ;<br>Clainz   | Imported      | China         |
| 4          |   | Woether sensors cell<br>(leng, wind, irrediation<br>etc) competible with the<br>system as per F.FP   | 84             |         | 7 senserar Huawei  | Imporied      | China         |
| 5          | Solar HV mounting<br>etucture as per RF⊃  | Soler PV mounting<br>structure as per RFP<br>complete won Colliand<br>Medianical work as per<br>crawing opproved by<br>cansultant.                                   | chi            | 1       | Concrete Pile Structure   160km/hr  <br>PAIdSTAN - General Construction<br>Mechanics | Locel         | Pakistan      |
| 9          | Solar IPV Cables<br>as per IPO standard S0519 OR<br>IEC 82830 (10 years warranty in<br>case of Local Cable)                                 | Single Core 4min.Sq. 2V<br>Cablo tostad at 1,5KV<br>will standing at 120<br>Degree XLPE: XLPC<br>nsulation must be<br>obligitant with IEC<br>standers' EC 62230.2017 | Jab            | 1       | Pakistan Garios  | .508'         | Pakistan      |
| 7          | AC Cables from Invertere Ic<br>K OSK and than from KIOSK to<br>point of connectivity  | Thrac Gree 120 (hol Sq<br>Cu, AC cap etimotral to<br>LV)<br>"hree Cara MV 95 minSq<br>Al, AC cable (KICSK to<br>point of connecticity)                               |                | 1       | Pakstan Çațieș   | Local         | Pakstan       |
| в          | KICSK compact elision   | LV Side Paner 2 x 320A<br>MOCE, 300Volts and<br>1 x 680A<br>ACB Transformor 530<br>(VA, HT Side Panes 630A<br>VOB  | 5न             |         | , Terq Elactic   | Local         | Pekistan      |
| 9          | Earthing Sylam at DC and AC<br>sub-soperate with meterial,<br>drilling upts water level, and<br>labour as par BOC approved by<br>consultant | Complete Reithing with<br>pure pappenrad, conpen-<br>electrodes having leas<br>than 8 Ohm earch<br>registance.   | دەر            | 1       | NRTČ EN ERČIES   | Local         | Paosian       |
| 14         | Lightening Americans  | E6E (Early Streamer<br>Errission) Jightening<br>Protection System as<br>per REP.   | Nr             | 3       | CONTRA60 CESE LIGHTENING   | Imported      | Тижеу         |
| 11         | Férraing für oralection of Plant  | Ferraing wall for<br>protection (rom entimate<br>and that  | ₩αb            | 1       | NRTC ENERGIPS  | Local         | <br>Paksian   |
| 2          | Control Room  | Wail-eqt(pped Control<br>room with LED and<br>FutriBute  | Job            | 1       | Signaltus Archilect  | Local         | Pøklstan      |
| 3          | SCADA   | Scada system for<br>monifoling and Control as<br>per RFP Specifications  | dat            | 4       | licss  | l coaj        | Pakstan       |
| <br>د<br>ا | Lanc preparation  | Debris removal, disaning,<br>leveling, paving<br>walkways foundations,<br>making isnd ready for<br>SPP.  | .'as           | 1       |  |               | Pakistan      |
| 5          | Energy Meter  | 8050T  | Jcb            | 1       | MicroStar  | inteq         | China         |
| ō          | Bluttes, are reversed and requile   | All Bladles approvals and<br>pomots required as per<br>authorities in Pakistan as [  | Jeb            |         | NRTC ENERGIES  | <br>Losa      | Pakistan:     |

.

# Annex A-3



# **PVsyst - Simulation report**

Grid-Connected System

Project: Lahore Mes (CMH)

Variant: New simulation variant No 3D scene defined, no shadings System power: 1001 kWp Lahore MES (CMH) - Pakistan

Author



# Project: Lahore Mes (CMH)

### Variant: New simulation variant

#### PVsyst V7.3.1 VCD, Simulation date: 08/01/24 10:37 with v7.3,1

|  |                         | Project s   | ummary                                   |   | •                            |
|--|-------------------------|---|--|---|------------------------------|
| Geographical Site<br>Lahore MES (CMH)<br>Pakistan              |                         | <b>Situatio</b> n<br>Latitud <del>e</del><br>Longitude<br>Allitude<br>Time zone | 81.54 °N<br>74.37 °E<br>210 m<br>UTC+5   | Project settings<br>Albedo                  | n <b>2</b> 0                 |
| <b>Meteo data</b><br>Lehore MES (CMH)<br>Meteonorm 8.1 (1996-2 | 2015), Sat=100% - Sy    | nthetic   |  |   |                              |
|  |                         |   | ummary                                   | •••   | ····                         |
| Grid-Connected Sys<br>Simulation for year no 1                 |                         | No 3D scene defin   | ed, no shadings                          |   |                              |
| <b>PV Field Orientation</b><br>Fixed plane<br>Tilt/Azimuth     | n<br>2670 °             | Near Shadings<br>No Shadinga  |  | <b>User's neods</b><br>Unlimited load (grið | )                            |
| System information<br>PV Array                                 |                         |   | Inverters                                |   |                              |
| Nb. of modules<br>Priom total                                  |                         | 1726 prits<br>1001 kWp  | Nb. af unite<br>Prom totel<br>Pram ratio |   | 3 units<br>900 kWac<br>1.112 |
|  |                         | Results s   | ummary                                   | ·····.                                      |                              |
| Produced Energy  | 1201970 kWh/year        | Spacific production   | 1201 kWh/kWp/year                        | Perf. Retio PR                              | 73.94 %                      |
|  |                         | Table of a  |  |   |                              |
| General parameters, PV   | / Arrey Characteristic: | s, System losses  |  |   | 3                            |
| Main results<br>Loss diagrani                                  |                         |   |  |   | 5<br>0                       |
| P50 - P90 evaluation   |                         |   |  |   | ·····                        |



# PVsyst V7.3.1 VC0, Simulation dato: 08/01/24 10:37 with v7.3.1

# Project: Lahore Mes (CMH)

Variant: New simulation variant

- --

|                              | General                   | parameters —–                                |  |
|------------------------------|---------------------------|--|--|
| Grid-Connected System        | No 3D scene de            | fined, no shadings                           |  |
| PV Field Orlentation         |                           |  |  |
| Orientation                  | Shada configurati         | οπ   | Models used                            |
| Fixed plane                  | No 3D scene defin         | ed   | Transposition Perez                    |
| Till/Azimuth 2670            | •                         |  | Diffuse Perez, Meleonorm               |
|                              |                           |  | Circumsolar separate                   |
| Horizon                      | Near Shadings             |  |  |
| Free Horizon                 | No Shadings               |  | User's needs                           |
|                              | No onadinga               |  | Unilmited lose (grid)                  |
|                              | PV Array C                | haracteristics                               | ······································ |
| PV module                    | •                         | Inverter                                     |  |
| Manufacturer                 | CSI Solar                 | Manufacture/                                 | Line and the state of the state        |
| Model                        | CS7L-580MB-AG 1500V       | Manaracturer<br>Mođel                        | Huawol Technologies                    |
| (Original PVsyst database)   | 5615 5KAN 1346 1360Y      |  | SUN2000-330KTL-H2                      |
| Unit Nom, Powor              | 580 Wp                    | (Custom peramete<br>Unit Nom, Power          | -                                      |
| Number of PV modules         | 1726 units                |  | 300 kWaq                               |
| Nominal (STC)                |                           | Number of inverters                          | 3 Unite                                |
|                              | 1001 kWp                  | Total power                                  | 900 kWac                               |
| Array #1 - PV Array          | ·                         |  |  |
| Number of PV modules         | 8៥8 units                 | Number of Investors                          | 8 * MPPT 17% 1.3 unlt                  |
| Nominal (STC)                | 503 kWp                   | Total power                                  | 400 kWac                               |
| Modules                      | 31 Strings x 28 In series |  |  |
| At operating cond. (50°C)    |                           | Operating voltage                            | 500-1600 V                             |
| Ртрр                         | 463 kWp                   | Max. power (=>30°C)                          |  |
| U трр                        | 854 V                     | Pnom ratio (DC:AC)                           | 1.26                                   |
| І трр                        | 542 A                     | No Power sharing bet                         |  |
| Array #2 - Sub-array #2      |                           | -  |  |
| Number of PV modules         | 858 units                 | Number of inverters                          |  |
| Nominal (STC)                | 498 kWp                   |  | 10 * MPPT 17% 1.7 units                |
| Modules                      | 33 Strings x 26 In series | Total power                                  | 500 kWac                               |
| At operating cond. (50°C)    | aa quinge x 20 m senus    | Onerflerent                                  | <b></b>                                |
| Pinpp                        | 157 MAIN                  | Operating voltage                            | 500-1500 V                             |
| нарр<br>И трр                | 457 kWp<br>702 V          | Max. power (≂>30°C)<br>Coorr matic (⊐C. a c) | 330 kWac                               |
| о тър<br>Глур                | 793 V                     | Priomiratio (BC;AC)                          | 1.00                                   |
| LIL PR                       | 577 A                     | No Power sharing betw                        | VCGN MPPTe                             |
| Total PV power               |                           | Total Inverter powe                          | ÷r                                     |
| Nominal (STC)                | 1001 kWp                  | Total power                                  | 900 kWac                               |
| Total                        | 1726 modules              | Number of inverters                          | 3 units                                |
| Module area                  | 4885 m²                   | Phom ratio                                   | 1.11                                   |
|                              |                           | No Power sharing                             |  |
|                              | Arrav                     | losses                                       | ,,,,                                   |
| Array Soiling Losses         | Thermal Loss fac          |  | Sector Diada I                         |
| Loss Fraction 4.0 9          |                           | according to irradiance                      | Sarie Diode Loss                       |
| 4.0                          | Ue (canst)                | 29.0 W/m²K                                   | Voltage drop 0.7 V                     |
|                              | Uv (wind)                 | 29.0 W/m²K/m/s<br>0.0 W/m²K/m/s              | Loss Fraction 0.1 % at STC             |
|                              |                           |  |  |
| LID - Light Induced Degradat |                           |  | Module mismatch losses                 |
| Loss Fraction 2,0 %          | 6 Loss Fraction           | -0.4 %                                       | Loss Fraction 2.0 % at MPP             |

.

ļ

| 100 |
|-----|

.

.

# Project: Lahore Mes (CMH)

Variant: New simulation variant

**PVsyst V7.3.1** VC0, Simulation date: 08/01/24 10:37 with v7.3.1

| — <del>"</del>                                 |                   | An                 | ay losses                          | • n                                   |
|--|-------------------|--------------------|------------------------------------|---------------------------------------|
| Strings Mismatch loss<br>Loss Fraction         | 0.1 %             | Year no            | ge degradation<br>10               |                                       |
|  |                   | Loss factor        | 0.4 %/year                         |                                       |
|  |                   | Mismatch due to    |                                    |                                       |
|  |                   | Imp RMS dispers    | •                                  |                                       |
|  |                   | Vn₂p RMS dianer    | sion (1,4 %/year                   |                                       |
| IAM loss factor<br>Incidenco offect (IAM); Use | r đefinad profile |                    |                                    |                                       |
| 10° 20°  | 36^               |                    | 50° 60° 70°                        |                                       |
| 0.998 0.998                                    | 0.995             | 0.992              |                                    |                                       |
| 0.000  | 0.000             | 0.332              | .0.986                             | <u> </u>                              |
|  |                   |                    |                                    |                                       |
| ·  |                   | DC w               | Iring losses                       |                                       |
| Global wiring resistance                       | 10 mΩ             |                    | -                                  |                                       |
| Loss Fraction                                  | 1.5 % at STC      |                    |                                    |                                       |
| Array #1 - PV Array                            |                   |                    |                                    |                                       |
| Global array res.                              |                   | 26 mΩ              | Array #2 - Sub-array #2            |                                       |
| Loss Fraction                                  |                   | 1.5 % at STC       | Global array res.<br>Loss Fraction | 23 mΩ                                 |
|  |                   |                    |                                    | 1.5 % at STC                          |
| ·  |                   | Svet               | em losses                          |                                       |
|  | - <b>-</b>        |                    |                                    |                                       |
| Unavailability of the sys<br>Time fraction     |                   | Auxiliaries los    | —                                  |                                       |
| time racion                                    | 3.4 %             | Proportionnal to P |                                    |                                       |
|  | 12.4 days,        | 0.0 kW fram Pow    |                                    |                                       |
|  | 3 periods         | Night aux, cons,   | 500 W                              |                                       |
|  |                   | AC wi              | ring losses                        | · · · · · · · · · · · · · · · · · · · |
| Inv. output line up to M                       | V transfo         |                    |                                    |                                       |
| Inverter voltage                               | T Mulliolo        | 800 Vac tri        |                                    |                                       |
| Loss Fraction                                  |                   | 0.08 % at STC      |                                    |                                       |
| Inverter: SUN2000-330KTL                       | -H2               |                    | Inverter: SUN2000-330KTL-H:        |                                       |
| Wire section (1 /nv.)                          |                   | k 240 mm²          | Wire section (2 Inv.)              | د<br>Ału 2 x 3 x 150 mm²              |
| Wires length                                   |                   | 20 m               | Average wires length               |                                       |
|  |                   | 23 11              | Averege wirds length               | 0 m                                   |
| MV line up to injection                        |                   |                    |                                    |                                       |
| MV Voltage                                     |                   | 11 KV              |                                    |                                       |
| Wires  | - Alu 3 x         | 4120 mm²           |                                    |                                       |
| Length   |                   | 100 m              |                                    |                                       |
| Loss Fraction                                  |                   | 0.02 % at STC      |                                    |                                       |
|  | <u>.</u>          | AC losses          | in transformers —                  |                                       |
| MV transfo                                     |                   |                    | -                                  |                                       |
| Medium voltage                                 |                   | 11 kV              |                                    |                                       |
| Transformer from Datashe                       | ets               |                    |                                    |                                       |
| Nominal power                                  |                   | 1250 kVA           |                                    |                                       |
| Iron Loss (24/24 Connexion                     |                   | 1.0D kVA           |                                    |                                       |
| Iron loss fraction                             | -                 | 0.08 % of PNom     |                                    |                                       |
| Copper loss                                    |                   | 0.00 KVA           |                                    |                                       |
| Coppor loss fraction                           |                   | 1.60 % at PNom     |                                    |                                       |
| Colls equivaient resistance                    |                   | 8.19 mΩ            | ·                                  |                                       |
|  |                   |                    | <b>_</b>                           |                                       |
|  |                   |                    |                                    |                                       |



.

÷

# Project: Lahore Mes (CMH)

#### Variant: New simulation variant

PVsyst V7.3.1 VC0, Simulation date: 08/01/24 10:37 with v7.3.1

#### Main results

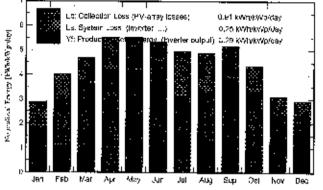
#### System Production

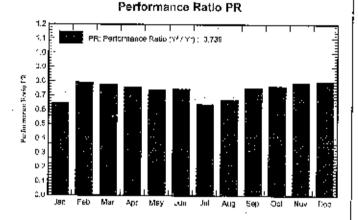
Produced Energy (P50) 1201970 kWh/yeer Produced Energy (P90) 1103932 kWh/year Produced Energy (P99) 1024030 kWh/year

Produced Energy (P90) Produced Energy (P99)

Specific production (P50) 1201 kWh/kWp/year Performance Ratio PR 73.94 % 1103 kWh/kWp/year 1823 kWh/kWp/year

# Normalized productions (per installed kWp)





#### Balances and main results

|              | GlobHor                     | DiffHor      | T_Amb | Globinc     | GlobEff             | EArray .             | PR       |
|--------------|-----------------------------|--------------|-------|-------------|---------------------|----------------------|----------|
|              | kWh/m²                      | kWh/tŋ²      | °C    | kWh/m²      | kWh/m²              | kWh                  | ratio    |
| January      | 69.8                        | 43.8         | 11.97 | B9.2        | 84.1                | 75051                | 0.648    |
| February     | 01.5                        | 47.0         | 16.08 | . 112.8 -   | 106.6               | 93022                | 0,793    |
| March        | 130.8                       | 77.5         | 22.10 | 145.7       | 137.2               | 117704               | 0.779    |
| April        | 160.2                       | 87.6         | 27.05 | 165.9       | 156.2               | 130724               | 0.760    |
| May          | 176.0                       | 99.4         | S3.10 | 171.5       | 161.5               | 132088               | 0.742    |
| June         | 169.5                       | 102.6        | 33.65 | 160.2       | 150.7               | 124093               | 0.747    |
| July         | 160.6                       | 102.3        | 31.57 | 153.2       | 144.1               | 119956               | 0.641    |
| August       | 151.4                       | 85.3         | 30.79 | 151.6       | 142.7               | 118810               | 0.675    |
| September    | 141.5                       | 71.5         | 29.07 | 154.5       | 145.6               | 121017               | 0.755    |
| October      | 115.7                       | 69.5         | 26.00 | 135.2       | 127.6               | 107744               | 0.768    |
| November     | 76.5                        | 52.0         | 19.07 | 93.4        | 88.0                | 76644                | 0.788    |
| December     |                             | . 41.9       | 13.92 | 90.7        | 85.5                | 75726                | 0.801    |
| Year         |                             | 890.5        | 24,52 | 1623.8      | 1529.9              | 1292479              | 0.739    |
| Legends      |                             |              |       |             |                     |                      |          |
| GlobHar Glo  | bai horizontal Irradiation  |              |       | EAiyay Effe | ctive energy at the | e output of the arra | 67       |
| Dl:'Hor Hori | izontal diffuse Irradiation |              |       | •           | formance Ratio      | o ouper er int arra  | <i>y</i> |
| T_Amb Amb    | bient Temporature           |              |       |             |                     |                      |          |
|              | bal incident In coll. plane |              |       |             |                     |                      |          |
|              | ctive Global, corr. for IAM | and shodings |       |             |                     |                      |          |



Γ

.

:

.,

# Project: Lahore Mes (CMH)

Variant: New simulation variant

Loss diagram

\_ \_

**PVsyst V7.3.1** VC0, Simulation date; 08/01/24 10:37 with v7.3.1

|                          |                             | + ••••     |  |
|--------------------------|-----------------------------|------------|--|
|                          | 1512 kWh/m²                 | 7          | Global horizontal irradiation  |
|                          |                             | +7.4%      | Giobal Incident in coll, plane   |
|                          |                             | N          | · · · ·  |
|                          |                             | -1.86%     | IAM factor on global   |
| :                        |                             | >>) -4.0℃% | Soiling loss factor  |
|                          | 1530 kWh/m² ^ 4885 m² co    |            | Effective irradiation on collectors  |
|                          | efficioncy at STC = 20.589  | %          | PV conversion  |
| درهن العاقبة أنتقد أنتاج | · · · · · · · · 1538279 kWh |            | Array nominal energy (at STC effic.)"  |
|                          |                             | 9-3.80%    | Module Degradation Loss ( for year #10)  |
|                          |                             | 9-0.27%    | PV loss due to irradiance fevel  |
|                          |                             | 6.53%      | PV loss due to temperature   |
|                          |                             | (+0.43%    | Module quality lass  |
|                          |                             | 9-2.00%    | LID - Light induced degradation  |
|                          |                             | 9-3.91%    | Mismatch loss, modules and strings<br>{Including 1.8% for degradation dispersion |
|                          |                             | o.93% ب    | Ohmic wiring loss  |
| :                        | 1292479 kWh                 |            | Array virtual energy at MPP  |
| •                        |                             | -1.66%     | Inverter Loss during operation (efficiency)                                      |
| ļ                        |                             | 9 0.00%    | Inverter Loss over naminal inv. power  |
|                          |                             | 9 0.00%    | Inverier Loss due to max, input current  |
|                          |                             | 90.00%     | Inverter Loss over nominal inv. voltage  |
|                          |                             | 9-0.01%    | Inverter Loss due to power threshold   |
|                          |                             | 9 0.00%    | Inverter Loss due to voltage threshold   |
|                          | 4                           | 9 -0.01%   | Night consumption  |
|                          | 1270870 kWh                 |            | Available Energy at inverter Output  |
|                          |                             | 9-0.66%    | Auxiliaries (fans, other)  |
|                          |                             | 9-0.03%    | AC ohmic loss  |
|                          |                             | 9-1.21%    | Medium voltage transfo loss  |
|                          |                             | 9-0.01%    | MV line of mic loss  |
|                          | l N                         | ⇒-3.55%    | System unavailability  |
| :                        | 1201970 kWħ                 |            | Energy injected into grid  |
|                          |                             |            |  |
|                          |                             |            |  |
| 1                        |                             |            |  |

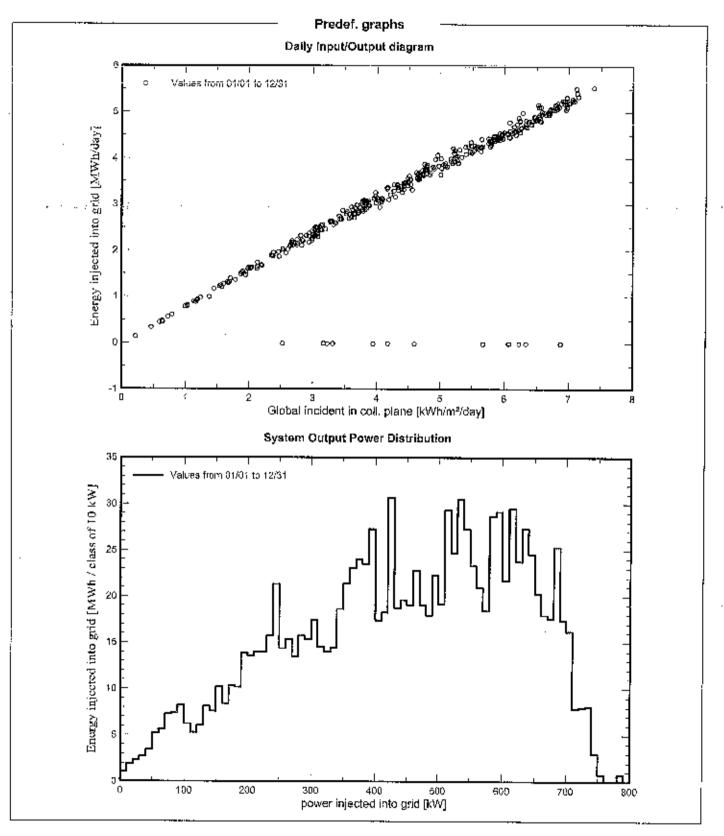


;

Project: Lahore Mes (CMH)

#### Variant: New simulation variant

PVsyst V7.3.1 VCD, Simulation date: 08/01/24 10:37 with v7.3.1





1

;

•

# Project: Lahore Mes (CMH)

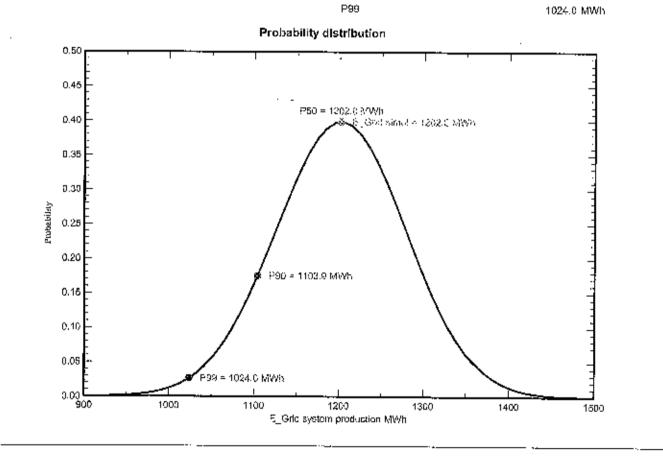
#### Variant: New simulation variant

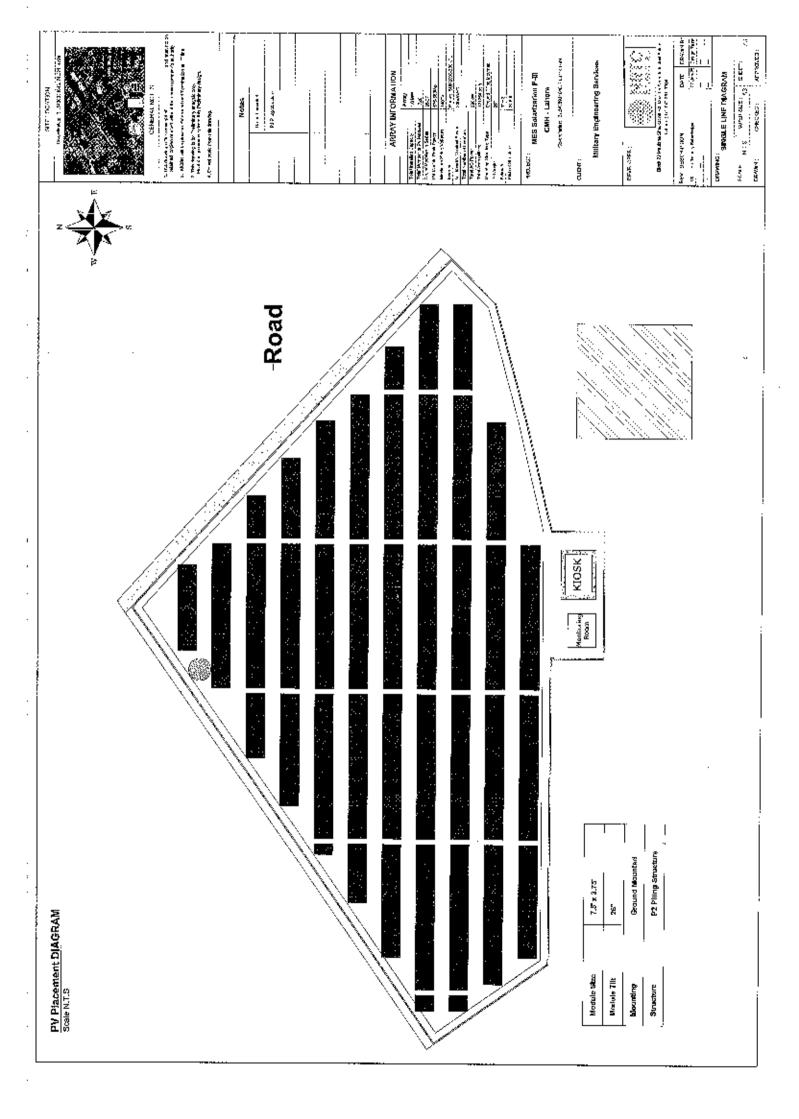
#### PVsyst V7.3.1 VC0. Simulation date: 08/01/24 10:37 with v7.3.1

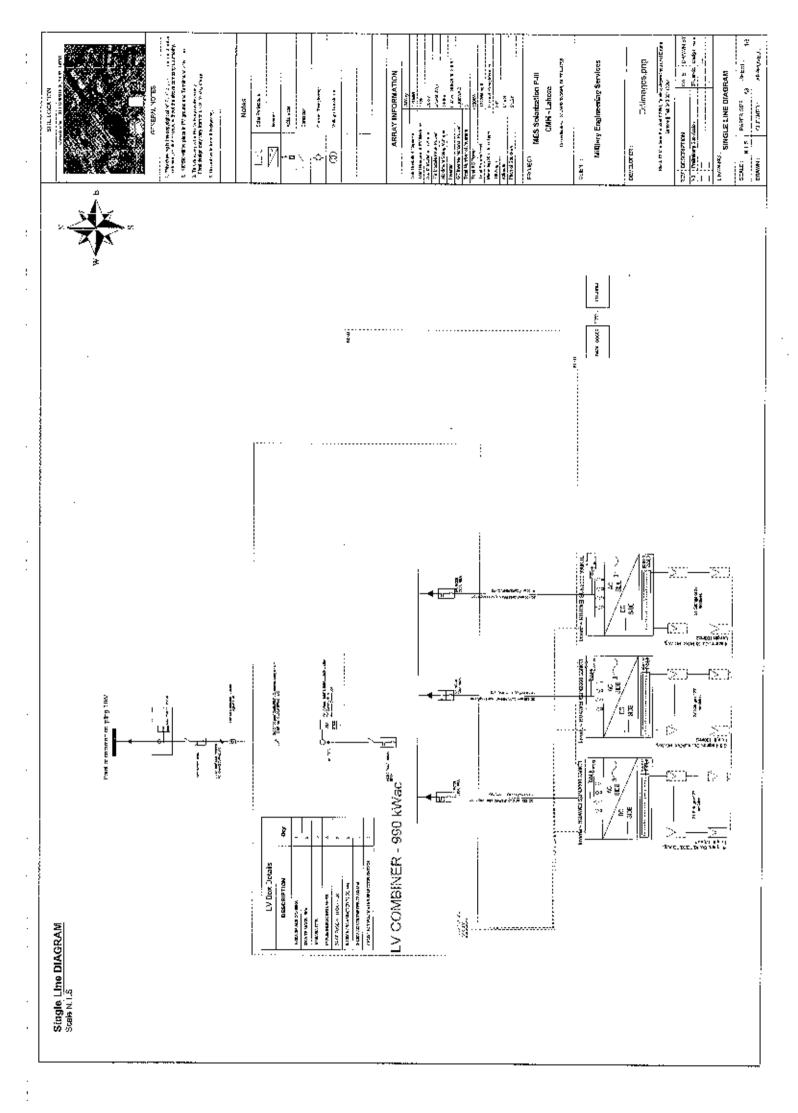
|           |                           | - Ji           |
|-----------|---------------------------|----------------|
| Meteo d   | lata                      |                |
| Source    | Meteonorm 8.1 (1996-201   | l5), Sat≐100%  |
| Kind      | Mor                       | nthly averages |
| Synthetic | - Multi-year average      |                |
| Year-to-y | ear veriebility(Variance) | B.1 %          |
| Specifier | d Deviation               |                |
| Climato c | hange                     | 0.0 %          |
| Global y  | /ariabliity (meteo + syst | em}            |
|           | (Quadratic sum)           | 6.4 %          |
|           |                           |                |

# P50 - P90 evaluation

| Simulation and parameters unce     | rtainties  |
|------------------------------------|------------|
| PV module modelling/parameters     | 1.0 %      |
| Inverter efficiency uncertainty    | 0.5 %      |
| Solfing and mismatch uncertainties | 1.0 %      |
| Degradation uncertainty            | 1.0 %      |
| Annual production probability      |            |
| Varlability .                      | 76.5 MWh   |
| P50                                | 1202.0 MWh |
| . P90                              | 1103.9 MWh |







|         |  |   | ( ::     |      |  |                                   | 1               |
|---------|--|---|----------|------|--|-----------------------------------|-----------------|
| -37 Mr. | Rect   | Specificationa  | Unde     | Qty  | Model and there                                  | LOCALIMPORTED                     | Country of Orlg |
|         |  | 50  | AR SVS   |      | MPONENTS   |                                   |                 |
|         |  |   |          |      |  | <u>. (</u>                        |                 |
| ٦       | Solar PV Modules<br>(12 years product & 25 years<br>"performance warranty)   | 580Ws Tier-1 Pflacial<br>Meno N Type<br>Technology having<br>officiency_22.5%   | ٩r       | 1725 | N-lype Bifsclei 590 w - JA; Chrra                | і Іпрозас                         | <br>Chire       |
| 2       | Solar PV Inverters ()<br>years warransy)<br>with Will Dongle   | 030KVA naving<br>"efficiency of \$9.62% with<br>built-in SPC at DC and<br>"AC Skie  |          | 8    | Huawel 330 KT., ; China                          | Imported                          | Chne            |
| з       | Dataloggor (Five<br>years warranty)  | Datalogger for<br>Summunication   | N-       | 1    | Haawei Smart Lagger 2000A .<br>Ontoa             | Imentied                          | China           |
| 4       | Wəsələr веласна ен.  | Weather sensate sol<br>(temp, wind, inactation<br>ofc) compatible with the<br>system as per REC   | 8e;      | 1    | 7 sonsors : Huewei                               | imperted                          | Colga           |
| 6       | Sidet PV motiviling<br>structure as per RFP  | So an PV mounting<br>attructure as per REP<br>recruited with Civil and<br>Mooran callwork as per<br>prawing approved by<br>paraultant   | lsb      |      | Concrete (His Structure   150km/or<br>  PARISTAN | raneral Construction<br>Modaenica | -'akistar       |
| Ġ       | Solar PV Cables<br>as per 'EC standard 50316 OR<br>HC 62030 (10 years warranty<br>in<br>cuse of Local Octrie)                                | Single Lors Annal, W<br>Caste tested at 1 SKV<br>Will standing at 120<br>Segree XLPET XLPO<br>the Italian must be<br>compliant with IEC<br>standard IEC<br>estandard IEC<br>estandard IEC | <br>dal. | 1    | Pakislar Dablos                                  | Local                             | Pakislen        |
| 7       | AC Cables from Invertain to<br>KIOSK end then from KIOSK to<br>point of congradivity   | Three Core 120 mmSq<br>Cla AC cable(Invertor to<br>LV)  | Jat      | 1    | Pak etan Gables                                  | Local                             | Facstaj         |
| g.      | KIOSIC cour sect station   | LV Side Panel 2 x 3204<br>MCCB, 800Volts and<br>1 x 103DA<br>ACB, Transformer 5 25<br>MVA, 41 Side Fanel<br>630A VCB  | Se:      | 1    | Tarlq Electric                                   | Local                             | Paklalan        |
| ç       | Eaching Sylem at DC and AC<br>alde separate with material ,<br>offling upto water level, and<br>lebour as per BCQ approved by<br>consultent. | Complete Earthing with<br>pure copper rod, copper-<br>electrodes having less<br>than 5 Ohm serth<br>resistance  | Jab      | 1    | N 9TC HNERG ES                                   | Local                             | Pakjalan        |
| 10      | Ligittening Arrestons  | ESE (Carly Streamor<br>Emission) Lightening<br>Protection System as<br>per RFP  | МГ       | 2    | CONTRAGCICESE LICHTENINO<br>TERMINAL             | Imported                          | Turkey          |
| 11      | Fending for protection of Plant  | Fenang well for<br>protection from entropies<br>and theft   | Jab      | 1    |  |                                   | Pakislan        |
| °2      | 'Cortrai Reair.  | Well-actipated Control<br>room with LED and<br>Formare  | Joh      | 1    | Signature Architect                              | Losa I                            | faxistan        |
| 15      | SCADA  | Scace system for<br>monktoring and Contro-<br>as por REP<br>Succifications  |          |      | 1C85   | Local I                           | , ekial8L∙      |
| 14      | and properation  | Debfile rannoval,<br>deathig, evening,<br>paving, welkwaye<br>foundations, melking land<br>ready for SPP  | Jab      | 1    | NIRTE ENERGIES                                   | Lorasi F                          |                 |
| 15      | Energy Meter   | 2005  | Job      | 1    | Moroëter   | limported (                       | inne            |
| :6      | Studies, approvais and pemilis   | All studies approvale and<br>bemils recurred as per<br>authorities in Pokistan as<br>per fawidirectives/SRQs  | Jeb j    | 1    | NRTC ENERGIES                                    | local F                           |                 |

# Schedule-II- BOQ FOR\_1\_MWp for SITE Name\_Lahore Site-1 (CMH)

1

T

· . . .

# Annex A-4



:

# **PVsyst - Simulation report**

Grid-Connected System

Project: Lahore MES (Akram Line)

Variant: New simulation variant No 3D scene defined, no shadings System power: 501 kWp Lahore Mes (Akram Line) - Pakistan



# Project: Lahore MES (Akram Line)

## Variant: New simulation variant

**PVsyst V7.3**.1 VC0, Simulation date: 08/01/24 10:40 with v7.3.1

| <u> </u>  | Project s  | Summary —                                |  |  |
|---|--|--|--|--|
| Geographical Site<br>Lahore Mes (Akram Lino)<br>Pakistan                            | <b>Situation</b><br>Latitude<br>Longitude<br>Attitude<br>Time zone | 31.53 °N<br>° 74.39 °E<br>217 m<br>UTC+5 | Project settings<br>Albedo                   | 0.20                                   |
| <b>Meteo data</b><br>Lehore Mes (Akram Line)<br>Meteonorm 8.1 (1998-2015), Sat=100' | % - Synthetic  |  |  |  |
| ,,  | System a   |  |  |  |
| Grid-Connected System<br>Simulation for year no 10                                  | No 3D scene dafir  | -  | the second second                            |  |
| PV Field Orlentation<br>Fixed plane<br>Fill/Azimuth 2670 °                          | Near Shadings<br>No Shadings                                       |  | <b>User's needs</b><br>Unlimited load (grid) |  |
| System information<br>∾V Array  |  | Inverters                                |  |  |
| Nb. of modules<br>Pnom total  | 864 units<br>501 kWp   | Nb. of units<br>Pnom totel<br>Pnom ratio | c  | 2 units<br>600 kWac<br>).835           |
|   | Results s  | ummary —                                 | ·  |  |
| Produced Energy 595529 kWh/   |  | -  | Perf. Ratio PR                               | 72.86 %                                |
| -,  | Table of a   |  |  | ······································ |
| Project and results summary<br>General parameters, PV Array Charact<br>Aain results | enerica, oystein losses  |  |  | 3                                      |
| Aain results<br>.oss diagram  |  |  |  | 6                                      |
| riedel, grapris   |  |  |  | 7                                      |

# Project: Lahore MES (Akram Line)

.

### Variant: New simulation variant

...

| 1 1 have                               | 22 |
|--|----|
|  | 8  |
| 1 I I I                                | ō. |
| ···· • • • • • • • • • • • • • • • • • | р. |
| - 20 Da                                | α. |
|  | Ξ. |
|  | -  |

.

PVsyst V7.3.1 VC0, Simulation date: 08/01/24 10:40 with v7.3.1

|                            |                | General             | parameters —              |                                    |                          |  |
|----------------------------|----------------|---------------------|---------------------------|------------------------------------|--------------------------|--|
| Grid-Connected Syste       | m              | No 3D scene de      | fined, no shadings        |                                    |                          |  |
| PV Field Orientation       |                |                     | -                         |                                    |                          |  |
| Orientation                |                | Sheds configurati   | on                        | Modela used                        |                          |  |
| Fixed plane                |                | No 3D scene definad |                           | Transposition Perez                |                          |  |
| Tift/Azimuth               | 28/0°          |                     |                           |                                    |                          |  |
| 2210                       |                |                     |                           |                                    |                          |  |
|                            |                |                     |                           | on component                       | separate                 |  |
| Horizon                    |                | Near Shadings       |                           | Usor's needs                       |                          |  |
| Free Horizon               |                | No Shadings         |                           | Unlimited load (grid)              |                          |  |
|                            |                | – PV Array C        |                           |                                    |                          |  |
| PV module                  |                |                     |                           |                                    |                          |  |
| Manufecturer               |                | CSI Solar           | Invertor<br>Museufactures |                                    |                          |  |
| Madel                      |                | i80MB-AG 1500V      | Manufacturer              |                                    | Technologies             |  |
| (Orfginal PVsyst datab     |                | A0061 SN-900A       | Madei<br>(Custore second  |                                    | 0-330KTL-112             |  |
| Unit Nom, Power            | 433)           | 590 \Ww             | (Custom paramete          |                                    |                          |  |
| Number of PV modules       |                | 580 Wp<br>864 wolu  |                           | Unit Nom, Power 300 kWac           |                          |  |
| Nominal (STC)              |                |                     | Number of invertors       | 2 units                            |                          |  |
| Modules                    | 501 kWp        |                     | Total power               |                                    | )0 kWac                  |  |
|                            |                | Operating voltage   | 500-1500 V                |                                    |                          |  |
| At operating cond. (50°C)  |                | Max. power (≂>30°C) |                           |                                    |                          |  |
| Ртрр<br>И трр              | 460 kWp        |                     |                           | Phominatio (DC:AC) 0.84            |                          |  |
| Limpp                      |                | 976 V<br>472 A      | Power sharing within t    | Power sharing within this inverter |                          |  |
|                            |                | 412 8               |                           |                                    |                          |  |
| Total PV power             |                |                     | Total inverter pow        | er                                 |                          |  |
| Nominal (STC)              |                |                     | Total power 600 kWad      |                                    | 0 kWac                   |  |
| Totel                      |                | 884 modules         | Number of invertors       | 2 units                            |                          |  |
| Module area                | -              | 2445 m²             | Priom ratio               | 0.8                                | 4                        |  |
|                            | <b></b>        | Array               | losses                    |                                    |                          |  |
| Array Soiling Losses       |                | Thermal Loss fa     | ctor                      | DC wiring losses                   |                          |  |
| Loss Fraction              | 4.0 %          | Module temperature  | according to irradiance   | Global arrey res.                  | 34 mΩ                    |  |
|                            |                | Uc (const)          | 29.0 W/m <sup>2</sup> K   | Loss Fraction                      | 1.5 % at STC             |  |
|                            |                | Uv (wind)           | 0.0 Wim²Kim/s             |                                    |                          |  |
| Serie Diode Loss           |                | LID - Light Induc   | ed Degradation            | Module Quality Loss                |                          |  |
| Voltage drop               | 0.7 V          | Lose Fraction       | 2.0 %                     | Loss Fraction                      | -0.4 %                   |  |
| Loss Fraction              | 0.1 % at STC   |                     |                           |                                    | ~ <b>∀</b> .++ ,0        |  |
| Module mismatch loss       | es .           | Strings Mismatel    | h loss                    | Module average degr                | adation                  |  |
| Loss Fraction              | 2.0 % at MPP   | Loss Fraction       | 0.1 %                     | Year no                            | 10                       |  |
|                            |                |                     |                           | Loss factor                        | 0.4 %/year               |  |
|                            |                |                     |                           | Mismatch due to degrad             |                          |  |
|                            |                |                     |                           | Imp RMS dispersion                 | 0.4 %/year               |  |
|                            |                |                     |                           | Vmp RMS dispersion                 | 0.4 %/year<br>0.4 %/year |  |
|                            | defeed out!!!. |                     |                           |                                    | 0. <del>4</del> //ry881  |  |
| AM loss factor             |                |                     |                           |                                    |                          |  |
| ncidence effect (IAM): Use |                | <b>-</b>            |                           |                                    |                          |  |
|                            |                | T 40° 5             | 50° <u>i 60</u> ° i       | 70° 80°                            |                          |  |

1



•

# Project: Lahore MES (Akram Line)

- . .-

#### Variant: New simulation variant

- . . ...

#### PVsyst V7.3.1 VC0, Simulation date: 08/01/24 10:40 with v7.3.1

|                                       |                        |  | 995          |  |
|---------------------------------------|------------------------|--|--------------|--|
| Unavailability of the syst            | tem<br>3.4 %           | Auxiliarles loss                             | E 6 18/11/2  |  |
|                                       | 0.4 78<br>2.4 Jays,    | Proportionnal to Power                       | 5.0 W/kW     |  |
| I                                     | 2.4 bays,<br>3 periods | 0.0 kW from Power thresh<br>Night aux, cons. | 500 W        |  |
|                                       |                        | -Hight adx. colla.                           | 300 99       |  |
|                                       | <u> </u>               | AC wiring to                                 | sses         |  |
| Inv. output line up to MV             | transfo                |  |              | •                                      |
| Inverter voltage                      |                        | 800 Vac tri                                  |              |  |
| Loss Fraction                         |                        | 0.10 % at STC                                |              |  |
| invertor: SUN2000-330KTL4             | H2                     |  |              |  |
| Wire section (2 Inv.)                 | Alu 2 x 3              | x 240 mm²                                    |              |  |
| Average wires length                  |                        | 20 m   |              |  |
| MV line up to injection               |                        |  |              |  |
| MV Voltage                            |                        | 11 kV  |              |  |
| Wires                                 | Alu 3                  | × 95 mm²                                     |              |  |
| Length                                |                        | 100 m  |              |  |
| Loss Fraction                         |                        | 0.01 % at STC                                |              |  |
| · · · · · · · · · · · · · · · · · · · |                        | AC losses in tran                            | sformers ··· | ······································ |
| MV transfo                            |                        |  |              |  |
| Medium voltage                        |                        | 11 kV  |              |  |
| Transformer from Datasheel            | ts                     |  |              |  |
| Nominal power                         |                        | 630 kVA                                      |              |  |
| Iron Loss (24/24 Connexion)           |                        | 1.00 kVA                                     |              |  |
| Iron loss fraction                    |                        | 0.15 % of PNom                               |              |  |
| Copper loss                           | á                      | 20.00 kVA                                    |              |  |
| Copper loss fraction                  |                        | 3.17 % at PNom                               |              |  |
| Coils equivalent resistance           | 3 x 3                  | 2.25 mΩ                                      |              |  |



:

.

### Project: Lahore MES (Akram Line)

#### Variant: New simulation variant

. . . . . \_

**PVsyst V7.3.1** VC0, Simulation date: 08/01/24 10:40 with v7.3.1

#### Main results

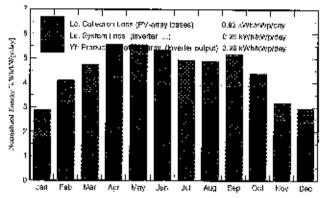
#### System Production

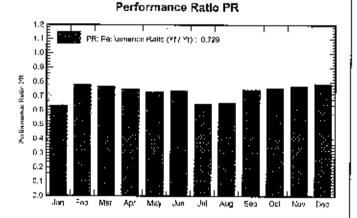
Produced Energy (P50) 595529 kWh/year Produced Energy (P90) 546955 kWh/year Produced Energy (P99) 507367 kWh/year

Specific production (P50) Produced Energy (P90) Produced Energy (P99)

) 1188 kWh/kWp/year Performance Ratio PR 72.85 % 1091 kWh/kWp/year 1012 kWh/kWp/year

#### Normalized productions (per installed kWp)





#### Balances and main results

|           | GlobHar                                  | DiffHor         | T_Amb            | Globine | GlobEff     | i EArray         | E_Grid             | PR    |
|-----------|--|-----------------|------------------|---------|-------------|------------------|--------------------|-------|
|           | kWh/m²                                   | kWh/m²          | °C               | kWh/m²  | kWh/m²      | kWh              | kWh                | ratio |
| January   | 69.8                                     | 43.8            | 11.37            | 89.2    | 84.1        | 37528            | 28371              | 0.638 |
| February  | 92.5                                     | 46.5            | j 15 <b>.</b> 69 | 114.4   | 108.1       | 47087            | 44653              | 0.779 |
| March     | 131.6                                    | 77.3            | 21.71            | 146.8   | 138.3       | 59241            | 56368              | D.768 |
| April     | 161.0                                    | 87.2            | 26.85            | 166.8   | 157.1       | 65640            | 62526              | 0.748 |
| May       | 176.7                                    | 99.0            | 32.94            | 172.2   | 162.2       | 66243            | 63090              | 0.731 |
| June      | 169.5                                    | 105.7           | 32.79            | 160.3   | 150.8       | 62018            | 59076              | 0.736 |
| July      | 160.5                                    | 105.1           | 31.24            | 153.2   | 144.0       | 59925            | 49693              | 0.647 |
| August    | 151.1                                    | 95.5            | 30.47            | 150.9   | 142.0       | <b>5921</b> 3    | 49407              | 0.653 |
| September | 141.8                                    | 74.6            | 28.75            | 154.3   | 145.4       | 60574            | 57618              | 0.748 |
| October   | 116.2                                    | 71.3            | 25.59            | 135.5   | 127.9       | 54007            | 51303              | 0.758 |
| November  | 77.2                                     | 50,6            | 18.59            | 95.9    | 90.4        | 39371            | 97206              | 0.774 |
| December  | 69.1                                     | 42.5            | 13.44            | 91,7    | 86.5        | 38375            | 36218              | 0.788 |
| Year      | 1517.3                                   | 899.2           | 24.16            | 1631.1  | 1536.7      | 649223           | 595529             | 0.729 |
| Legends   |  |                 |                  |         |             |                  |                    |       |
| -         | Global horizontal (wadla                 | ation           |                  | EArray  | Effective ( | enerav at the ou | itput of the array |       |
| DiffHor   | Horizontal diffuse Irradiation           |                 |                  | E_Grid  |             | ected into grid  |                    |       |
| T_Amb     | Ambient Tomperature PR Performance Ratio |                 |                  |         |             |                  |                    |       |
| Globine   | Giobal Incident in coll. p               | lane            |                  |         |             |                  |                    |       |
| GlobEff   | Effectivo Global, corr. 5                | or IAM and shad | dings            |         |             |                  |                    |       |



.

# Project: Lahore MES (Akram Line)

Variant: New simulation variant

PVsyst V7.3.1 VC0, Simulation date: 08/01/24 10:40 with v7.3.1

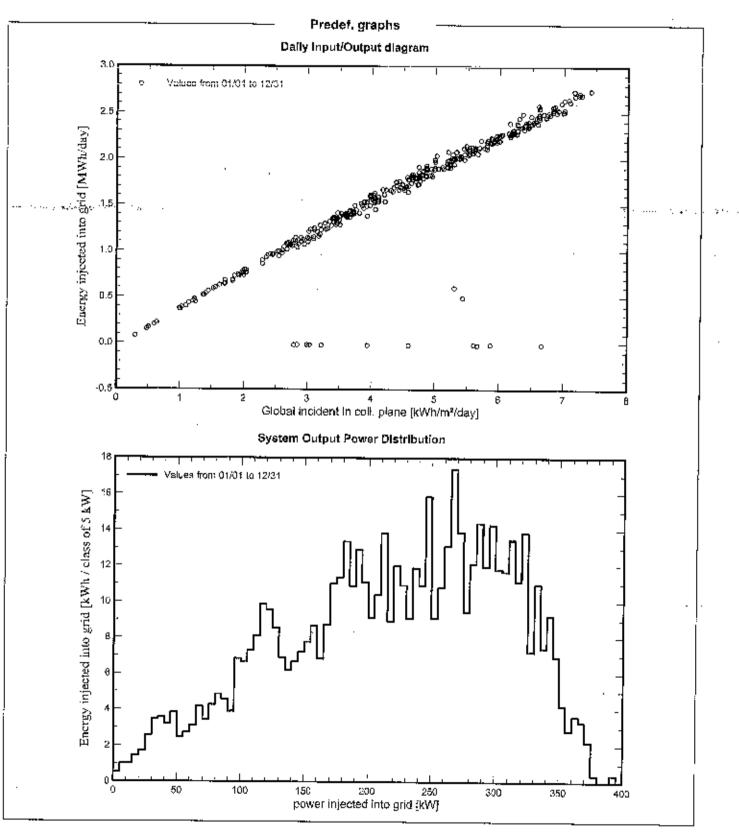
| Loss di                     | agram  |
|-----------------------------|--|
| 1517 kWh/m²                 | Global horizontal Irradiation  |
| +7.5%                       | Global incident in coll, plane   |
| -1.86%                      | IAM factor on global   |
| -4 00%                      | Sailing loss factor  |
| 1537 kWh/m² * 2445 m² coll. | Effective irradiation on collectors  |
| efficiency at STC = 20.58%  | ₽V conversion  |
| 773457 kWh                  | Array hominal energy (at STC effic.)   |
| N-3.80%                     | Module Degradation Loss ( for year #10)  |
| <b>N</b> -0.26%             | PV loss due to irradiance level  |
| -6.34%                      | PV loss due to temperature   |
| ×+0.43%                     | Module quality loss  |
| -2.00%                      | LID - Light Induced degradation  |
| -4.18%                      | Mismatch loss, modules and strings<br>(including 2.1% for regradation disporsion |
| -0.96%                      | Ohmle wiring loss  |
| 649223 kWh                  | Array virtual energy at MPP  |
| 9-1.83%                     | Inverter Loss during operation (efficiency)                                      |
| ¥ 0.00%                     | Inverter Loss over nominal inv. power  |
| 9 0.00%                     | Inverter Loss due to max, Input current  |
| · \ 0.00%                   | Inverter Lose over nominal inv. voltage  |
| 90.00%                      | Inverter Lose due to power threshold   |
| 9 0.00%                     | Inverter Loss due to voltage threshold   |
| ን -0.01%                    | Night consumption  |
| 638567 kWh                  | Available Energy at Inverter Output  |
| 9-0.84%                     | Auxiliaries (fans, other)  |
| 9-0.04%                     | AC olunia loss   |
| 9-2.46%                     | Modium voltege transfo loss  |
| 9-0.01%                     | MV fine ohmic loss   |
| 3.53%                       | System unavailability  |
| 595529 kWh                  | Energy injected into grid  |

:

Project: Lahore MES (Akram Line)

Variant: New simulation variant

**PVsyst V7.3.1** VC0, Simulation date: 08/01/24 10:40 with v7.3.1





ъ.

# Project: Lahore MES (Akram Line)

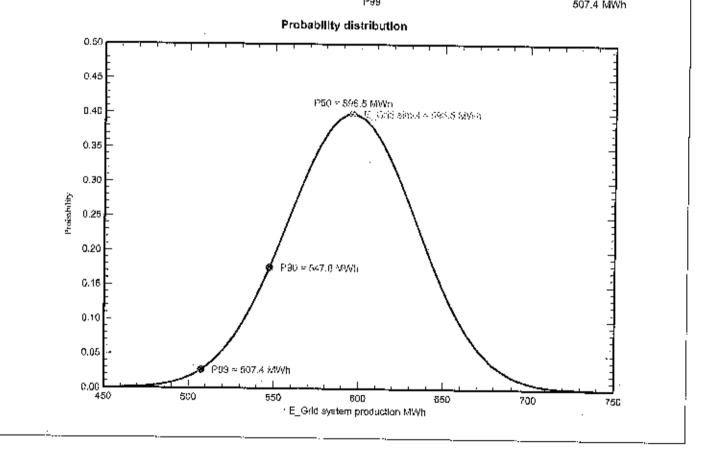
#### Variant: New simulation variant

**PVsyst V7.3.1** VC0, Simulation date: 08/01/24 10:40 with v7.3.1

|           | 7                           |             | P50 - P90 i |
|-----------|-----------------------------|-------------|-------------|
| Meteo (   | data                        |             |             |
| Source    | Meteonom 8.1 (1996-2015)    | , Sat=100%  |             |
| Kind      | Month                       | ly averages |             |
| Synthetic | ⊱ Mul‼-year average         |             |             |
| Year-to-y | /car variability(Variance)  | 6.1%        |             |
| Specifie  | d Deviation                 |             |             |
| Climate d | change                      | 0.0 %       |             |
| Giobal    | variability (meteo + system | 1)          |             |
|           | y (Quadratic sum)           | 6.4 %       |             |
|           |                             |             |             |

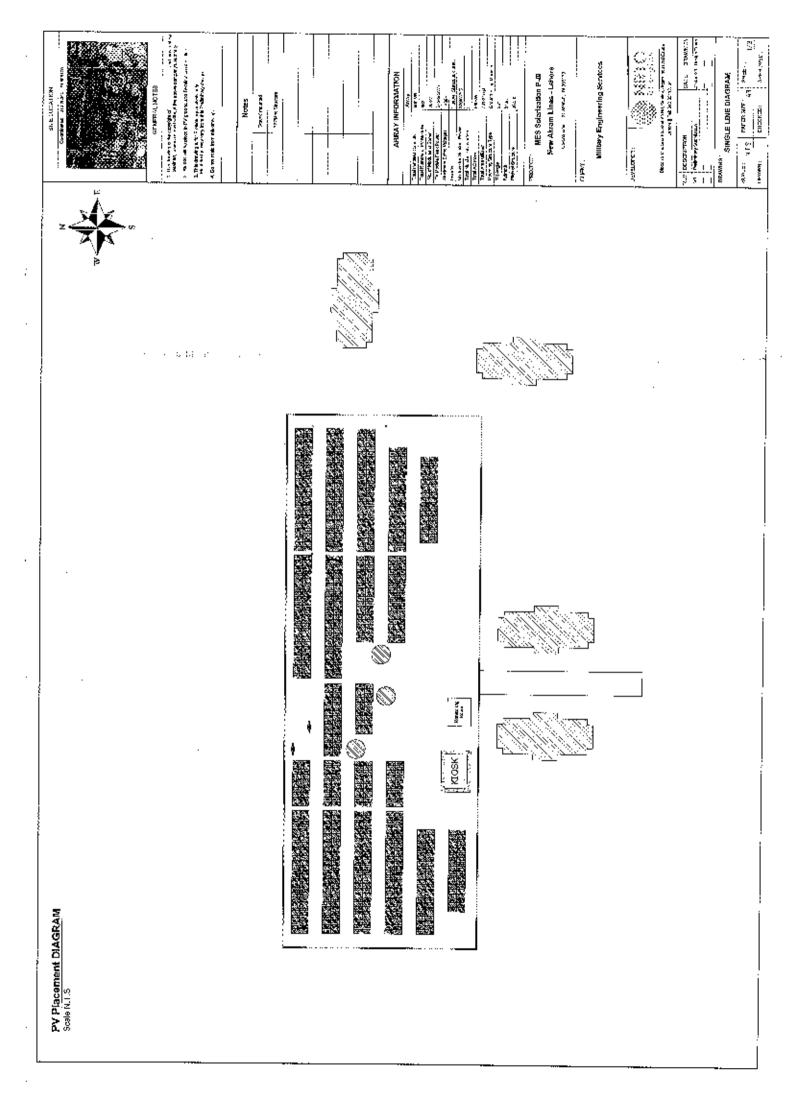
## P50 - P90 evaluation

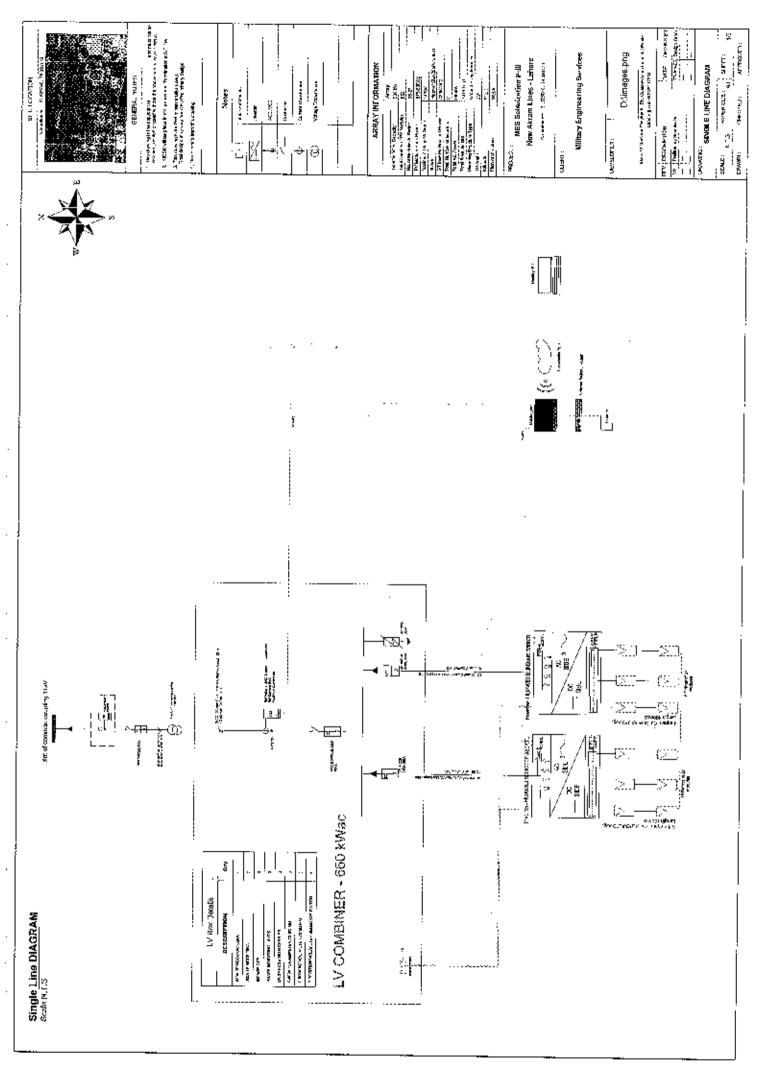
| Simulation and parameters uncer<br>PV module modelling/parameters | 10%      |
|---|----------|
| Inverter efficiency uncertainty                                   | 0.5 %    |
| Solling and mismatch uncertainties                                | 1.0 %    |
| Degradation uncertainty   | 1.0 %    |
| Annual production probability                                     |          |
| Variability   | 37.9 MW  |
| P50   | 595.5 MW |
| P90 .   | 547.0 MW |
| P99   | 507.4 MW |



08/01/24

.





:

# Schoule-II - BOQ FOR\_0.5\_MWp for SITE Name\_Labore Site-2 (New Akram Line)\_

| Se the 2 | treat  | Specifications   | i cumu - | CLI O                                  | Modatandmake  | LOCALASPORTED                     |                 |
|----------|--|--|----------|--|---|-----------------------------------|-----------------|
|          |  | Concentration of the second se |          |  | NORCE STREET  | SLOCALAMPER TED                   | COUNTY OF OWNER |
|          |  | SOL  | AR SY    | STEM CON                               | PONENTS   |                                   |                 |
| 1        | Solar PV Modulos<br>(12 yéans product & 25 years<br>performance warranty)  | 580Wp Tier-1 Bifzcial<br>Mono N Type<br>Trachnology heving<br>efficiency_22.5%   | <u> </u> | 20000000000000000000000000000000000000 | s <u>toria (</u> )<br> <br> <br> <br>N-typa Eilacia (SEO w - JA: China<br>        | Intponed                          | Chipa           |
| 2        | Solar PV hverters (5<br>years wertenly)<br>with Whit Congka  | 330KVA having<br>efficiency of 69,03% with<br>built-in SPD of DC and<br>AC Side  | ۲ı       | 2                                      | Hugwei 280 k ft. Come   | nparted                           | 'Chica          |
| 2        | Datalogger (Five<br>yeare wananty)   | Detalogger for<br>communication  | Nr       | . ,                                    | Huswel Sinar: Logger 2000A ;<br>Chris   | :mported                          | Сліна           |
| 4        | Weather sensers set  | : Weather sensors sot<br>(Snip, whu, irradiation<br>sto) compatible with the<br>system as per RFP  | - Sai    | 1                                      | 7 serieors : l-uawr.)   | Inapried                          | Ohna            |
| 5        | Sclar PV mounting<br>structure as per R-P  | Sclar PV mounting<br>structure as per kPP<br>complete with Clivit and<br>Michanicel work seper<br>drawing sport/yod by<br>consultant.  | Jat      | 1                                      | Contense Pilo structura (150km/hr<br>  "AKISTAN- General Constraying<br>Machaneis | Ceneral Construction<br>Mechanics | Pak stan        |
| 6        | Saler PV Cables<br>as per EC standard SIXI'B OR<br>IEC 62920 (12 years warranty<br>In<br>case of Local CatXe)                                  | is right Circl Animset Part<br>Cable Insign at 13(0)<br>willingtandig at 120<br>Degree XUPE/XUPC<br>Instration must be<br>compliant with IEC<br>standort IEC<br>6250/2012  | јсь      |  | Feidelen Cables   | Jocal                             | Pakislan        |
|          | AC Cables from Inveners to<br>ICOSK and then from K OSK to<br>point of connectivity  | Thise Cole 120 mm\$q<br>'Cul AC cable(Inverter to<br>LV)   | - Jol:   | 1                                      |   | Lcoal                             | Pakistan .      |
| ¥.       | KIC&K compact stet on  | I.V 6 de Panel 2 x 220A<br>MCC3, 600Volta and<br>1 x 630A<br>AC3 Transformer 830<br>AVA, HT Side Panel<br>830A VCB   | 891      | 1                                      | Tariq Electric  | <br>                              | Feidelan        |
| จ        | Earthing System at CC and AC<br>side separate with material ,<br>drilling upto water level, and<br>leadur as per BCC seproved by<br>consultant | Complete Earthing with<br>para cooperited, copperi<br>efectroace treving nes<br>that: 3 Ohm earch<br>realstance.   | -02      | ۲.                                     | NRTC ENERGIES   | l ecsi                            | Pakistan        |
| 10       | Lightening Arrestors   | ESE (Early Streamer<br>Fm'ssion) Lightening<br>Protection System as<br>pet RFP.  | Nr       | 1                                      | CONTRA60 CESE LIGI TENING<br>TERMINAL   | rrported                          |                 |
| -1       | Fending for protection of Planc  | Fending wai for<br>protoction from an meta<br>and theft  | મા       | 1                                      | NRTC ENERG'ES   | Loca                              | Pekistan        |
| 12       | Calitrai Roam  | Well-equipped Control<br>room with LED and<br>Furn Mirc  | Joù      | 1                                      | Signalure Architec:   | Local                             | <br>Pakistan    |
| 12       | SCADA  | Scada aystant for<br>monitoring and Collero,<br>as por RHP<br>Specifications   | jap :    |  |   | Local                             | Pausian         |
|          |  | Debits removal,<br>dicarling loveling,<br>paving, walkways,<br>foundations making land<br>ready for SPP.   | Job      | 1                                      | NRTG ENPROIES   | Local                             | Pakiston        |
| 15       | Chergy Meter   | 2000/F   | JUE      | 1                                      | N creStar   | Imported                          | Ctine           |
|          | Studies, approvals and permits   | Al' studies approvale and<br>pomitis required as par<br>numentios in Reidstan as<br>per lawb(podiyos/SROs.   | -03<br>  | 1                                      | NRTC ENERGIES   | i                                 | °ckisler        |

- -

# Annex A-5



·x\* - -

# **PVsyst - Simulation report**

Grid-Connected System

## Project: Okara MES

Variant: New simulation variant No 3D scene defined, no shadings System power: 1001 kWp Okara MES - Pakistan



.

## Project: Okara MES

Variant: New simulation variant

.....

#### PVsyst V7.3.1 VC0, Simulation date: 01/08/24 17:58 with v7.3.1

|   |                       | Project :  | summary ——                               |  | ••                           |
|---|-----------------------|--|--|--|------------------------------|
| Geographical Site<br>Okare MES<br>Pakistan                | 1                     | <b>Situation</b><br>Latitude<br>Longitude<br>Attitude<br>Time zone | 30.75 °N<br>73.35 °E<br>170 m<br>UTC+5   | <b>Project settings</b><br>Albedo                        | 0.20                         |
| <b>Meteo data</b><br>Okara MES<br>Meteonom 8.1 (1996      | -2015). Sat≏100% - Sy | nthelic  |  |  |                              |
|   |                       |  | summary                                  |  |                              |
| Grid-Connected S<br>Simulation for year no                |                       | No 3D scene defi   | •  | -  |                              |
| <b>PV Field Or</b> ientatio<br>Fixed plane<br>Til/Azimuth | on<br>26/0°           | Near Shadings<br>No Shadings                                       |  | <b>User's needs</b><br>Unlimited <del>ioert</del> (grid) |                              |
| System Informatio<br>PV Array                             | n                     |  | litvêrters                               |  |                              |
| Nb. of modules<br>Pnom total                              |                       | 1726 units<br>1001 kWp   | Nb. of units<br>Pnom total<br>Pnom ratio |  | 3 units<br>900 kWac<br>1.112 |
|   |                       | Results :  | summary                                  |  |                              |
| Produced Energy   | 1353019 kWh/year      | Specific production  | 1352 kWh/kWp/year                        | Perf. Ratio PR   | 78.68 %                      |
|   |                       | Table of   | contents                                 |  |                              |
| Main results<br>Loss diegram<br>Predef, graphs            |                       |  |  |  | !<br>!                       |

.



\_

:

ļ

PVsyst V7.3.1 VC0, Simulation date: 01/08/24 17:58 with v7.3.1

**Grid-Connected System** 

# Project: Okara MES

#### Variant: New simulation variant

**General parameters** 

No 3D scene defined, no shadings

.. ..

| Orientation                     | Sheds configu             | ration                                | Modela used           |                    |
|---------------------------------|---------------------------|---------------------------------------|-----------------------|--------------------|
| Fixed plane                     | No 3D scene de            |                                       |                       | <b>D</b>           |
| •                               | 10 30 20210 00            | Filled                                | Transposition         | Perez              |
| 20                              |                           |                                       |                       | , Meteonorm        |
|                                 |                           |                                       | Circumsolar           | eeparate           |
| H <b>orizon</b><br>Free Horizon | Near Shading              | )5                                    | User's needs          |                    |
|                                 | No Shadings               |                                       | Unlimited load (grid) | >                  |
|                                 | PV Array                  | y Characteristics –                   |                       | <u> </u>           |
| °V module                       |                           | Inverter                              |                       |                    |
| danufacturer                    | CSI Solar                 | Manufacturer                          | Hua                   | awei Technologies  |
| Aodel                           | CS7L-580MB-AG 1500V       | Model                                 |                       | v2000-330KTL-H2    |
| (Original PVsyst database       | 2)                        | (Custom parameter                     |                       |                    |
| Jnit Nam, Power                 | 580 Wp                    | Unit Nom, Power                       | ,                     | 300 kWac           |
| Number of PV modules            | 1726 units                | Number of Inverters                   |                       | 3 แก่ไร            |
| Nominal (STC)                   | 1001 kWp                  | Total power                           |                       | 900 kWac           |
| Array #1 - PV Array             |                           |                                       |                       |                    |
| Number of PV modules            | 868 units                 | Number of Inverters                   | 9 ° MPPT 17           | % <b>1.5</b> units |
| Vominal (STC)                   | 503 kWp                   | Total power                           |                       | 450 kWac           |
| Aodules                         | 31 Strings x 28 In series | · · · · · · · · · · · · · · · · · · · |                       |                    |
| At operating cond. (50°C)       | Ť                         | Operating voltage                     | 500                   | -1500 V            |
| mpp                             | 463 kWp                   | Max. powar (=>30°C)                   |                       | 330 kWac           |
| Jmpp                            | 854 V                     | Phom ratio (DC:AC)                    |                       | 1.12               |
| mpp                             | 542 A                     | No Power sharing bet                  | ween MPPTs            | 1.12               |
| Array #2 - Sub-array #2         |                           |                                       |                       |                    |
| Number of PV modules            | 858 units                 | Number of Inverters                   | 9 * MPPT 175          | % 15 unite         |
| Vominal (STC)                   | 498 kWp                   | Total power                           |                       | 450 kWac           |
| Adules                          | 33 Strings x 26 in series |                                       |                       | 400 41180          |
| t operating cond. (50°C)        |                           | Operating voltage                     | 500                   | -1500 V            |
| mpp                             | 457 kWp                   | Max. power (=>30°C)                   | 000                   | 330 kWac           |
| Impp                            | 793 V                     | Phom ratio (DC:AC)                    |                       | 1.11               |
| прр                             | 577 A                     | No Power sharing bet                  | ween MPPTs            | 1.11               |
| otal PV power                   |                           | Total Inverter powe                   |                       |                    |
| lominal (STC)                   | 1001 kWp                  | Total power                           |                       | 900 kWac           |
| otal                            | 1726 modules              | Number of inverters                   |                       | 3 units            |
| fodule area                     | 4885 m²                   | Phom ratio                            |                       | 1.11               |
|                                 |                           | No Power sharing                      |                       | 1.11               |
|                                 | Δr                        | ray losses                            |                       |                    |
| array Solling Losses            | Thermal Loss              | -                                     | Serie Diode Loss      |                    |
|                                 |                           | ture according to irradiance          | Vollage drop          | 0.7 V              |
|                                 | Vc (const)                | 29.0 W/mªK                            | Loss Fraction         | 0.1 % at STC       |
|                                 | Uv (wind)                 | 0.0 W//m²K/m/s                        | -0001120001           |                    |
| ID - Light Induced Degra        | adation Module Qualit     | y Loss                                | Module mismatch       | losses             |
| oss Frection                    | 2.0 % Loss Fraction       | -0.4 %                                | Loss Fraction         | 2.0 % at MPP       |



## Project: Okara MES

#### Varlant: New simulation variant

#### **PVsyst V7.3.1** VC0, Simulation date: 01/08/24 17:58 with v7.3.1

|   | · • • • • • • •                        | Array losses                |  |
|---|--|-----------------------------|--|
| Strings Mismatch loss                         | Module av                              | erage degradation           |  |
| Loss Fraction 0.1                             | 1% Yearno                              | 10                          |  |
|   | Loss factor                            | 0.4 %/year                  |  |
|   |  | ue to degradetion           |  |
|   | Imp RMS dis                            |                             |  |
|   | Vmp RMS di                             | spersion 0.4 %/year         |  |
| IAM loss factor                               |  |                             |  |
| Incidence effect (IAM): User defi             | ned profile                            |                             |  |
| 10" 20" ;                                     | 30° 40°                                | 50° 60° 70"                 | 80° 90°                                |
| 0.998 0.998                                   | 0.995 0.992                            | 0.986 9.970                 | ·                                      |
| · · · · · · · · · · · · · · · ·               |  |                             | ···· 0.763 0.000                       |
| ·   | ······································ | · · · ·                     |  |
|   |  | wiring losses               |  |
| -   | ) πΩ                                   |                             |  |
| Loss Fraction 1.5                             | i% at STC                              |                             |  |
| Array #1 - PV Array                           |  | Array #2 - Sub-array #2     |  |
| Global array res.                             | 26 mΩ                                  | Global array res.           | <b>2</b> 3 mΩ                          |
| Loss Fraction                                 | 1.5 % at STC                           | Loss Fraction               | 1.5 % at STC                           |
| ·   |  |                             | ······································ |
|   |  | wiring losses               |  |
| Inv. output line up to MV tra                 |  |                             |  |
| Inverter voltage                              | 800 Vac tri                            |                             |  |
| Loss Fraction                                 | 0.03 % at STC                          |                             |  |
| Inverter: SUN2000-330KTL-H2                   |  | Inverter: SUN2000-330KTL-H2 |  |
| Wire section (2 Inv.)<br>Average wires fength | Alu 2 x 3 x 240 mm²                    | Wire section (2 Inv.)       | Alu 2 × 3 × 150 mm²                    |
| Average wros rangin                           | 10 m                                   | Average wires length        | 0 m                                    |
| MV line up to injection                       |  |                             |  |
| MV Voltage                                    | 11 kV                                  |                             |  |
| Wires   | Alu 3 x 120 mm²                        |                             |  |
| Length  | 392 m                                  |                             |  |
| Loss Fraction                                 | 0.08 % at STC                          |                             |  |
| <u> </u>                                      | AC loss                                | es in transformers          | ······································ |
| MV transfo                                    |  |                             |  |
| Medium voltage                                | <ul> <li>11 kV</li> </ul>              |                             |  |
| Transformer from Datasheets                   |  |                             |  |
| Nominal power                                 | 1250 kVA                               |                             |  |
| Iron Lass /04/04_A-sectors                    | 1.00 kVA                               |                             |  |
| Iron Loss (24/24 Connexion)                   |  |                             |  |
| Iron loss fraction                            | 0.08 % of #Nam                         |                             |  |
|   |  |                             |  |
| Iron loss fraction                            | 0.08 % of PNom                         |                             |  |

ï

:



۰,

: .

.

## Project: Okara MES

#### Variant: New simulation variant

PVsyst V7.3.1 VC0, Simulation date: 01/08/24 17:58 with v7.3.1

#### Main results

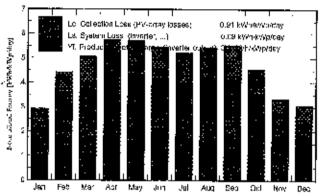
#### System Production

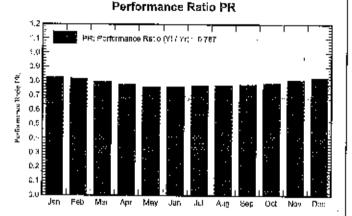
Produced Energy (P50) 1353019 kWh/year Produced Energy (P90) 1267301 kWh/year Produced Energy (P99) 1197439 kWh/year

Produced Energy (P90) Produced Energy (P99)

Specific production (P50) 1352 kWh/kWp/year Performance Ratio PR 78.88 % 1266 kWh/kWp/year . 1196 kWh/kWp/year

#### Normalized productions (per installed kWp)





#### Balances and main results

|                                 | GlobHor                | DiffHor         | T_Amb                            | Globine | GlobEff  | EArray           | E_Grid            | PR    |
|---------------------------------|------------------------|-----------------|----------------------------------|---------|----------|------------------|-------------------|-------|
|                                 | kWh/tŋ²                | kWħ/m²          | °C                               | kWh/m²  | K\Vh/m*  | kVVh             | , kWh             | ratio |
| January                         | 72.0                   | 44.1            | 12.67                            | 90,8    | 87.4     | 77537            | 75382 j           | 0.830 |
| Fobruary                        | 100.5                  | 52.8            | 16.58                            | 123,9   | 119.5    | 104112           | 101593            | 0.619 |
| March                           | 139.6                  | 76.4            | 22.74                            | 156,9   | 151.2    | 128386           | 125384            | 0,799 |
| April                           | 166.7                  | 89.5            | 28.19                            | 172.4   | 165.8    | 137437           | 134293            | 0,778 |
| May                             | 183.4                  | 101.2           | 33.85                            | 177.8   | 170.9    | 138844           | 135639            | 0,762 |
| June                            | 173.7                  | 107.9           | 34.21                            | 163.3   | 156,8    | i 128088         | 125087            | 0.765 |
| July                            | 170.9                  | 104.8           | 33.08                            | 162.4   | 156,0    | 128382           | 125359            | 0.771 |
| August                          | 168.5                  | 99.0            | 31.92                            | 168.6   | 162,1    | 133754           | 130648            | 0.774 |
| September                       | 152.3                  | 78.4            | 29.90                            | 166.1   | 159,8    | 132403           | 129346            | 0.778 |
| October                         | 120.0                  | 68.2            | 26.94                            | 141.0   | 135.9    | 113872           | 111127            | 0.788 |
| November                        | 80.9                   | 52.4            | 20.30                            | ! 100.1 | 96,3     | 83178            | 80993             | 0.809 |
| December                        | 71.7                   | 44.1            | 14.94                            |         | 91.1     | 80339            | 78167             | 0.825 |
| Year                            | 1600.1                 | .919.0          | 25.49                            | 1717.7  | 1652.6   | 1086311          | 1353019           | 0.787 |
| <b>Legends</b><br>GlabHor Globi | al horizontal Irradia  | atlan           |                                  | EArray  | Frective | energy at the ou | tput of the erray |       |
|                                 | ontal diffuse irradi   | ation           | E_Grid Energy injocted into grid |         |          |                  |                   |       |
| T_Amb Ambi                      | ent Temperatura        |                 | PR Performance Retio             |         |          |                  |                   |       |
| Glabino Gioba                   | al incident In coll. p | alene           |                                  |         |          |                  |                   |       |
| GlobE# Effec                    | tive Global, corr. fr  | or IAM and shad | Inas                             |         |          |                  |                   |       |



## Project: Okara MES

#### Variant: New simulation variant

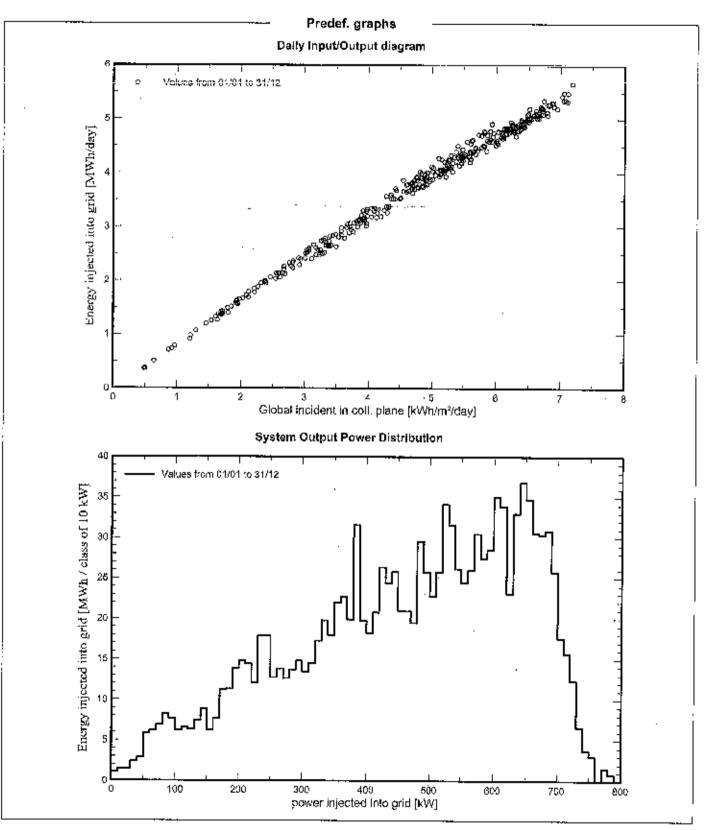
PVsyst V7.3.1 VC0, Simulation date: 01/08/24 17:58 with v7.3.1

Loss diagram 1600 kWh/m<sup>2</sup> Global horizontal Irradiation +7.4% Giobal incident in coll. plane -1.83% IAM fector on global -2.00% Solling loss factor 1653 kWh/m² \* 4885 m² cell. Effective Irradiation on collectors efliciency at STC = 20.58% PV conversion f86.1877 kWh، -13 14.4 Array nominal energy (at STC effic.) : . -3.80% Module Degradation Loss ( for year #10) -0.19% PV loss due to irradiance lovef -7.00% PV loss due to temperature **⊀**+0.49% Module quality loss 9-2.00% LID - Light Induced degradation -4.14% Mismatch loss, modules and strings (Including 2% for degradation dispersion 9-0.97% Ohmic wirling loss 1386311 kWh Array virtual energy at MPP 9-1.65% Inverter Loss during operation (officiency) 40.00% Inverter Loss over nominal inv, power 9 0.00% inverter Loss due to max, input ourrent 9 0.00% Inverter Loss over nominal inv. voltage 90.00% Inverter Loss due to power threshold 90.00% Inverter Loss due to voltage threshold 10.00% Night consumption 1363346 kWh Available Energy at Inverter Output 9-0.02% AC ohmic loss **9**-0.70% Medium voltage transfo loss 9-0.04% MV line ohmic loss 1353019 kWh Energy injected into grid



PVsyst V7.3.1 VC0, Simulation date: 01/08/24 17:58 wilh v7.3.1 Project: Okara MES

Variant: New simulation variant





## Project: Okara MES

#### Variant: New simulation variant

# PVsyst V7.3.1 VC0, Simulation date: 01/08/24 17:58 with v7.3.1

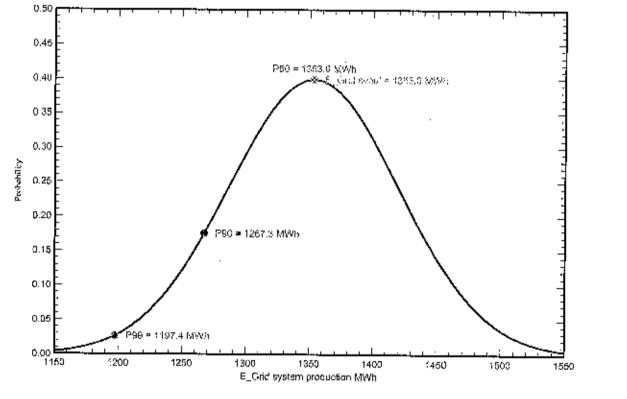
|                                    |             | P50 - P90 e | valuation         |
|------------------------------------|-------------|-------------|-------------------|
| Meteo data                         |             |             | Simulation a      |
| Source Meteonorin 8.1 (1998-2015)  | , Sat=100%  |             | PV module mot     |
| Kind Month                         | ly averages |             | Inverter officien |
| Synthetic - Multi-year avorage     |             |             | Solling and mis   |
| Year-to-year variability(Variance) | 4.6 %       |             | Degradation un    |
| Specified Deviation                |             |             | -                 |
| Climate change                     | 0.0 %       |             |                   |
| Global variability (meteo + system | n)          |             | Annual produ      |
| Veriability (Quadratic sum)        | 4.9 %       |             | Variability       |
|                                    |             |             | P50               |
|                                    |             | A           | · P90             |

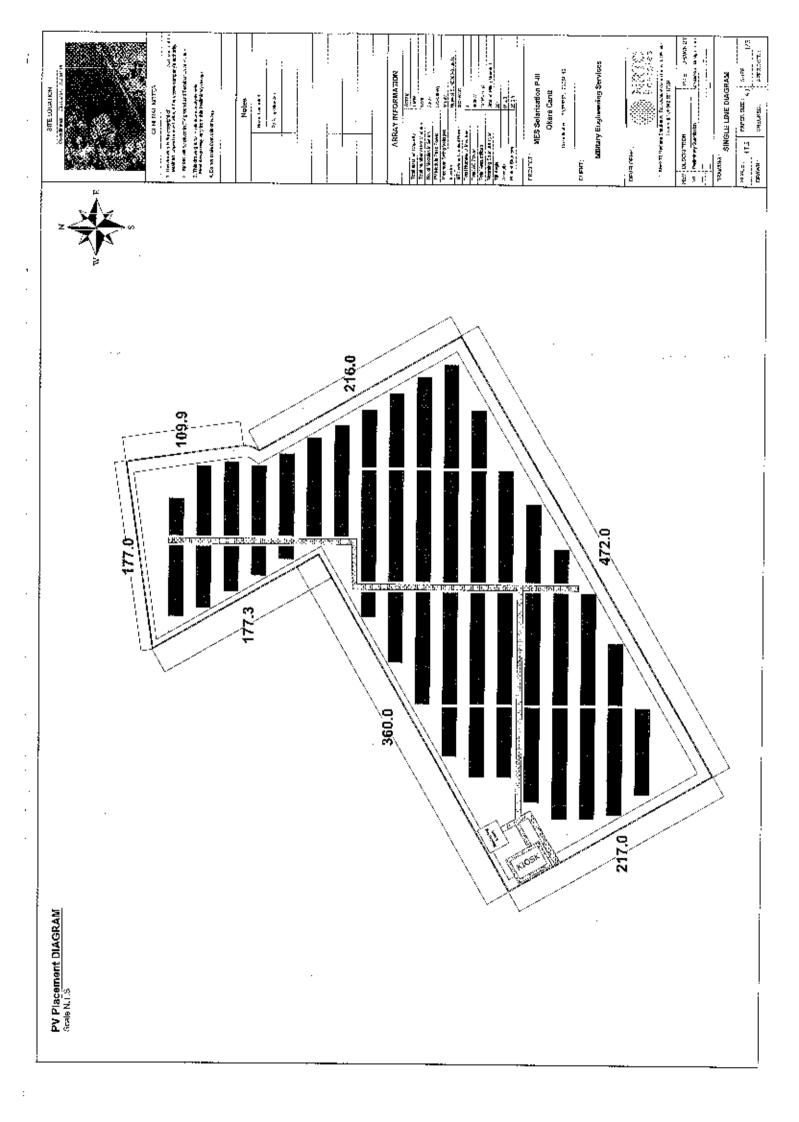
#### and parameters uncertainties delling/parameters 1.0 % ncy uncartainty 0.5 % smatch uncertainties 1.0 % ncertainty 1.0 %

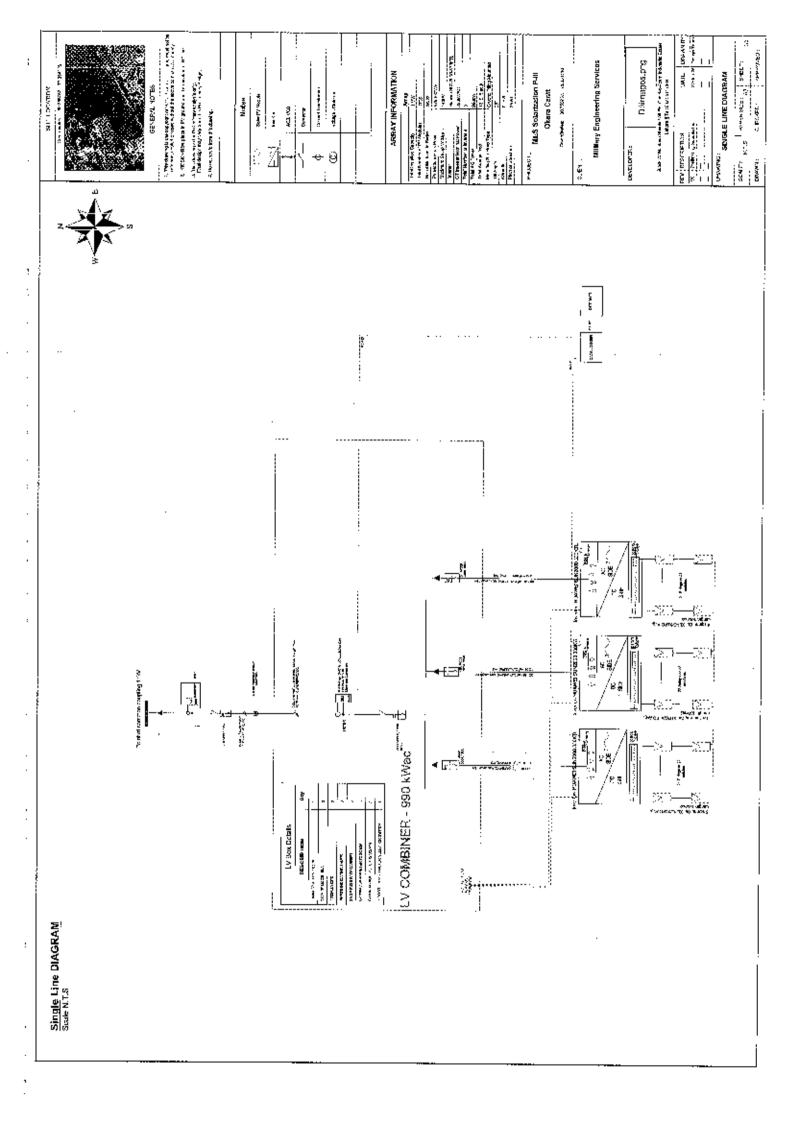
#### luction probability

|   | Variability | 66.8   | MWh |
|---|-------------|--------|-----|
|   | P50         | 1359.0 | MWh |
| • | P90         | 1267.3 | MWh |
|   | P99         | 1197.4 | MW5 |

## Probability distribution







|               |   | Schedule - II - B   | OQ FOI  | R_1_MWr | ofor SITE Name_Okara_  |               | ·                    |
|---------------|---|---|---------|---------|--|---------------|----------------------|
| Se Ne         | Dáin  | Sprofications   | Unit    | Cay     | Model and matter   | LOCALAMPORTED | Country (#CHg)       |
|               |   | 801   | AR SY   | STÉM CO | MPONENTS   |               |                      |
|               | Solar PV Modulos<br>(12 years product & 25 yoars<br>performance warranty)   | 530Wp Tier-1 Bracie)<br>Morie Ni Type<br>Technology having<br>Ioff clengy_22 5%   | Nr      | 1726    | N-type Rifectal 530 - JA. China  | / Imponed     | Chice                |
| 2             | Solar PV Invertera (S<br>vecto vertenty)<br>with Wife Dangto  | 330kVA heving<br>"chicloney of 98,03% with<br>built-in SPD & DC and<br>AC Side  | nir     | 3       | Huawai 330 kT., ; China  | Imported      | Chna                 |
| 3             | Detalogger (Five<br>years warrenty)   | Dataloggar for<br>communication   | Nr      | 1       | Haawo Smert Logger 20034 :<br>China  | Im-ported     | China                |
| <u>ا</u>      | Weather sensors set   | Weather sensors on)<br>(temp, wind, imadiation<br>etc: compatible with the<br>system as par REP   | 80ť     | 1       | 7 sonsora ; Hugwe  | Imported      | :                    |
| Ű             | Scier ⊃V nounling<br>Scier ⊃V nounling  | Solar PV mounting<br>altracture as per RFP<br>compete with Civit and<br>.Modhence work as per<br>urawing expertived by<br>particultant.                   | Joh     | 1       | Concrete Pile Structure   15tkm/tr<br>  PAKISTAN - Ceneral<br>Construction Machanica | Locai         | Pakistap             |
| ñ             | Solar FV Cattles<br>as per EC stenaard 50016 ()R<br>EC 32330 (10 years warronty<br>in<br>case of Local Cente)   | Single Core Annual 197<br>Caule tessor at 5 SKV<br>will standing at 120<br>Degree XLPC/XLPC<br>incutation must be<br>compliant with IEC<br>stance of IFC  | John -  | 1       | Pakistan (Jatijes  |               | Pekislan             |
| 7             | i<br>AC Califies fram investers to<br>KIOSK and then from IOCSK to<br>pand of connectivity  | ecosity shi 2<br>Three Core 120 mms of<br>Car AC cable (Investor to<br>LV)<br>Three Core VV 98<br>turns 41, AC cable<br>(KIOSIK to part of<br>some of LV) | Jat     | 1       | Pak stur Cables  | Losgi         | Pak stan             |
| A             | <iusk compact="" station<="" td=""><td>LV Side Panel 3 x 320A<br/>MCCE, 860volte and<br/>1 x 1000A<br/>ACE Trensformer 1,25<br/>MVA, HT Sico Panel<br/>636A VCB</td><td>Şet</td><td>1</td><td>Taiiq Electric</td><td>Local</td><td>Pzkislar</td></iusk> | LV Side Panel 3 x 320A<br>MCCE, 860volte and<br>1 x 1000A<br>ACE Trensformer 1,25<br>MVA, HT Sico Panel<br>636A VCB                                       | Şet     | 1       | Taiiq Electric   | Local         | Pzkislar             |
| 9             | Earthing Sytem et DC and AC<br>side separate with material,<br>dvilling upto webri kavel, end<br>labour as per BCQ approver: by<br>tonsultant.  | resistance.   | 10D     | 1       | NHTC ENERGIES  | _ocal .       | <br>Pakialan         |
| 10            | Lightening Arrestors  | ESE (Forly Streamer<br>Einission) Lightoring<br>Protection System es<br>per RFD   | ħr      | 2       | CONTRAID CESE LIGHTENING<br>TERMINAL   | Imauried .    | Tukey                |
| 11<br>        | Feasing for protection of Pfani   | Fonding well for v<br>protection from entreds<br>and theft  | dol dol | 1       | INRTC ENERGIES   |               | <sup>n</sup> £kielzn |
| 1Z            | Centrol Room  | Wel-souipped Control<br>ream with LED and<br>Furniture  | .І=ь    | 1       | Signalure Architest  | Lose :        | Pukistan             |
| 13            | SQADA   | Snace system for<br>monitaring end Contro<br>as per RFP specifice; ons  | Jaa     |         | icsa   | -···          | akistan              |
| 14            |   | Debris removal,<br>dicarling leveling,<br>poving, welkways<br>foundations, melung land<br>ready for SPP   | Job     | 1       | NRTC ENERG-ES  |               | n<br>Pakistan        |
| 15            | Energy Mele-  | 20367   | Jat     |         | MicroStan  | ) tehoqm      |                      |
| <sup>10</sup> | Studiee, approvals and portnits   | Al' studies approvais and<br>permits required as per<br>auxiont es un Pakisian as<br>achiav#directives/SROs   | . on    | 1       | NRTG ENHROIES  | Loce' "       | 'akistan             |

# Annex B-1

# Harvest the Sunshine

# DEEP BLUE 4.0 SOUVIN-type Bifacial Double Glass High Efficiency Mono Module JAM72D40 555-580/GB

Power by the taskest SMBB in-type seller cell, half-cell conliguestion and gabless itboon connection technology. These postsiles have highly outpower, lower buy boar weak illumitation reagines, and botton temperature acetacient.

| 1 · ·   | •        |     |       |             |     |                    |
|---------|----------|-----|-------|-------------|-----|--------------------|
| . :     | 1.       |     | · · . | - Yarteaniw |     |                    |
|         |          |     |       | ź           |     |                    |
|         | 1        | : . |       | 3.          |     |                    |
| •···    |          |     |       | ··· }.      |     | in the part of the |
|         |          |     |       | 1           |     |                    |
|         |          | :   |       |             |     |                    |
|         | 2        |     | ;     |             |     |                    |
|         | :        |     |       | . 3         |     |                    |
|         |          |     |       | ÷           |     |                    |
| \$ . ·  |          |     |       | i           | •   |                    |
|         |          |     |       |             |     |                    |
|         |          |     |       |             |     |                    |
|         |          |     |       | 1           | • • |                    |
|         | <u> </u> | ,   |       |             |     |                    |
| · ·     |          | : . |       |             | ÷., |                    |
|         | 1.       | ÷ . |       | S.          |     |                    |
| · . ·   |          |     |       |             |     |                    |
|         | · ·      |     |       |             |     |                    |
|         | · · ·    |     |       | ÷.          |     |                    |
|         | 1.1      |     |       | 1           |     |                    |
|         |          |     |       |             | ••• | ·                  |
| · · · . | ·.       | ·   |       | 1           |     |                    |
|         |          |     |       |             |     |                    |
| 1 A 1   |          |     |       | - S         |     |                    |
|         |          |     |       |             |     |                    |
| :       |          |     |       |             | · · |                    |
| :.      |          |     |       |             | ÷   |                    |
| :       |          |     |       |             |     | • •                |
|         |          |     |       |             |     | · · ·              |
|         |          |     |       |             |     |                    |



#### Higher power generation batter &COE



n-type with very Lower LID



80% A

batter LCOE

Better weak illemination response



Better Temperature Coefficient



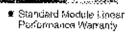
## Superior Warranty |

- < 32-year product werranly
- < 30-year brear power output warranty





P. n-type Elfablal Double Class Wodule Linear Performance Womenty



## Comprehensive Certificates

- (EC 61235, ISC 61730)
- ISO 9001; 2015 Ouzlity management systems
- ISO 14001; 2015 Environmental management systems.
- ISO 45001: 2018 Occupational health and safety management systems
- EC 82941: 2019 Terrestrial photovoltaio (PV) modules -Quality system for PV module menufacturing







# **JA** SOLAR

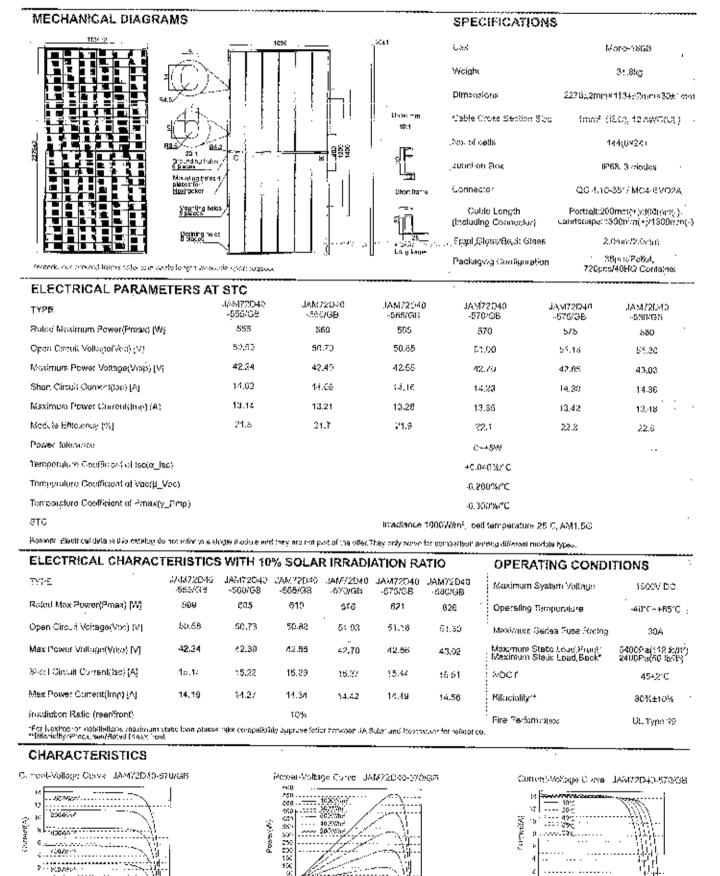
29 61 92 49

Voltege(V)

JAM72D40 555-580/GB

10 30 95 70

VoltagetV)

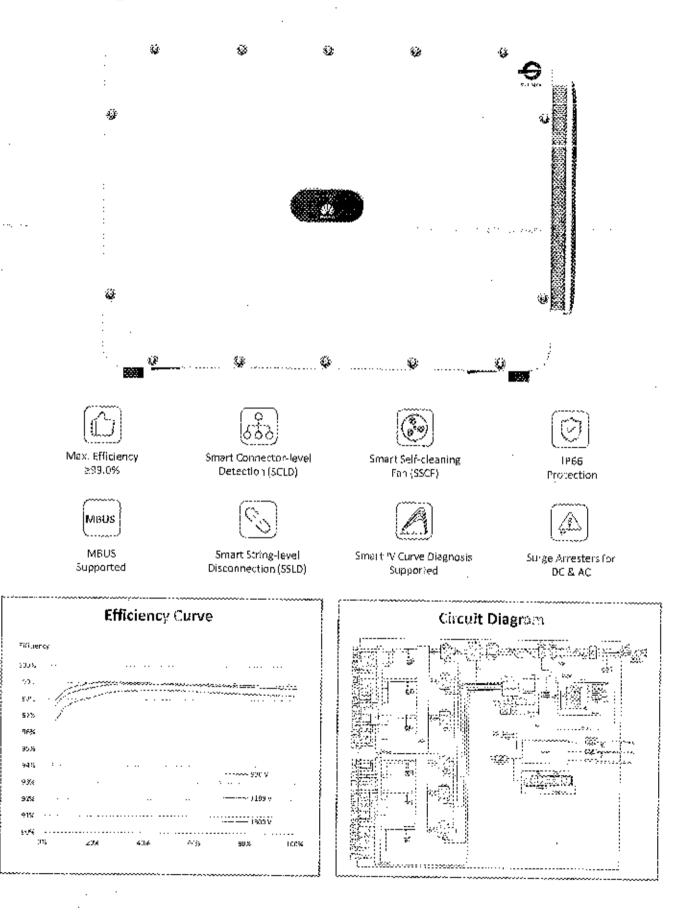


Prentium Cells, Premium Modules

00 in:

VoitooarVN

# SUN2000-330KTL-H1 Smart String Inverter



SOLAR HUAWELCOM

SUN2000-330KTL-H1

# Technical Specifications

|  | Efficiency  |
|--|---|
| Max. Efficiency  | 299.0%  |
| European Efficiency  | ≥28.8%  |
|  | Input   |
| Max. Input Voltege   | 1,500 V   |
| Number of MPP Treckers   | t   |
| Max. Current per MPP?  | 55 A  |
| Max, Short Circuit Current per MPPT  | ана на страна на стра<br>На страна на r>На страна на 
| Max. PV Inputs per MPPT  | 4/3/5/4/5/5   |
| Start Voltage  | 550 V   |
| MPAT Operating Voltage Range   | 500 V = 1,500 V   |
| Nominal mout Voltage   |   |
| A A A A A A A A A A A A A A A A A A A  | 1,080 V   |
|  | Output  |
| Vom nal AC Active Power  | 300.000 W   |
| Most AC Apparent Power   | AV 000,007  |
| Max. AC Active Power (costd=1)   | X30.000 W   |
| Nomina: Output Voltage   | 300 V, 2W i PE  |
| Rated Af-Grid Frequency  | 50 Hz / 60 Hz   |
| Nominal Output Current   | 216.6 Å   |
| Max. Caupet Carrent  | 238.2 A   |
| Adjustable Rower Factor Range  | 0.81G 0,51D   |
| Teta: Harmonic Distortion  | · · · · · · · · · · · · · · · · · · ·   |
|  | <15   |
| Connect States I and Discourses and Mill PA  | Protection  |
| Smart String-Level Disconnex Lor(SSLD)   | Yes   |
| Antl-Islanding Protection  | . Yes   |
| AC Overcurrent Protection  |   |
| DC Reverse-polar by Protection   | Yes   |
| PV-array String Fault Monitoring   | Yes   |
| DC Surge Arreston  | Туре II   |
| AC Surge Arrester  | Туре II   |
| DC Insulation Resistance Detection   | Yas   |
| AC Grounding Fault Protection  | V <sub>65</sub>   |
|  | ······································  |
| Residual Current Monitoring Unit   | Yes   |
|  | Communication   |
| Display  | LEO Indicators, WLAN + APP  |
| USX  | Yes   |
| MIQUS  | Yas   |
| k)485  | "#\$  |
|  | General   |
| Dimensions (Wix Hix D)   | 1,048 x 732 x 393 (nm   |
| Weight (with mounting plate)   | s112 kg   |
| Doe roting Temporature Range   |   |
| Cooling Method   |   |
| and the second second second second second second second second second second second second second second second | Smart Air Cooling   |
| Max. Operating Alticude without Denating   |   |
| Relative Humidity  | 0~100%  |
| Aŭ Connector   | Waterproof Connector + OT/Dff Termina   |
| Protection Regree  | IP 66   |
| Fopology   | and the second second second second second second second second second second second second second second second  |

;





# TECHNICAL DATA SHEET

# SOLAR CABLE PHOTOVOLTAIC (PV) - EN 50618 H1Z2Z2-K 62930 IEC 131

124mm<sup>2</sup> TOU/XLPO/XLPO, 1.5kV D.C ((NATURAL), BLACK) (8SEN 50618) FLEXERE TIMPED COPPER CONDUCTOR, HALOGEN-FREE CHOSS-LINKED (SLFO) INSULATION SINGLE CORE HALOGEN FREE FLAME RETARDANT CROSS-LINKED (XLPO) SHEATHED.

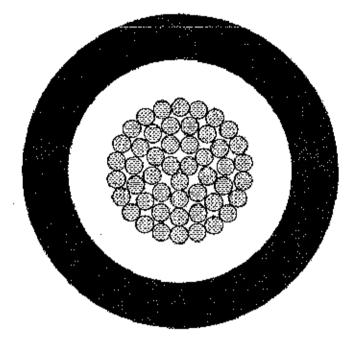
| erence Standard     |
|---------------------|
| er Standard(s)      |
| ed Voltage of Cable |
|                     |

8SEN 50618

IEC 60228, EN 50395, EN 50396, EN 60332-1-2, EN 61034-3/2 & EN 60754-1/2.

1.5/1.5kV D.C (Max. Voltage;1.8kV D.C)

Core colour(s) as per Customer Request.



#### Cable Components

| No. of Core(s)<br>Cross Section Area of Conductor<br>Shape of Conductor<br>Conductor Material/Type<br>Max Diameter of Single Strand<br>Diameter of Conductor<br>Insulation Material<br>Thickness of Insulation<br>Temperature Rating<br>Thickness of Outer Sheath<br>Overall Diameter of Cable<br>Minimum Bending Radius<br>High Voltage Test on Cable in Water Dipping<br>Maximum DC Resistance @ 20°C<br>Weathering / UV Resistance | <ul> <li>1</li> <li>(*) 4 mm<sup>2</sup></li> <li>Flexible</li> <li>Tinned Annealed Copper Class 5 Flexible as per IEC 6022\$</li> <li>0.31 mm</li> <li>(*) 2.6 mm</li> <li>(*) 2.6 mm</li> <li>XLPQ</li> <li>0.7 mm</li> <li>-40°C to +90°C (120°C for max, 20,000 hours)</li> <li>0.8 mm</li> <li>-40°C to +90°C (120°C for max, 20,000 hours)</li> <li>0.8 mm</li> <li>(*) 5.99 mm (Tolerance Range: ±5%)</li> <li>Flixed: 4 X Overall diameter and Flexing: 5 X Overall diameter</li> <li>6.5 kV A.C. for 5 Minutes</li> <li>5.09 Ω/km</li> <li>720 Hrs. No Cracking</li> </ul> |
|---|---|
| Minimum Bending Radius<br>High Voltage Test on Cable in Water Dipping<br>Maximum DC Resistance @ 20°C   | <ul> <li>Fixed: 4 X Overall diameter and Flexing: 5 X Overall diameter</li> <li>6.5 kV A.C. for 5 Minutes</li> </ul>  |
| Continuous Current Rating   | -   |
| Ambient temperature: 60°C<br>Conductor operating Temperature: 90°   |   |

| Method of Installation:                  |   |         |
|--|---|---------|
|  |   |         |
| Single cable free in air                 | : | 65 Amps |
| Single cable free in surface             | : | 52 Amps |
| Two Loaded cables touching, on a surface | : | 44 Amps |

Disclaimen. The Information vorticined within this datasheet is for guipence only and is subject to change without notice or lightlip. All the Information is provided in good faith and is believed to be correct at the time of publication/circulation. When selecting cable accesscribes, pieces note that entries cable dimensions they vary due to manufacturing

Primal to Tableir ( , 'Autob 2006/5022



# TECHNICAL DATA SHEET

## SOLAR CABLE PHOTOVOLTAIC (PV) - EN 50618 H1Z2Z2-K 62930 IEC 131

1x6mm<sup>2</sup> TCU/XLPO/XLPO, 1.5kV D.C ((NATURAL), BLACK) (BSEN 50618)

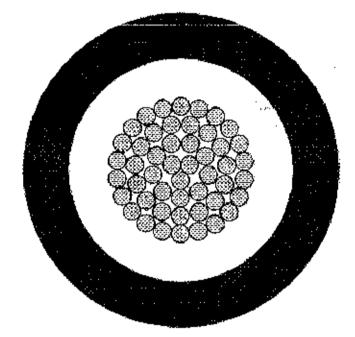
FLEARLE TINNED COPPER CONDUCTOR, HALOGEN-PREE CROSS-LINKED (ALFO) INSULATION SINGLE CORE HALOGEN FREE FLAME RETARDANT CROSS-LINKED (ALFO) SHEATHED.

Reference Standard Other Standard(s) Rated Voltage of Cable BSEN 50618

IEC 60228, EN 50395, EN 50396, EN 50332-1-2, EN 61034-1/2 & EN 50754-1/2.

1.5/1.6kV D.C (Max, Voltage:1.6kV D.C)

Core colour(s) as per Custamer Request.



#### Cable Components

No. of Core(s) Cross Section Area of Conductor Shape of Conductor Conductor Material/Type Max Diameter of Conductor Insulation Material Thickness of Insulation Temperature Rating Thickness of Outer Sheath Overall Diameter of Cable Minimum Bending Radius High Voltage Test on Cable in Water Dipping Maximum DC Resistance @ 20°C Weathering / UV Resistance

#### 1 (\*) 6 mm<sup>3</sup> Flexible Copper Class 5 Flexible as per IEC 80228 0.31 mm (\*) 3.4 mm XLPO 0.7 mm -40°C to +90°C (120°C for max, 20,000 hours) 0.8 mm (\*) 6.85 mm (Tolerance Range: ±5%) Fixed: 4 X Overall diameter and Flexing: 5 X Overall diameter 6.5 kV A.C. for 5 Minutes 3.39 Ø/km 720 Hrs., No Cracking

#### **Continuous Current Rating**

| Amblent temperature: 60°C                |   |         |
|--|---|---------|
| Conductor operating Tomperature: 90°     |   |         |
| Method of Installation:                  |   |         |
| Single cable free in air                 | : | 70 Amps |
| Single cable free in surface             | : | 67 Amps |
| Two Loaded cables touching, on a surface | : | 57 Amps |

Disclatiner: The information contained within this deteched is drawleding only and is subject to change without notice or liability. All the information is provided in good faith and is believed to be correct at the time of publication/birculation. When selecting cable accessories, please note that actual caple dimensions may vary due to manufacturing faitances.

Ref No: TE-148-012025-R1 Dated: 23-01-2025



No. of Pages: 11

| No. of | Pages: 11   |                                       | "Anne        | x B"      |
|--------|---|---------------------------------------|--------------|-----------|
|        | Technical Submit  | tal                                   | _ ! ,        |           |
|        | For supply of KIOSK Sul                                   | stations                              | ·            | ·         |
|        | M/S: Nrtc Energi  |                                       |              |           |
| Gene   | ral Enclosure Specifications:                             |                                       |              |           |
| *      | MANUFACTURING STANDARD IEC 61439-2.                       |                                       |              |           |
| ×      | ENCLOSURE PROTECTION OUTDOOR TYPE.                        | 500M at                               | 10 11 4      |           |
| x      | CUBICAL MATERIAL M.S SHEET THICKNESS 14/16-SWG.           | FORM - 01                             | (P-54        |           |
| ×      | FULLY PAINTED AFTER SURFACE TREATMENT WITH ELECTROS       | TATIC DOLUDED DAME                    |              |           |
| ×      | FOLLOWING COPPER BUSBARS DESIGNED ACCORDING TO JEC        |                                       | RAL -7035.   |           |
| x      | BUS BAR WILL BE PAK MADE, RATED @ 35°C & ACCORDING TO     |                                       |              |           |
| ×      | NEUTAL WILL BE 50% OF THE MAIN BUSBAR & EARTH BAR WI      |                                       | 100.40       |           |
|        | KIOSK Substation SOUKVA (0.5 MW)                          | LL BE 25% OF MAIN BU                  |              |           |
| Sr. #  | Item Description  | na-1-                                 |              | y 08 No.  |
|        | MV Section:   | Make                                  | Model        | Qty       |
|        | 11KV VCB 630A, 25KA Outgoing Panel                        | ·                                     |              |           |
| 1      | as per attached "Annex C"                                 | TE with ABB VCB                       |              | 01 No.    |
| 2      | MV Cable (MV Panel to Transformer)                        | WAPDA approved                        |              | 01 Job.   |
| 3      | LV Cable (LV Panel to Aux. Transformer)                   | WAPDA approved                        |              | 01 Job.   |
|        | Transformer Section:                                      | 100 a Dit approved                    | <b>.</b>     | 101300.   |
| 1      | 630KVA Oil Type Step Up Transformer 0.8/11KV              | Client Scope                          |              | 01 No.    |
|        | Bus Tie Dct Section:                                      |                                       |              |           |
| 1      | Bus Tie Duct TP 630A                                      |                                       | · · ·        |           |
| T      | 2 x (30 x 05) mm per Phase                                | TE                                    |              | 01 Job.   |
|        | Ventilation Section:                                      |                                       |              | <b></b> . |
| 1      | Ventilation System For Transformer (4 Heavy Duty Fan With | *r                                    | Ţ            |           |
|        | Control DB)   | TE                                    |              | 01 Job.   |
|        | Marshiling Box:   |                                       |              |           |
| 1      | Marshiling Box For LV, MV & Tarnsformer Signals           | ΤΈ                                    |              | 01 Job.   |
|        | LV Section:   | · · ·                                 |              |           |
|        | Incoming  |                                       |              |           |
|        | MCCB TP 320A, RC-32KA @ 800V                              | ABB - Italy                           | XT5V-HA 400  | 02 No.    |
| 2      | MCCB TP 320A, RC-32KA @ 800V                              | Space Only                            |              | 02 No.    |
|        | Outgoing  | · · · · · · · · · · · · · · · · · · · | ·            |           |
| 1      | MCCB TP 630A, RC-32KA @ 800V                              | ABB - Italy                           | XT5V-IIA 630 | 01 No.    |
| 2      | Aux.Contacts For MCCB                                     | ABB - Italy                           | XT5          | 01 No.    |
| 3      | Digital Energy Analyzer (0.5 class with TCP/IP Port)      | Circutor/Eqv,                         | CVM-C11      | 01 No.    |
| 4      | Current Transformers 600/5A (0.5 Class)                   | Metelx/Eqv.                           |              | 03 No.    |
| _5     | Surge Protection Device TP @ 800V                         | Citel/Eqv.                            |              | 01 No.    |

Labore: Taij Gerh Boad, Yadgar Shubada Stop, G.Y. Road, Manawan, Labore-Pakistan,
 +92-42-36522861-62-63 +92-42-36522864 info@tariqelectric.com
 Karachi: 1st Floor, MA Tabba Foundation Building, Gizri Road, Stock - 9, Clifton, Karachi,
 Cell: +92-301-1163120

www.tarigalectris.com



Page 6 of 17

Ref No: TE-148-012025-R1 Dated: 23-01-2025



| No. of   | Pages: 11  |   | "Ann        | ex B"     |
|----------|--|---|-------------|-----------|
|          | Technical Submit   | tal                                     |             |           |
|          | For supply of KIOSK Sub                                    | ostations                               |             |           |
|          | M/S: Nrtc Energi   |   |             |           |
| 6        | Indication Lights ON/OFF/Trip                              |   | <u> </u>    |           |
| 7        | Indication Lights R,Y,B                                    | Schneider/Eqv.                          |             | 03 No.    |
| 8        | Control MCB 6ASP, 6KA                                      | Schneider/Eqv.                          |             | 03 No.    |
|          | Panel Accessories:   | ABB - Germany                           | 5H 201      | 06 No.    |
| 1        | Panel Light With Micro Switch                              | Chine .                                 |             |           |
| 2        | Panel Exhaust Fan With Thermostat                          | Chint                                   |             | . 01.Set. |
| ~        | Auxiliary DB:  | Imported                                |             | 01 Set.   |
| 1        | MCCB TP 50A, RC-18KA @ 415V                                | 400                                     |             |           |
| 2        | Indication Lights R,Y,B                                    | ABB                                     | A18 125     | 01 No.    |
| 3        | Control MCB 6ASP, RC-06KA                                  | Schneider/Eqv:                          |             | 03 No.    |
| <u>_</u> | MCB TP 10A, RC-06KA  | ABB - Germany                           | SH 201      | 03 No.    |
| 5        | MCB SP 10A, RC-06KA  | ABB - Germany                           | SH 203      | 02 No.    |
|          | MCB SP 06A, RC-06KA  | ABB - Germany                           | SH 201      | 12 No.    |
|          | Misc. Accessories;   | ABB - Germany                           | 5H 201      | 12 No.    |
| 1        | Lightning Arrester for KIOSK                               |   |             |           |
| 2        | Light Plug Universal (Piano Type)                          | Local                                   |             | 01 No.    |
| 3        | industrial Plug and sockets 32A 4PIN                       | Imported                                |             | 01 No.    |
| 4        | Photoelectric EE Switch                                    | Imported                                |             | 01 No.    |
|          | Alarm Activation System:                                   | Panasonic/Eqv.                          |             | 01 No.    |
| 1        |  |   | · .         | · · ·     |
| 2        | Smoke Dectector System Indication Light for Trip           | Imported                                |             | 03 No.    |
| 3        |  | Schneider/Eqv.                          |             | 01 No.    |
| 4        | Control MCB 6A SP, 6KA<br>Push Button Fault Acknowledge    | ABB                                     | SH 201      | 01 No.    |
| -4<br>5  |  | Camsco/Eqv.                             |             | 01 No.    |
| <u> </u> | Control Relays 4NC/ 4NO 220V<br>Hooter / Buzzer            | Finder/Relpol                           | · · · · ·   | 02 No.    |
| 7        | Revolving Light  | Imported                                |             | 01 No.    |
| 8.       |  | Imported                                |             | 01 No.    |
| <u> </u> | Temperature Sensor with Alarm Contact Panel Accessories:   | Imported                                |             | 01 No.    |
| 1        |  | · . · · · · · · · · · · · · · · · · · · |             | · .       |
| 2        | Tube light 220V (Indoor)<br>Door limit switch              | Imported                                |             | 08 No.    |
|          | Boundry Wall light 220V (Outdoor)                          | Imported                                | _           | 05 No.    |
| 4        |  | Imported                                | · <b></b> · | 06 No.    |
| 4        | Exhaust Fan with Dust filters                              | Imported                                |             | 03 Set.   |
|          | Temperature Section  |   | ·           |           |
| 1        | Temperature Indicator with Sensor & Alarm Contact For Each | Imported                                |             | 03 Set.   |
|          | Compartment (Signal 04-20mA)                               |   |             | 09 Jet.   |
| -        | Auxiliary Transformer:                                     |   |             |           |

Lahore: Taij Garh Road, Yadgar Shuhada Stop. G.T. Road, Manawan, Lahore-Pakistan,
 + 92-42-36522861-62-03 + 92-42-36522864 info@tariqelectric.com
 Karachi: 1st Ptoor, MA Tabba Foundation Building, Gizri Road, Block - 9, Cläten, Karachi,
 Celk + 92-301-1168120

www.tarigetectric.com



Ref No: TE-148-012025-R1 Dated: 23-01-2025





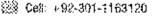
"Annex B"

Technical Submittal For supply of KIOSK Substations M/S: Nrtc Energies Auxiliary Transformer 25KVA, 800/415V 1 TE 01 No. 2 MCCB TP 80A, RC-20KA @ 900V A6B - Italy T4V 250 01 No. Heat Insulation of KIOSK: Roof, Walls & Doors of KIOSK will be insulated with Glass wool 01 Job. which will be with MS Sheet internally. A second second KIOSK Substation 1000KVA (1 MW)  $\mathbf{2}$ Qty 15 No. Sr. # Item Description Make Model MV Section: 11KV VCB 630A, 25KA Outgoing Panel 1 TE with A88 VC9 01 No. as per attached "Annex C" 2 MV Cable (MV Panel to Transformer) WAPDA approved 01 Job. З LV Cable (LV Panel to Aux. Transformer) WAPDA approved 01 Јођ. Transformer Section: 1250KVA Oil Type Step Up Transformer 0.8/11KV 1 Client Scope 01 No. **Bus Tie Dct Section:** Bus Tie Duct TP 1000A 1 ΤE 01 Jab. 2 x (60 x 05) mm per Phase Ventilation Section: Ventilation System For Transformer (4 Heavy Duty Fan With 1 TE 01 Job. Control DB) Marshilling Box: Marshlling Box For LV, MV & Tarnsformer Signals 1 TE 01 Job. LV Section: Incoming MCCB TP 320A, RC-32KA @ 800V 1 ABB - Italy XT5V-HA 400 03 No. 2 MCCB TP 320A, RC-32KA @ 800V Space Only 02 No. Outgoing ACB TP 1250A, RC-66KA @ 900V (ADJ.) LSI 1 ABB - Italy E2.2H/E9 1250 01 No. 2 Motor Mechanism 220V AC ABB - Italy E2.2H/E9 01 No. 3 UVT 220V AC ABB - Italy E2.2M/E9 01 No. 4 Shunt Trip (Open/Close) ABB - Italy E2.2H/E9 02 No. 5 Digital Energy Analyzer (0.5 class with TCP/IP Port) Circutor/Eqv. CVM-C11 01 No. 6 Current Transformers 1200/5A (0.5 Class) Metelx/Eqv. 03 No. 7 Surge Protection Device TP @ 800V Citel/Eqv. 01 No. Indication Lights ON/OFF/Trip 8 Schneider/Eqv. 03 No.

🛞 Lahore: Taij Garh Read, Yadgar Shuhada Stop, G.T. Road, Manawan, Latiore-Pakistan.

3 +92-42-36522861-62-63 3 +92-42-36522864 info@tariqelectric.com

Karachi: 1st Floor, MA Tabba Foundation Building, Gizri Road, Block - 9, Olffton, Karachi.



www.tarigelectric.com

A88 535

Page 8 of 17

Ref No: TE-148-012025-R1 Dated: 23-01-2025



"Annex B"

No. of Pages: 11

Second state

|                    | Technical Submit   | tal            |                  |         |  |  |  |
|--------------------|--|----------------|------------------|---------|--|--|--|
|                    | For supply of KIOSK Sub                                    | stations       |                  |         |  |  |  |
| M/S: Nrtc Energies |  |                |                  |         |  |  |  |
| 9                  | Indication Lights R,Y,B                                    | Schneider/Egv. |                  | 03 No.  |  |  |  |
| 10                 | Control MCB GASP, 6KA                                      | ABB - Germany  | SH 201           | 06 No.  |  |  |  |
| •                  | Panel Accessories:   |                |                  |         |  |  |  |
| 1                  | Panel Light With Micro Switch                              | Chint          |                  | 01 Set. |  |  |  |
| . 2                | Panel Exhaust Fan With Thermostat                          | Imported       | and the state of | 01 Set. |  |  |  |
|                    | Auxiliary DB:  |                |                  |         |  |  |  |
| 1                  | MCCB TP 50A, RC-18KA @ 415V                                | АВВ            | A1B 125          | 01 No.  |  |  |  |
| 2                  | Indication Lights R,Y,B                                    | Schneider/Egv. |                  | 03 No.  |  |  |  |
| 3                  | Control MCB 6ASP, RC-06KA                                  | ABB - Germany  | SH 201           | 03 No.  |  |  |  |
| 4                  | MCB TP 10A, RC-06KA  | ABB - Germany  | 5H 203           | 02 No.  |  |  |  |
| 5                  | MCB SP 10A, RC-06KA  | ABB - Germany  | 511 201          | 12 No.  |  |  |  |
| 6                  | MCB SP 06A, RC-06KA  | ABB - Germany  | 5H 201           | 12 No.  |  |  |  |
|                    | Misc. Accessories:   |                |                  |         |  |  |  |
| 1                  | Lightning Arrester for KIOSK                               | Local          |                  | 01 No.  |  |  |  |
| 2                  | Light Plug Universal (Plano Type)                          | Imported       |                  | 01 No.  |  |  |  |
| 3                  | Industrial Plug and sockets 32A 4PIN                       | Imported       |                  | 01 No.  |  |  |  |
| 4                  | Photoelectric EE Switch                                    | Panasonic/Eqv. |                  | 01 No.  |  |  |  |
|                    | Alarm Activation System:                                   |                |                  |         |  |  |  |
| 1                  | Smoke Dectector System                                     | imported       | · _ · · ·        | 03 No.  |  |  |  |
| 2                  | Indication Light for Trip                                  | Schneider/Eqv. |                  | 01 No.  |  |  |  |
| 3                  | Control MCB 6A SP, 6KA                                     | ABB            | SH 201           | 01 No.  |  |  |  |
| 4                  | Push Button Fault Acknowledge                              | Camsco/Eqv.    |                  | 01 No.  |  |  |  |
| 5                  | Control Relays 4NC/ 4NO 220V                               | Finder/Relpoi  |                  | 02 No.  |  |  |  |
| 6                  | Hooter / Buzzer  | Imported       |                  | 01 No.  |  |  |  |
| 7                  | Revolving Light  | Imported       |                  | 01 No.  |  |  |  |
| 8                  | Temperature Sensor with Alarm Contact                      | Imported       |                  | 01 No.  |  |  |  |
|                    | Panel Accessories:   |                | · · · · · · ·    | 01100.  |  |  |  |
| 1                  | Tube light 220V (Indoor)                                   | Imported       |                  | 08 No.  |  |  |  |
| 2                  | Door limit switch  | Imported       | ··•              | 05 No.  |  |  |  |
| 3                  | Boundry Wall light 220V (Outdoor)                          | Imported       |                  | 06 No.  |  |  |  |
| 4                  | Exhaust Fan with Dust filters                              | Imported       |                  | 03 Set. |  |  |  |
|                    | Temperature Section  |                | · -              | 00.000  |  |  |  |
| 4                  | Temperature Indicator with Sensor & Alarm Contact For Each |                |                  |         |  |  |  |
| 1                  | Compartment (Signal 04-20mA)                               | Imported       |                  | 03 Set. |  |  |  |
|                    | Auxiliary Transformer:                                     |                |                  |         |  |  |  |
| 1                  | Auxiliary Transformer 25KVA, 800/415V                      | TE             |                  | 01 No.  |  |  |  |

Lakore: Tałj Garh Road, Yadgar Shuhada Stop, G.T. Road, Manawan, Lahors-Pakistan, +92-42-36522861-62-63
 H-92-42-36522864
 info@tariqetecbic.com
 Karachi: 1st Floor, MA Tabba Foundation Building, Gizri Road, Biock - 9, Clifton, Karachi:
 Colt: +92-301-1163120



www.tarigelectric.com

Page 9 of 17

Ref No: TE-148-012025-R1 Dated: 23-01-2025



No. of Pages: 01

## "Annex C"

| Technical Submitteel (BA) Cuite-L                                  |   | Annex C   |  |  |  |
|--|---|---|--|--|--|
|  |   |   |  |  |  |
|  |   |   |  |  |  |
|  |   |   |  |  |  |
|  |   |   | ty D1 No.  |  |  |
|  | Make  | Model   | Qty  |  |  |
|  | <u> </u>  | <u>/////////////////////////////////////</u>  |  |  |  |
|  |   |   |  |  |  |
|  | ABB - Italy   |   | 01 No,   |  |  |
|  |   |   |  |  |  |
|  | JSE - Chína   | <u> </u>  | 01 No.   |  |  |
|  |   | T   |  |  |  |
|  |   | REX-610   | 01 No.   |  |  |
|  |   |   | 01 No.   |  |  |
|  |   |   | 01 No.   |  |  |
|  |   |   | 01 No.   |  |  |
|  |   |   | _01 No.  |  |  |
|  |   |   | 01 No.   |  |  |
|  | Schneider / Eqv.  |   | 03 No.   |  |  |
|  | Schneider / Eqv.  |   | 03 No.   |  |  |
|  |   |   | 01 No.   |  |  |
|  | Schneider / Eqv.  |   | 01 No.   |  |  |
|  | Schneider / Eqv.  |   | 02 No.   |  |  |
|  | Klemsan / Eqv.  |   | 01 No.   |  |  |
|  | E-Logics / Eqv.   |   | 01 No.   |  |  |
|  | E-Logics / Eqv.   |   | 01 No.   |  |  |
|  | ABB   |   | 01 No.   |  |  |
|  | ABB   |   | 03 No.   |  |  |
|  |   |   |  |  |  |
| Current Transformers Ratio: (XXX/5/5A), Burden: 10VA, 15VA, Class: |   |   |  |  |  |
|  | FICO / Eqv.   |   | 03 No.   |  |  |
| Potential Transformers, 11kV/V3/110V/V3, Class 0.2 Burden: 100VA,  |   |   |  |  |  |
| 12/36/95KV, SC-25KA  | FICO / Eqv.   |   | 03 No.   |  |  |
| 11KV Surge Arrestor  | Nanyang (china)   |   | 03 No.   |  |  |
| Panel Accessories  |   |   |  |  |  |
| Panel Light + Door limit Switch                                    | Chint - China   |   | 01 No.   |  |  |
| Anti Condenstate Heater 60W With Thermostat                        |   | ···   | 01 No.   |  |  |
| Auto Manual Selector Switch For Heater ON                          |   |   | 01 No.   |  |  |
| Terminal Blocks  | Klemsan   |   | 01 Set.  |  |  |
| E/M Scada Register Shall be verified during FAT.                   |   |   |  |  |  |
|  | For supply of KIOSK Substatic<br>M/S: Nrtc Energies<br>11KV 630A, 25KA Outgoing Panel (I/O)(Inside KIOSK)<br>Item Description<br>Breaker Compartment<br>Motorized VCB 630A, Rated Voltage 12KV withdraw able Typc,<br>Operating Voltage 11KV, 25KA, BIL 36/95KV, with Shunt Coll @<br>110VAC/DC & Motor Mechanism @ 220VAC<br>Earthing Switch<br>Low Voltage Compartment<br>Digital O/C, E/F & S/C Protection Relay With Auto Recloser Function<br>Digital Energy Mater (0.2s accuracy class Compatible with Scada)<br>Analogue Voitmeter scaled (0-15KV)<br>Analogue Ammeter scaled (0-15KV)<br>Analogue Ammeter scaled (0-2XXXA)<br>Voltmeter selector switch (4-Position)<br>LED Type Indication Lights for Phase R/V/B @ 110VAC<br>LED Type Indication Lights for CLB On/Off/Trip @ 110VDC<br>LED Type Indication Lights for CLB On/Off/Trip @ 110VDC<br>LED Type Indication Lights for E.S On @ 110VDC<br>Indication Lights for Heater ON @ 220VAC<br>Push Button ON/OFF<br>Phase Failure Phase Sequance Relay<br>Capacitor/DC Trip Unit<br>TP MCB 06A<br>DP MCB 10A<br>Cable Compartment<br>Current Transformers, 11kV/V3/110V/V3, Class 0.2 Burden: 100VA,<br>12/36/95KV, SC-25KA<br>11KV Surge Arrestor<br>Panel Light + Door limit Switch<br>Anti Condenstate Heater 60W With Thermostat<br>Auto Manual Selector Switch For Heater ON<br>Terminal Blocks | 11kV 630A, 25kA Outgoing Panel (J/O)(Inside XIOSK)         Make           Breaker Compartment         Make           Motorized VCB 630A, Rated Voltage 12kV withdraw able Type,<br>Operating Voltage 11kV, 25kA, Bil 36/95kV, with Shunt Coll @         ABB - Italy           110VAC/DC & Motor Mechanism @ 220VAC         ABB - Italy           Earthing Switch         JSE - China           Low Yoltage Tormpartment         ABB           Digital Energy Mater (0.2s accuracy class Compatible with Scada)         Bile Star / Eqv.           Analogue Voltmeter scaled (0-15kV)         Lumel - Poland           Analogue Voltmeter scaled (0-25kV)         Lumel - Poland           Analogue Voltmeter scaled (0-25kV)         Lumel - Poland           Analogue Voltmeter scaled (0-25kV)         Lumel - Poland           Motorized VCB meter scaled (0-25kV)         Lumel - Poland           Voltmeter selector switch (7-Position)         Camsco / Eqv.           LED Type Indication Lights for Phase R/Y/B @ 110VAC         Schneider / Eqv.           LED Type Indication Lights for C.B On/Off/Trip @ 110VDC         Schneider / Eqv.           IDIgital D Concerner Status Relay         Klemsan / Eqv.           Transformer Status Relay         E-Logics / Eqv.           Phase Failure Phase Sequance Relay         Klemsan / Eqv.           Phase Failure Phase Sequance Relay         Klemsan / Eqv. | Technical Submittal (MV Switchgear)         For supply of KIOSK Substations         M/S: Nrtc Energies         Site A Outgoing Panel (I/O)(Inside KIOSK)         Item Description       Make       Model         Breaker Compariment:       Quarter Site A Bit Science       Quarter Site A Bit Science       Quarter Site A Bit Science         Mate (Voltage 12KV with draw able Type,       ABB - Italy         Operating Voltage 11KV, 25KA, Bit 36/95KV, with Shunt Coll @       ABB - Italy         JONACC & Motor Mechanism @ 220VAC       ABB - Italy         Digital Comparition Mate Colspan="2">ABB - Italy         JONAC Colspan="2">ABB - Italy         Digital Comparition Mate Colspan="2">ABB - Italy         Digital Comparition Mate Colspan="2">ABB - Italy         Digital Comparition Mate Colspan="2">ABB - Italy         Digital Comparition Mate Colspan="2">ABB - Italy         Digital Comparition Mate Colspan="2">ABB - Italy         ABB - Italy         Digital Comparition Mate Colspan="2">ABB - Italy         Digital Comparition Mate Colspan="2">ABB - Italy         Mate Mate Colspan= Equitation Ligh |  |  |

麓 Cell: + 92-301-1163120

www.tarigelectric.com



Page 17 of 17

## EXTERNAL LIGHTNING PROTECTION



GENERAL DESCRIPTIONS

Walt Courses and the

CONVRAGE Early Streamer Emission (COSI) lightning terminal can anticipate of other elements and items within its protectable range according to its protoction level radius by an accepting the lightning strikes and conducting these strikes into the earch through the safest and projected ways. COMTRAGE CESE Terminal work as to principle of creating IONs by its interval iON GUNLAGEON channels. This structure itself allows the terminal to read set the high voltage sightning strikes, even up to 200kA, to the earthing system then to the earth at the kafest way.

8439

3 V. . . .

CONTRACT CESE Lightning Remninal is exclusively suitable to install where primary protection is needed like critical points; nullitary zones and aaro-space bases at higher protection radiuses range.

Tested and certified according to NFC17-102/2011 Early Streamer Emission -Standard including Defial' (ΔT) advance fime tesh current with standing lost to determine CONTRAGO's protection levels.

|                                       |         |     | • •  | • •   |          |     | <br> | <br> |     | - |
|---------------------------------------|---------|-----|------|-------|----------|-----|------|------|-----|---|
| > Righ Salt mist treatment            |         |     |      |       |          |     |      |      |     |   |
|                                       |         |     | •    | • • • | • •      | ••• |      | •    | -   | 1 |
| > Comio sulphurous at nospinere tra   | atur    | ۱e  | •••• | ι     |          |     |      |      |     | ł |
|                                       |         | ••• |      |       |          |     | <br> | <br> | • • | Į |
| > Current withstanding tast: 200kA () | 10/3    | 33  | ιU   | 2L    | <b>:</b> |     |      |      |     |   |
|                                       | • • • • | • • |      |       |          |     | <br> | <br> |     | - |
| > Advance time D./ Ja? (AT) tost      |         |     |      |       |          |     |      |      |     |   |
|                                       |         |     |      |       |          |     |      |      |     |   |

| TECHNSCAL CHARAC                               | TERISTICS                             |  |  |
|--|---------------------------------------|--|--|
| Məterial                                       | Stainless 5.001                       |  |  |
| Weight   | 3.00 kg                               |  |  |
| Ext. Dlameter                                  | 120 mm.                               |  |  |
| enght ih)                                      | 52 cm.                                |  |  |
| Box orght                                      | 55 cm.                                |  |  |
| Red Dometer                                    | 20 mm.                                |  |  |
| Aslaptar Diameter                              | 60mm.Male                             |  |  |
| Code   | IP67                                  |  |  |
| Wirtking Temperature                           | -25°C/ <del>30°C</del>                |  |  |
| : ype of Transipal                             | Electroatme/loheric                   |  |  |
| Internal Insulation                            | ation High Density Polyprothane Rasin |  |  |
| Stundard NFC 17-102/201                        |                                       |  |  |
| Grounding Methoo                               | Wire/Tapp                             |  |  |
| Max, Current Withstend (16/350ps) / >2.5 Mp/g) | 20010A                                |  |  |
| Advance Toris, Adv                             | <u>б0</u>                             |  |  |

| Organizations and the second s | -leigistini |    | NARCH OF CO<br>Protection A<br>Corea | NTHARAS<br>Musica<br>Lauris | <b>U</b><br>Leef |
|--|-------------|----|--------------------------------------|-----------------------------|------------------|
| aur<br>Karneda / SanEsheSm   | 2           |    | 32                                   | ЗУ                          | 43               |
| nor the statistic processing of the statistic statistics   | ۷           | 63 | 69                                   | 76                          | สร เ             |
| I(a) w veter of Kp from tions (b) retentions to the<br>n 20 more that soften look (gives sign proved real<br>soften time content on kernel (sign content) and  | · · · · ·   | 79 | 96                                   | 97                          | 107              |
| eSine for el publicar (set uk (Pértinan Astrocetor)<br>del ni mare pranten (set ki) (Suentard astrocetor)<br>ado = kiešE tre districtus (districtus) de ce úng tu der  | 10          | /9 | อส                                   | 59                          | - 35             |
| <ol><li>and total re.</li></ol>  |             |    |                                      |                             |                  |

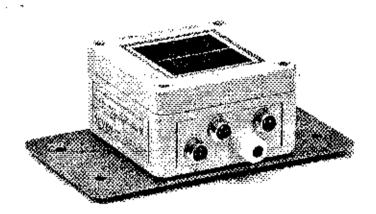
| Akgh vältäge höpušterinines.              | KON GENERALISE DAK                    |
|---|---------------------------------------|
| Completely autonomous                     | Testable with ORBITAL Texters         |
| 10% moint efficient than passive systems. | -Fally composition with the standards |
| Electroatmospheric repactor Inside        | 20 years thin that unon warranty      |

ODTÜ METU

# 3S-SR-3T-WS-MB



# PROJ-0121-YWM-MS-DWG-0002-00 Solar Radiation Sensor Box Measurement of Solar Irradiance



#### MODE OF OPERATION

A silicon solar cell can be used as an irradiance sensor, because the short-circuit current is proportional to irradiance. Our sensors are built out of a monocrystalline solar cell connected to a shunt. Due to the low resistance of the shunt the cell operates next to short circuit.

The temperature coefficient of the short-circuit current creates a small error.

The compensation is realized by using a specific temperature sensor laminated to the rear side of the solar cell. The measuring signals of short- circuit current of the cell and the resistance value of the temperature sensor are measured by a micro controller.

The calculated values of irradiance and temperature given onto a RS485 port with customer specification protocol. The electronic circuit is optimized for low power consumption.

#### MECHANICAL CONSTRUCTION

The solar cell is embedded in Ethylene- Vinyl- Acetate (EVA) between glass and Tedlar. Plain integration into the top cover of the box Advanced weatherproof junction box made of UV resistant material with cable gland and screw-less terminal for the connection of the measuring cable, therefore, the sensor construction is comparable to that of a standard PV module. The electrical connection is realized by a 3m cable.

# 3S-SR-3T-WS-MB

.....

. .....



ALL SENSOR'S ARE CALIBRATED IN SIMULATED SUNLIGHT AGAINST A REFERENCE CELL OF THE SAME TYPE. THE REFERENCE CELL IS PERIODICALLY CALIBRATED AGAINST A REFERENCE CELL CALIBRATED BY FRAUNHOFER ISE, FREIBURG.

## TECHNICAL DATA

| General Information   |   |
|-----------------------|---|
| Solar Cell            | Monocrystalline Skicon (52 mm x.52 mm)  |
| Current Short         | High precision shunt resistor directly soldered to the terminals of the cell  |
| Operating Temperature | 30°C is +70°C   |
| Electrical Connection | 3 m PUR Cable, UV and weather registant   |
| Power Supply          | 12 to 30 VDC (30 mA typically at 20 VDC)  |
| interface             | RS485 0p to 19200 Badd  |
| Protocol              | The censor is connected via s 2-wire RS465 bus with open vendor-<br>independent Modbus RTU protocol   |
| Galvanic Isolation    | 1000 V between power supply and RS485 bus   |
| Case                  | Advanced weatherproof junction box made of UV resistant material  |
| Dimensions, Weight    | 94 mm x 94 mm x 57 mm, approx, 200 g  |
| Protocžen             | (F64  |
| Acouracy              |   |
| Imadiance             | 10 1500W/m <sup>2</sup> , Accuracy of monthly sums compared to a W.M.O. class 1<br>Pyranometer (s.g. CMP 11) according to ISO 9080: better ±5%  |
| Dritt                 | Very small drift of <0.3% year  |
| Electrical Connection |   |
| Brown                 | Power (+)   |
| White                 | Power (-)   |
| Green                 | R\$485 Data (+) / A   |
| Yellow                | RS485 Data (-) / B  |
| Raputri               | 3S-WS-PLS, Wind speed sensor. 2 pip connector   |
| laput 2               | 3S-AT-18B20, Ambient temperature sensor, 3 pin connector  |
| Input 3               | 33-MT-18620, Modula temperatura sansor, 4 pin connactor   |
| Others                |   |
| Calibration           | individual calibration of each sensors in the natural sublight at AM 1.5<br>spectrum by means of a compatible calibrated reference calibrated reference calibration.  |
| Happiling Case        | The sensor can be cleaned using a smooth potton cloth, water and a mild<br>cleaning fuld. Opening of the sensor case by the user or installation staff is not<br>necessary. If the case is opened, we cannot gue/antee the seaf of the case<br>anymore. |
| Modbus Specification  |   |
| Baud Rate             | 1200, 2400, 9600, 19200, 38400  |
| Parity                | No, aven, odd   |
| Stop Bit              | 1, 2 (enly at no parity)  |
| Factory Default       | 9600 Bazd, SN1, address: 1  |

3S-SR-3T-WS-MB

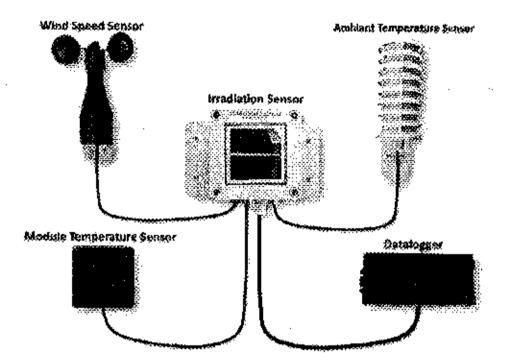
-----



. . . . . . . . . . . . . . . .

. . . .

### WIRING EXTERNAL SENSORS



#### RELATED PRODUCTS

| SS-WS-PLS   | Wind speed sensor, read cordact, polse   |
|-------------|--|
| 38-AT-18B20 | Ambient temperature sensor, DS15B20  |
| 3S-MT-18920 | Module icorperature sensor, OS18B20  |
| 38-PS-12VDC | Power supply, 220VAC, \$0/50Hz_32VDC, 300mA  |
| 38-Shield-A | Sclar Radiation Siteld for Ambient Temperature Sensor PT150, PT1000,<br>DS18820 stc. |



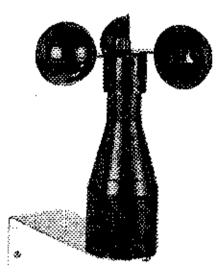
\_\_\_\_\_

# Wind Speed Sensor

## APPLICATION

Small and economical anemometer with digital output used to measure wind speed at solar power plants as well as at universal applications. Compatible with SEVEN Sensor Box, Supplied with stainless steel mounting bracket and Cable.

\_\_\_\_\_



## TECHNICAL DATA

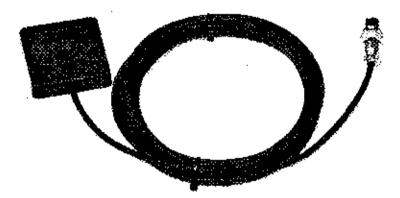
| Sensor type         | UV resistant plastic material cup star anemometer |
|---------------------|---|
| Output Signal       |   |
|                     | Roed relays, 2.5 Hz / (m/s) puise                 |
| Measuring Range     | 0,940m/s  |
| Accuracy            | ±0.5 m/s or ±5 % of measuring value               |
| Resolution          | 0.4 is wind run                                   |
| Frequency           | 0100 Bz   |
| Contact Load        | 10 W, 1788, 32 V DC, max, 0,4 A                   |
| Ambient Temperature | -25+88 °C, los-free                               |
| Cable               | 3 m LIMY Cable, UV and weather resistant          |
| Protection          | (P54)   |
| Stavival Speed      | Max, 60 m/s                                       |
| Dimensions          | 234 mm x 175 mm                                   |
| Weight              | 0.3 kg  |



# **Module Temperature Sensor**

# APPLICATION

Maxim DS18B20 is an economical digital module temperature sensor for universal application as well as for solar photovoltaics projects. Compatible with SEVEN Sensor Box.



## TECHNICAL DATA

| Géherai Information |   |
|---------------------|---|
| Sensor Type         | OS18820 digital temperatura probe, for flat surfaces (back side of solar panet) |
| Measuring Range     | ~\$5+\$25°C   |
| Accurecy            | ±0.6 °C   |
| Sensor Housing      | Plastic hoosing with atomizum plate, H x W x U 12 mar x 50 mm x 30 mm           |
| Cable               | 5 m PUR Cable, UV and waathar resistant   |
| Protection          | 8267  |
| Connectios          | One-Wire-Bus technique  |

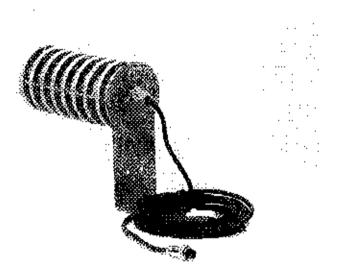


**. . . . . . . . . . . . . . . . .** . . . . . . .

# Ambient Temperature Sensor

## APPLICATION

Maxim DS18B20 is an economical digital ambient temperature sensor for universal application as well as for solar photovoltaics projects. Compatible with SEVEN Sensor Box. For this, SEVEN provides a stainless-steel mounting bracket and UV resistant solar radiation shield.



## TECHNICAL DATA

| General Information |   |
|---------------------|---|
| Seasor Type         | Dö16520 digitel temperature probe                 |
| Measuring Range     | -55+32610   |
| Accuracy            | ± 0.6 ℃   |
| Sensor Housing      | Staintess steet tube, 6 mm diamater, 60 mm tength |
| Cable .             | 3 m or 5 m PUR Cable, UV and weather resistant    |
| Protection          | 1965  |
| Connection          | Ons-Wire-Bus technique                            |



# Modbus RTU Specifications

## Supported Bus Protocol

BaudRate:1200,2400,9600, 19200,38400 Parity: No, even, odd Stop Bit: 1, 2 (only at no parity) Factory Default: 9600 Baud, 8N1, address: 1

Transmission mode: MODBUS RTU

Supported function codes:

- 0x04: Read Input Register

The following Mod bus data can be read individually or in blocks:

| D-Dec.     | ID-Hex | Value  |
|------------|--------|--|
| 0          | 0x00   | Irradiance value 016000 in 0.1 Watt/m²   |
| 1          | 0x01   | Temperature of measuring cell 01000 [range -2575°C] in 0.5°C                   |
| 2          | 0x02   | External temperature 1 01000 [range -2575°C] In 0.5°C                          |
| 3          | 0x03   | Wind speed in 1/100 m/s 06000  |
| 4          | 0x04   | External temperature 2 01000 [range -2575°C] in 0.5°C                          |
| 5          | 0x05   | Temperature compensated irradiance value 016000 in 0.1Watt/m <sup>2</sup>      |
| 6          | 0x06   | mV value of irradiance input 010000 in 0.01mV (raw data)                       |
| 7          | 0x07   | Temperature of measuring cell 01800 [extended range -55125°C] in 0.1°C         |
| 8          | 0x08   | External temperature 1 01800 [extended range -55125°C] in 0.1°C                |
| 9          | 0x09   | External temperature 2 01800 [extended range -55125°C] in 0,1°C                |
| 10         | 0x0A   | External humidity (Temp./Humidity sensor) 0100 [%] actual always "0"           |
| <b>1</b> 1 | 0x0B   | Digit value of the ADC [04096] (raw data)                                      |
| 12 ·       | 0x0C   | Wind sensor pulse frequency of last wind measurement cycle (raw data)          |
| 13         | 0x0D   | Wind sensor number of pulses since last modbus read out (high-word) (raw data) |
| 14         | 0x0E   | Wind sensor number of pulses since last modbus read out (low-word) (raw data)  |
| 15         | 0x0F   | Cell temperature as 'sign value' -550 +1250 [range -55 +125°C] in 0.1°C        |
| 16         | 0x10   | Ext. temp. 1 as 'sign value' -550 +1250 [range -55 +125°C] in 0.1°C            |
| 17         | 0x11   | Ext. temp. 2 as 'sign value' -550 +1250 [range -55 +125°C] in 0.1°C            |

SEVEN Sensor Solutions (3S) • sales@sevensensor.com • www.sevensensor.com

# Financial Breakup

|  |   |  |             |  |   |   |                | and part of them |
|--|---|--|-------------|--|---|---|----------------|------------------|
| 1 Ferners' on Lipost dig                               | NUPAR   | 36 km+ (A steel 2 dites)   |             |  |   | 200500000000000000000000000000000000000 |                |                  |
| > Inegr 8 Brghooting                                   | у<br>   | 749 B.M (2.2) 441 B.CH. 651  | ···-        | Jet  | 22YTH/te  | 197 AOK                                 | T-0.23         | 5, 217, 646      |
| 2 Unternation of Approxim                              | vidEd   | Luci As par Regtoral Environmentel Instanton Agency  |             | _  |   |   |                |                  |
| Civit Works  |   |  |             |  |   | ġ.                                      |                |                  |
| 1 Geo Toshofaal Shud wa                                | RE<br>  | Live and considered for each site members of in the zone.  | -           | 8  | 0000019280.   | 842309626                               | C 10011071     | 0178120          |
| V Lond properties                                      | ц   | SEE 2.3 M/V  | . <u> </u>  | ¥  | 9.'928'V.4.7  | 1.02,545.45                             | 1,772727.1     | 12 222 22 2      |
| I  | ¥   | 852 0 XW   | '           | بة   | 2,250,056,00  | <br>                                    |                |                  |
|  | 분   | the first stored for 20 di 420 consistend in the zone.   |             | ¢¢   | 2,630,000.00  | 13,000,000,00                           | 20/00/06/2     | 12,021,011-01    |
| _ I  | , w   | I twin valive 1000 motors also fusived length is considered for cash alle  |             | ę,   | 2,826,100,000   | 15,125 C0 0 0 0                         | Z 10C,920L/0   |                  |
| - 8%-1   | y   | Кора Пастана и собор Калариана   |             | de.  | MINE/00   | 16,000 000                              | 2400.000       |                  |
| <ul> <li>If very name</li> <li>Observations</li> </ul> | 7   | it was not the web back a second relief  | 10          | 3  | 2859.000  | 12,Setters                              | 200000         | 14:50:000        |
| 12   | NE<br>2000000000000000000000000000000000000         | i tri nati onstanto la vechale merioredia forto zaro.<br>540-2000 contrava secondo contrava e contrava e contrava e contrava e contrava e contrava e contrava e contrava   | 2           | 3  | 1, 130,030  | 200000                                  | 1,272.010      | B 375            |
| PV Plant   |   |  |             |  |   | â                                       |                |                  |
| i PV Parcis  | . WATMCJCANADIAN <sup>1</sup> Tim 1<br>11.//SOUWMAC | 4 <sup>1</sup> Tim 1   | 282         | W21  | 25,252,02   | 0010/2022/86                            | -<br> <br>     | 5 R S 3 7 89     |
| - I  | WOITUNGLAAR 4.                                      | Surt 37 ng aveter - NV Series  | <br>88<br>1 | kitikan.   | 10 202 00   | . w Janac                               |                |                  |
|  | ¥.  | +EC #W+122   |             | KM3T:  | 12400.00  | 78.750,000 00                           | 14.775 00.00   | 1.00.000 F       |
| 4 (300%)   | COMMAN 5  | Overal of the output of the ou | ·           | <br>  <u>*</u>   | x march   | 12.555,041-01                           | 2,205 (40) (0) | 14452 000        |
|  | 2 2   | и и жило удели (о токо токо жилисти<br>Ц ИЛА и Килит дер Пос дерани и нацин хулатте  | -<br> -     | 7  | 1,200,000,000   | 1100 Million                            |                |                  |
|  | Ne constant   | Lettra (sevene) un   | -           | Strain and a strain and a strain and a strain a strain a strain a strain a strain a strain a strain a strain a | ESCOLUTION DE LA COLUCIONE  | 10000000000000000000000000000000000000  |                |                  |
|  |   |  |             |  |   | 19393-00355799999999                    |                |                  |
|  |   | 方がらないというないで、「東京というないないない」  |             | 2212222222A0000  | Delete and the second |   |                |                  |

-

.

:

:

•

.

.

. . .

.

:

.

.

.

.

:

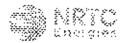
.

.

# O&M Manual



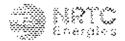
# NRTC Energies – Operation and Maintenance Plan (O&M Plan)



:

i

|          | itents<br>oduc | tion                                 |
|----------|----------------|--------------------------------------|
| 1)       |                |                                      |
| -)<br>2) |                | M Services                           |
| -/<br>3) |                | M team Organogram                    |
|          |                | ponsibilities                        |
|          |                | ead of Department (HOD)              |
|          |                | &M Engineer                          |
|          |                | ead HSE                              |
|          |                | ssociate O&M Engineer                |
|          |                | echnician                            |
|          |                | /ashing Supervisor                   |
|          |                | ashing Labor                         |
|          |                | pe of Services                       |
|          |                | onitoring                            |
|          |                | eaning Scope/Methodology:            |
|          |                | aintenance                           |
|          | ·5)            | Operational Maintenance              |
| -        | .6)<br>-`      | Preventative Maintenance             |
|          | .7)            | Monthly Inspections                  |
|          | .8)            | Bi-Annual Inspections                |
|          | .9)            | Annual Inspections                   |
| -        | .10)           | Corrective Maintenance               |
| •        | .11)           | Response to Fault Messages           |
|          | .12)           | O&M Strategy in case of the fault    |
|          | 13)            | Performance Reporting                |
|          | 14)            | Security:                            |
|          | 15)            | Safety:                              |
|          | 15.1           | Standard Guidelines for Safety       |
| 4.       | 15.2           | Operation,                           |
|          | 15.3           | Safety Warnings and Cautions General |
|          | 15.4           | Work Site                            |
| 4.       | 15.5           | Additional:                          |



## Introduction

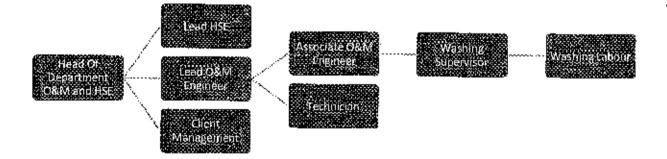
The goal of this plan is to reduce the cost and Improve the effectiveness of operations and maintenance (O&M) for photovoltaic (PV) systems. Reported O&M costs vary widely based on the requirements of the system, but a more standardized approach to planning and delivering O&M has the potential to both decrease costs and make those costs more predictable over time. However, the bigger payoff for improved O&M is increased performance.

#### 1) C O&M Services

O&M Services includes Operations, Maintenance and cleaning of complete plant, 24/7 monitoring of plant through online software, scheduled or Emergency corrective and preventive maintenance, monthly, biannually and annually inspection and testing of plant. Analyze the Data (fact and figures) make the reports on Daily, Weekly and monthly bases.

Detail Description of work is Defined Below

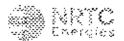
#### 2)E O&M team Organogram



#### 3): Responsibilities

#### 3.1) Elead of Department (HOD)

- Manage all the operation and Maintenance Activities of plant along with all the resources.
- Manage and report all sites activities to the BOD.
- Review the whole progress of all operational plants on daily, weekly and on annual basis.
- Manage the activities of O&M team.



- Manage and control the operational budget of the plant.
- Ensure the activities performed under HSE compliance.
- Client management.
- Over view the performance of O&M team.
- Ensure the quality of work.
- Engage the EPC-C during handover plant to O&M department and ensure the work done as per BOQ.
- Atrange the audit of hand overing plants to O&M department.

## 3.2)10&M Engineer

- Report site problems timely to the IIOD.
- Materials arrangements and mobilization for the site activities.
- Analyze all quality checks performed during monthly inspection of Solar system.
- Train on site resources for System operation, maintenance and cleaning.
- Maintain monthly report of installed system.
- Able to troubleshoot installed Solar system.
- Ensures that tools and test equipment are properly maintained and fit for purpose.
- Comply with Company health, safety and environmental policies.
- Manage the inventory by regularity checks.
- Keep the performance parameters under observation and perform tests time to time to improve the
  performance of plant.
- Proactively manage the team in case of fault and always try to minimize the down time or production loss.
- Maintain all kinds of record reports, inspection check lists, inventory and budget record.

#### 3.3) Lead HSE

- Conducting HSE compliance audits on regular basis.
- HSE trainings on weekly basis, physical and virtual.
- Reviewing HSE documentation and its implementation on regular basis.
- Inspection of fire extinguishers on monthly basis.
- Risk evaluation of the site and its prevention.
- PPEs provision to teams and inspection on regular basis.
- Waste management inspection on regular basis.
- Incident investigation and reporting.
- Reporting of HSE statistics to BOD on regular basis.
- Certified safety trainings of employees on annual basis.

#### 3.4) Associate O&M Engineer

- Prepare daily plant operations report.
- Responsible for generating weekly operation and maintenance progress report.
- Lead and supervise washing activities.
- Responsible for generating schedules of plant washing activities and mobilize the manpower accordingly
   across the fleet of solar plants.
- Identifies washing problems and develops corrective action plans.
- Co-ordinate and update higher management on net washing expenditure.
- Provide timely written review reports from field operation, status and constructive feedback as requested.
- Work with other members of the maintenance team, sub-contractors and other groups to equipment

replacement and installation.

- Record and report all faults, deficiencies, and other unusual occurrences on plants.
- Participate in continuous improvement initiatives and associated periodic meetings

## 3.5) Technician

- Daily inspection of PV modules, inverters, LT's, MV's, Transformers and update the issues accordingly.
- Monitoring a site and its activities with the instruction of Lead O&M engineer.
- Report all the activities/issues to Lead O&M Engineer.
- Able to troubleshoot and installed solar system.
- Manage all the maintenance activities of the plant.
- Report all the issues to the Lead O&M engineer.
- Perform all the preventive maintenance effectively and the corrective maintenance with the minimum loss impact.
- Perform all the quality checks during the all kinds of inspections.
- Update the Lead O&M engineer about the stock.
- Maintain the fault reports and inspection record.
- Comply with Company health, safety and environmental policies.
- Handle the labor and train them according to work conditions.

#### 3.6)IWashing Supervisor

- Pre-Inspection of PV modules, structure and working area.
- Training of washing labor on regular basis, according to HSE standards.
- Fill the washing inspection check list after completing the washing activity.
- Ensure the safety of labor and inspection of PPEs on regular basis.
- Inspection of washing equipment's before starting activity.
- Prepare daily report of washing and share the results with pictures.
- After completion of work ensure braker and pressure pumps are proper close and system is isolated.
- Ensure the SOPs of washing are followed.

#### 3.7) Washing Labor

- Inspection of PV modules.
- Inspection of washing tools.
- Washing of solar panels in compliance with washing SOP's.
- Cleaning of inverters.

#### 4) Scope of Services



The scope of O&M activities comprised of the following:

#### 4.1)Monitoring

Realtime online monitoring and controlling of the PV System 24/7.

Remote access to all operational data for the PV Power Plant will guarantee the uninterrupted transfer and acquisition of operational data to the remote monitoring system.

Following shall be the features of the gateway and remote monitoring system:

- Online monitoring system.
- Alarms / alerts and timely notification of key performance indicators.
- Monthly and annual reporting including system availability, system output (characterization of spatial and temporal variations), capacity factor, degradation trends, average and cumulative output opening/closing of service tickets, spare parts used, and any deviations from the guaranteed generation.
- Status of equipment and protections (DC & AC).
- Separate monitoring of inverters, DB including PV Module string level (current and voltage) monitoring.
- Any reductions in performance will be logged.
- The data shall present the status of the PV Power Plant, including the Performance Ratio, annual overview, and the current power being generated and exported to the Client.

## 4.2) @leaning Scope/Methodology:

Manual labor cleaning with wipers and pressure water.

This method requires human operator to clean manually with the help of mop or solar wipers. The quality of cleaned surface is judged by visual method by the O&M team and washing supervisor himself for the satisfactory level or till the dust particles get wiped out completely. For Minimum water consumption pressure nozzles and pressure-controlled water punsps are used.

#### Please check "Annexure A-Panel cleaning SOPs for more details".

#### 4.3)Maintenance

The Maintenance activities will be divided into the following parts:

- Operational Maintenance will include operation of Solar PV Systems.
- Preventative Maintenance will include inspections and tests of Solar PV equipment to depict their performance.
- Corrective Maintenance will include troubleshooting and parts replacement (if required) in case of abnormal behavior, component failure or breakdown.

#### O&M Task Sheet:

Below table summarizes the scope of work of operations and maintenance related work under the Operations and Maintenance of the Solar Equipment:

| TASK   | WEEKLY     | MONTHLY               | QUARTERLY                              | ANNUALLY   |
|--|------------|-----------------------|--|------------|
| System performance monitoring (remote)                       |            | · · · · · ·           | × .                                    | ·          |
| System performance analysis and report                       |            |                       | · · · į                                | ~          |
| Operator training for safe operation                         | ↓          | ×                     | ×                                      | 4          |
| Cleaning of panels   | ↓<br>✓     | × ···-                |  |            |
| System monitoring/inspection on-site                         |            | *                     | <u></u>                                |            |
| Inspection of modules (Thermal imaging)                      |            | · ·                   | <ul><li>✓ *</li></ul>                  |            |
| Each array voltage and current test                          | · ····     | ~                     | √ ×                                    | <b>_</b> _ |
| Checking inverter settings and its output                    |            |                       |  | √*         |
| Inverter power factor settings                               | 1          |                       |  | √*         |
| Electrical system and circuit breakers<br>inspection         | ~ <b>√</b> | ×                     | ~                                      | 4          |
| Analyzing system wiring condition                            | ·          | <u>├</u> ·── <u> </u> |  |            |
| System grounding test  |            |                       |  | √          |
| Inspection of panels mounting structure                      |            | 1                     | ······································ | √          |
| dentification of shading on panels by<br>surrounding objects |            | └<br>                 | <u></u>                                | _,         |

\* The activity/task may or may not be done, it may depend on the condition and requirement analysis of the plant.

#### 4.5).1 Operational Maintenance

Operational maintenance will include,

- Cleaning of solar panels monthly or according to site conditions.
- Checking Inverter Display Parameters.
- Visual Inspection of cable trays against any damage.
- Visual Inspection of solar panels against any damage.
- Checking functionality of installed equipment.
- Checking all the operation equipment status from the online portal.

#### **4.6)**□ Preventative MaIntenance

- Mounting Structure inspection for sturdiness and corrosion.
- Visual inspection of Solar Panels and DC Connectors.
- Checking terminal and cable connections of inverters.
- Monitoring on the online system which includes to check all the currents, inverter status and acknowledge of all the alarms and inform the maintenance team for rectification.
- Checking functionality of Inverters and online system.
- Inspection of LV DB of inverters and main DB.
- I-V characteristic curve measurements of the affected PV Module strings to identify the reason in case of reduced output.
- In addition, detailed BI-Annual and Annual Inspections of the complete plant shall be performed, and the report shall be submitted.

#### 4.7) I Monthly Inspections:

- Inspection of complete solar equipment during the monthly site visit.
- Inspection of Inverter, panels, structure, transformer and all related equipment.
- Testing of stings.
- Inspection of Fire cylinders and HSE equipment.
- PR calculation of PV plant.

Following checklists are filled during monthly inspection site visits:

- I- Inspection of washing
- li- Inspection of HSE equipment
- lii- Inspection of cables and tables
- iv- Inspection of inverter
- v- Inspection of PV modules.
- vi- Inspection of EMS
- vii- Inspection of Transformer
- viii- Inspection of electrical DBs

#### 4.8)□ Bİ-Annual Inspections

following parameters shall be checked and tested during the bi-annual inspections,

- 100% visual inspection of PV Modules regarding damage shall be performed during 1st blannual inspection.
- Random visual PV Module damage inspection during and biannual inspection.
- Random check for loosening of PV Modules.
- Random testing of sturdiness of mounting foundation / system and random substructure corrosion inspection.
- Testing of inverter features according to manufacturer's maintenance schedule.
- Maintenance of inverters according to manufacturer's instructions.
- Inspection and functional check of complete security surveillance system including fences if any, cameras, etc.
- Functionality testing of the monitoring system.
- Maintenance of all PV Plant components according to manufacturer's instructions.
- Checking of expiration date of the fire extinguishers installed on-site.

#### 4.9) Annual Inspections

- Visual damage inspection of all accessible cable trenches and cable trays.
- Visual inspection and random testing of PV Module string connectors.
- Visual inspection of all PV Modules, all components and degree of pollution.
- Thermography of PV Modules to identify hot spots of cells, busbars or connectors.
- Maintenance of sensors of weather station based on manufacturer's instructions.
- Visual inspection of all Breakers.
- Inspection of overvoltage protection regarding external damage.
- Functional check of internal and external overvoltage and undervoltage protection through operation
  of test terminal.
- Functional insulation monitoring check.
- Check of control and auxiliary voltages.
- Check of the safety circuit for the interruption of the AC-grid protection in the case of failure (emergency shutoff, over-/ undervoltage, over temperature, etc.).
- Visual inspection of AC- and DC clamps for tightness and discoloring, tightening of clamps.
- Maintenance of inverters according to manufacturer's instructions.
- Visual inspection of PV Power Plant regarding accessibility and stability for which would be needed for the replacement of an inverter or PV modules.
- Ground maintenance includes all procedures necessary to avoid PV Module shading. This includes the levelling or any new constructed buildings.
- Grounding continuity and resistive values verification.
- IV curve tracing of whole plant.
- Comparison report with respect to irradiance.
- PR calculations of PV plant,

#### 4.10)II Corrective Maintenance

Following corrective maintenance services will be perform during O&M,

- Critical Reactive Repair
- Condition Based Maintenarice
- Warranty Enforcement
- Equipment Replacement through Spares (planned/unplanned)
- Complaint Management

#### 4.11) Response to Fault Messages

Every fault message shall be registered and stored in our data record.

- All fault messages and results relevant for the operation of the PV Plant shall be documented in the ticketing system. Any fault messages resulting in fault calls shall be documented in the corresponding monthly reports, indicating start and end of fault, reason and/or any performed repair works, as well as the respective components of the PV Plant fault management / warranty defects.
- Fault management procedures shall include necessary communication of faults, coordination of on-site appointments with service staff, as well as the corresponding and general operational structure.
- Fault management procedures shall include the preparation, handling and support in events covered by
  insurance provided by OEM, and the enforcement of claims for compensation to third parties, including
  the component manufacturers.
- All defects shall be documented within the same day of detection, and a summary provided to Company
  on a monthly basis in the corresponding monthly report. All fault and defect rectification shall be
  included in the monthly reports, with reference to the initial alarm/notification of occurrence.
- Warranty claim matters will be dealt with the manufacturer of prescribed equipment and will have specified time.

#### 4.12)I. O&M Strategy in case of the fault

#### DC Side faults:

To perform any kind of testing/trouble shooting on the DC string in case of any fault, string must be isolated from the system before performing any task verify the irradiance fail is less then 350 w/m<sup>2</sup>.

- Turn off the AC switch.
- Turn off the DC Isolator.
- Check the current in the string from the clamp meter.
- Separate the string from the MC4 Connector.
- Perform the trouble shooting.

#### Inverter Trouble Shooting:

Isolate the inverter before any troubleshooting. If the maintenance works will be required then the inverter must be completely isolated from the system, the supply must be turned off from the MV panel prior to perform any activity and must confirm the voltages from the Meter before starting any kind of activity at the inverter.

#### Inverter Isolation

To perform any kind of the trouble shooting at the inverter it must be completely isolated from the system. Always keep in mind that the inverter is powered by dual sources: PV strings and utility grid.

Proceed as follows to stop the inverter during normal maintenanco and service work as follows:

- Stop the inverter using stop button instruction sent by the APP. The inverter stops.
- Disconnect the AC circuit breaker.
- Set the DC load-break switch of the inverter to OFF.
- Wait at least 10 minutes for inner capacitors to discharge completely.
- Verify that there is no voltage or current before pulling any connector.
- Wait for the module DC side voltage drops below the safety voltage.

When a fault occurs Proceed as follows to stop the inverter when a fault or emorgency loccurs as follows:

- Inverter will stop automatically in case of fault.
- Disconnect the AC circuit broaker.
- Set the DC load-break switch of the inverter to OFF.
- Walt at least 10 minutes for inner capacitors to discharge completely.
- Verify that there is no voltage or current before pulling any connector.
- Wait for the module DC side voltage drops below the safety voltage.

#### inspection before starting

After the maintenance or service work, you may start the inverter. Restart the inverter only after removing the fault that impairs safety performance.

As the inverter contains no component parts that can be maintained, never arbitrarily replace any internal components.

Inspect the following requirement before starting the inverter:

- All connections are done by strictly following the Installation manual and circuit diagram.
- The coverings of the internal devices are fixed and secured.
- Make sure, via suitable Instruments, that there is no ground fault of the PV modules.
- Measure the DC and AC current with multimeter to check if they fulfill the module startup conditions and there is no overvoltage bazard.
- After long time storage, a thorough and professional test is necessary before starting the inverter.

#### 

The performance of plant is monitored, recorded and shared on daily, weekly, monthly, half-yearly, and yearly basis.

Performance Reports shall include the following,

- Plant availability
- Daily Generation vs Daily Irradiation
- Actual Monthly Generation corresponding to Actual Irradiation
- Expected Monthly Generation corresponding to Expected Irradiation (PV Syst values)
- Actual Monthly Performance Ratio
- Lost Time log
- Committed Energy
- Inventory Status
- Information about any maintenance activity
- Fault messages and calls

A list of O&M reporting and its frequency is attached as an "Annexure F-List of O&M reporting".

#### 

Security of the entire Plant shall be in the Client's scope.

4.15)∃ Safety:

#### 4.15.1∃ Standard Guidelines for Safety

#### Disconnection

- a) Switching on or off an electrical disconnect is a process often taken for granted as safe, but it can be one of the most dangerous tasks involved in maintaining a PV system.
- All system components must be assumed to be energized with maximum DC voltages (up to 1500 V) until personnel verify that the voltage has been removed. Wait for at least o5 minutes after turning the inverter off to get the capacitances discharged completely.
- c) Workers must wear proper PPEs (Rubber Gloves, Safety Helmet and Safety Shoes) when operating disconnects, and care should be taken to use the proper LOTO technique for throwing switches.
- d) A recommended safety protocol is to follow the left-hand rule, which involves standing to the right side of the switch and using the left hand to throw the switch. This ensures that the worker's body is not in front of the switch should an arc flash occur.

#### 4.15.2 □ Operation

- a) Do not touch any live electrical part of PV Panel such as terminals with bare hands, always use appropriately rated safety gloves.
- b) Do not touch front side of PV Panel under sublight this may lead to thermal burn.
- c) Do not stand in front of PV panel during operation (this will cause shadows).
- Do not attempt at making an electrical connection with wet, soiled, or otherwise faulty connectors.

- e) Avoid sunlight exposure and water immersion of the connectors.
- f) Avoid connectors resting on the ground or roof surface (this might result in the connectors being immersed in water during rainy season).
- g) Check that all electrical connections are securely fastened. Make sure that all locking
- connectors are fully engaged and locked.
- Do not connect any extra energy sources other than the already installed ones.

To avoid product damage, personal injury, or even possible death, anyone installing or handling the equipment must carefully read, understand, and follow all the installation and safety instructions in this document before attempting to install, wire, operate the array, and/or perform maintenance.



WARNING

This document must be read and understood before attempting to handle, install, wire, operate, and/or perform maintenance. The panels produce DC electricity when exposed to sunlight or other light sources. Contact with electrically active parts of the Solar panels can cause injury or death, whether they are connected to other Solar panels or individually.



Observe all electrical safety precautions to prevent electrical shock while installing the solar equipment, and while wiring, testing, and/or performing maintenance of the PV array. Use insulated tools and proper personal protective equipment to reduce the risk of electric shock.

## 4-15-3 □ Safety Warnings and Cautions General

- Potentially lethal DC voltages can be generated whenever solar panels are exposed to a light source, therefore, avoid contact with electrically active parts and be sure to isolate live circuits before attempting to make or break any connections.
- Do NOT proceed if any doubt arises about the correct or safe method of performing any of the procedures found in this document
- NO washing of panels will be allowed during peak hours of sun light (11:00AM to 3:00PM) because of hot surface of the panels.
- During working hour if found any sort of abnormality which could lead to serious issues or unable to understand, personal should inform the condition to the immediate supervisor.
  - Always wear appropriate safety and protective equipment, such as:
    - Rubber soled shoes
    - Cutresistant and chemical resistant gloves.
    - Safety glasses
    - Hard hat

- When working on electrical connections, remove all metallic jewelry, and use insulated tools.
- Wear cut resistant gloves whenever handling Solar panels
- Do NOT drive screws into any part of the photovoltaic laminate. Altering the laminate or improper Installation could cause electric shock, may result in fire, and will void the product Limited Warranty.

#### 4.15.411 Work Site:

Follow all appropriate safety practices for the site.

- Do NOT handle PV laminate assemblies in high wind conditions.
- Do NOT perform maintenance on this product when Solar panels are wet or are in standing water.
- Ensure that the work area is clear of trip hazards. Personal injury can result from tripping over power cords, tools, electrical conduit, natural gas lines, and/or installation materials.
- Provide clear warning signage at each access point to the Installation. This signage should clearly state the dangers associated with a high voltage solar system, the personal protection equipment that should be worn, and emergency telephone numbers for fire and emergency medical service.
- All safety signs as per site to be pasted to different locations.

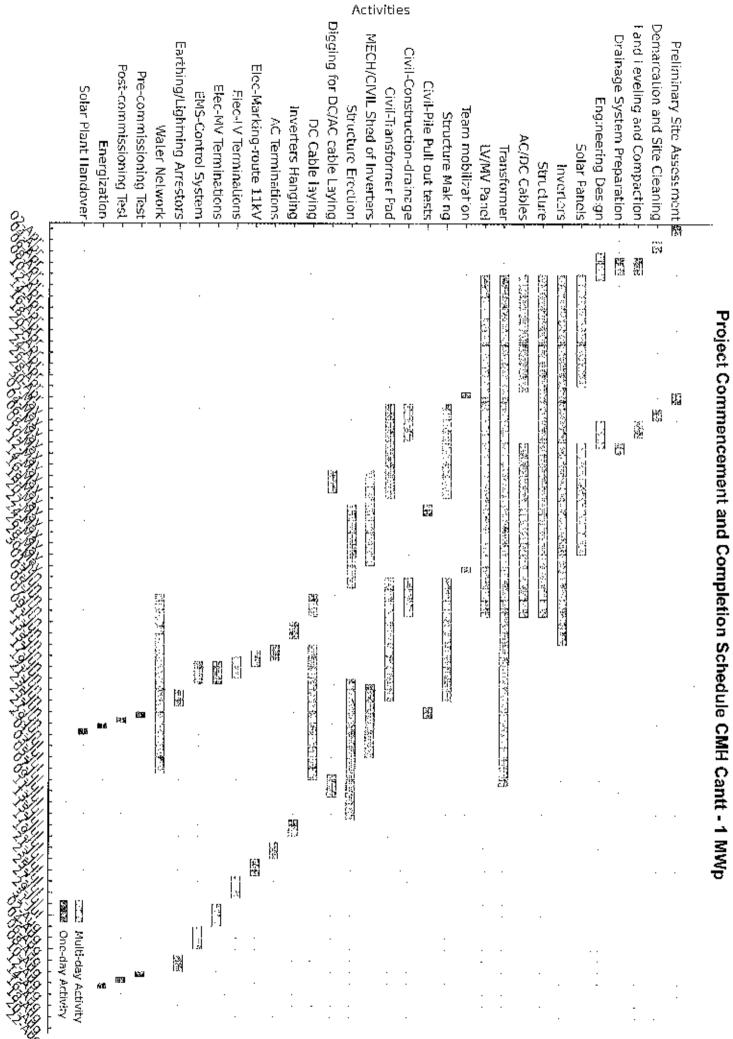
#### 4.15.51\_ Additional:

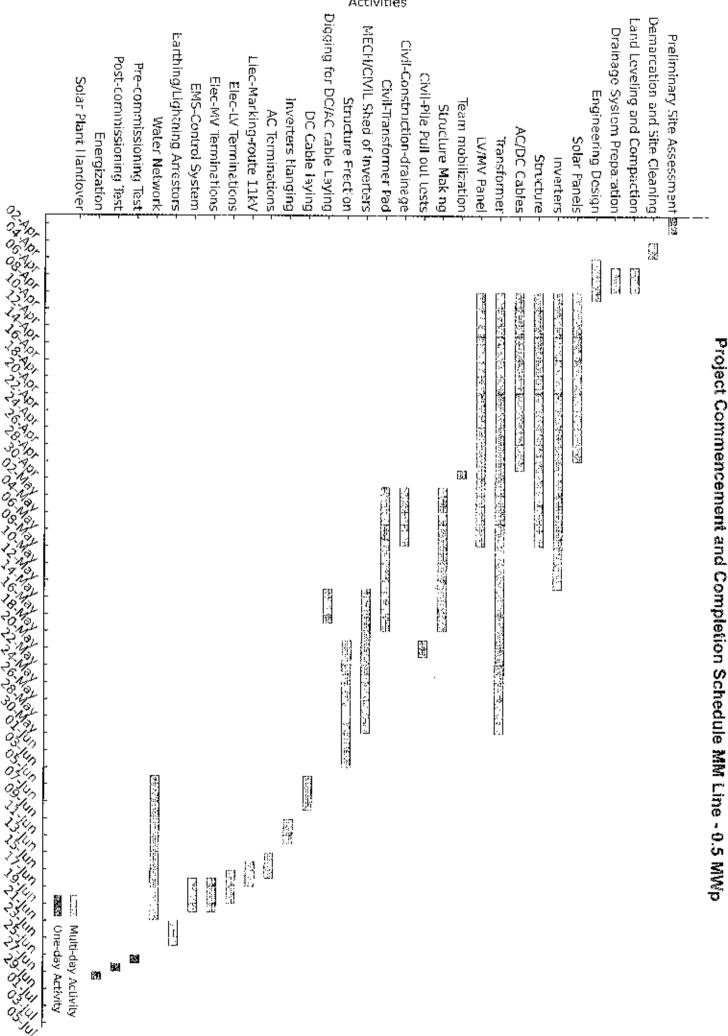
- Try NOT to walk or kneel on the Solar panels. Wear clean (free from small stones) soft soled shoes to avoid possible scratching of the front surface of the Solar panels.
- Avoid dropping sharp objects or placing objects on the Solar panels, and do NOT wheel carts or drag items across them.
- PV Solar panels contain electrical components, and cannot be trimmed or altered in any way.
- Do NOT connect or disconnect quick connect cables under load,
- To reduce the risk of electric shock or arc flash, cover Solar panels with an opaque material before making wiring connections.
- All test equipment, leads, and probes must be rated for maximum system voltage.
- Observe proper polarity when connecting Solar panels into an electrical circuit, as reverse connections
  may damage the Solar panels and will void the product Limited Warranty.
- Do NOT attempt to concentrate suplight (via lenses, mirrors, etc.) on the Solar panels to increase output, as damage may occur, which will void the product Limited Warranty.
- Follow all roof manufacturer and material safety data sheet (MSDS) instructions for the safe use of any chemicals.
- Do NOT use any chemical agents on or around Solar panels that are NOT approved by NRTC Energies.



MUST be worn on this site at all times

| Pacial provides in the last intervention of the cleaning intervention and cleaning intervention and cleaning intervention and cleaning intervention intervention and cleaning intervention interven |               |   |                                |
|---|---------------|---|--------------------------------|
| Specimization and Site Assessment 2013           Demandation and Site Cleaning         2011           Distance of Conjunction         2011           Disteneo of Conjunction         2011     <  |               |   | Solar Plant Handover           |
| Preliminary Site Assessment ES         Demarcation and Site Cleaning         Land Compaction         Diralnage System Preparation         Engineering Lesion         Brigineering Lesion         Sinctrue         ACUCC Calcles         Transformering         Sinctrue         Sinctrue <td></td> <td></td> <td>Energization -</td>  |               |   | Energization -                 |
| Preliminary Site Assessment         Site           Demarcation and Site Cleaning         Image: System Preparation         Image: System Preparation <t< td=""><td></td><td></td><td>Post-commissioning Test</td></t<>  |               |   | Post-commissioning Test        |
| Preliminary Site Assessment E           Democration and Site Cleaning         E           Land Leveling and Compaction         EE           Democration and Site Cleaning         EE           Solar Parels         EE           Solar Parels         EE           Structure         EE           ACDC Catles         EE           Transformer         EE           VIAW Panel         EE           Tansformer         EE           VIAW Panel         EE           Tansformer         EE           VIAW Panel         EE           Tansformer         EE           Structure Making         EE           Civil-Pile Pull out tests         EE           Structure Erection         EE           Novertes Hanging         EE           DC cable Laying         EE           DC cable Laying         EE           Elec-Marking Arrestores  | ale and and a |   | Pre-commissioning Test         |
| Preliminary Site Assessment       Image: System Region of Site Cleaning       Image: Site  |               |   | Water Network                  |
| Preliminary Site Assessment Importance         Demarcation and Site Cleaning         Land Leveling and Compaction         Drainage System Preparation         Structure         AC/DC Cables         Transformer         Civil-Piol Pull out tests         Structure         MECH/CIVIL Shed of Inverters         Structure Election         DC Cable Laying         DC Cable Laying         Directers         Structure Election         DC Cable Laying         DC Cable Laying         Diverters Hanging         AC Terminations         Elec-Marting-route 11kP         Elec-Marting-route         Elec-Marting-route 11kP         Elec-Nating-route         Elec-Nating-rout   |               |   | Earthing/Lightning Arrestors   |
| Preliminary Site Assessment E           Demarcation and Site Cleaning         Image: Site Cleaning           Land Leveling and Compaction         Email           Drainage System Preparation         Email           Solar Farels         Email           Solar Farels         Email           ACDC Catics         Email           Transformer         Email           V/MV Panel         Email           Transformer         Email           V/MV Panel         Email           Transformer         Email           V/MV Panel         Email           Transformer         Email           Civil-Pite Pull out tests         Email           Civil-Pite Pull out tests         Email           Civil-Pite Pull out tests         Email           Civil-Pite Paration         Email           Dic Cable Laying         Email           Elec-Marking-route 11/K         Email           Elec-Marking-route 11/K         Email   |               |   | EMS-Control System -           |
| preliminary Site Assessment iz         Demarcation and Site Cleaning         Land Leveling and Compaction         Drainage System Preparation         Solar Farels         Solar Farels         Invertes         Structure         AC/OC Catkis         Transformer         U/MV Panel         Team mobilization         Structure Making         Civil-Pilo Pull out tests         Civil-Pilo Pull out tests         Structure Exection         Structure Exection         Digging for DC/AC cable Laying         NeCHACING-Reserver         Structure Exection         AC Terminations         Elec-Marking-rout LIVP         Elec-Marking-rout Structure         Elec-Marking-rout Structure <td></td> <td></td> <td>Efec-MV lerminations</td>   |               |   | Efec-MV lerminations           |
| preliminary Site Assessment Ex         Demarcation and Site Cleaning         Land Leveling and Compaction         Drainage System Preparation         Engineering Lesign         Solar Farels         Structure         AC/OC Cables         Transformer         Structure         Structu   | · · · ·       | · · · · · · · · · · · · · · · · · · ·   | Elec-LV Terminations           |
| preliminary Site Assessment         Demarcation and Site Cleaning         Demarcation and Site Cleaning         Land Leveling and Compaction         Drainage System Preparation         Solar Far ets         Solar Far ets         AC/DC Catkes         Transformer         UNIV Panel         UNIV Panel         Civil-Pilo Pull out tests         December Pad         MECH/CIVIL Shed of Invertes         Structure Factor         Digging for DC/AC cable Laying         DC Cable Laying         DC Cable Laying         DC Cable Laying         DC Cable Laying         Civil-Transformer         Civil-Transformer         Civil-Transformer         Civil-Transformer         Civil-Transformer         Civil-Transformer         Civil-Transformer         Civil-Transformer         Civil-Transformer <tr< td=""><td></td><td></td><td>Elec-Marking-route 11kV</td></tr<>  |               |   | Elec-Marking-route 11kV        |
| Preliminary Site Assessment 20         Demarcation and Site Cleaning         Land Leveling and Compaction         Drainage System Preparation         Engineering Lesion         Soluri Par els         Inverters         AC/DC Cables         Transformer         Land Leveling and Compaction         Soluri Par els         Inverters         Structure         AC/DC Cables         Transformer         Land Monthalitzation         Structure Making         Civil-Dic Unit ut tests         Civil-Dic Unit ut tests         Civil-Transformer Pad         MECH/CIVIL Sched of Inverters         MECH/CIVIL Sched of Inverters         Structure Eleveling         MECH/CIVIC cable Laying         DC cable Laying         DC cable Laying         DC cable Laying         DC cable Laying         DC cable Laying         DC cable Laying         DC cable Laying         DC cable Laying         Diguing for DC/X cable Laying         DC cable Laying         DC cable Laying         DC cable Laying         DC cable Laying         DC cable Laying         <   | <u>5.25</u>   |   | AC Terminations                |
| Preliminary Site Assessment         Demarcation and Site Cleaning         Land Leveling and Compaction         brainage System Preparation         Engineering Cesign         Solar Farels         AC/DC Cables         Transformer         Lam mobilization         Structure         AC/DC Cable Laying         Civil-Pile Pull out tests         Elevel Pull out tests         Elevel Pull out tests         Elevel Pull out tests   |               |   | Inverters Hanging              |
| prediminary Site Assessment       Image: System Preparation       Imag  |               |   | DC Cable laying                |
| Preliminary Site Assessment       Image: Second State Cleaning         Demarcation and Site Cleaning       Image: Second State Cleaning         Land Leveling and Compaction       Image: Second State Cleaning         Drainage System Preparation       Image: Second State Cleaning         Engineering Cesign       Image: Second State Cleaning         Solar Panels       Image: Second Structure         AC/DC Catkles       Image: Second Structure         Transformer       Image: Second Structure         Team mobilization       Image: Second Structure Structure Making         Civil-Pile Pull out tests       Image: Second Structure Structure Structure Structure Structure Structure         MECH/CIVIL Shed of Inverters       Image: Structure Struc  | · · · · · ·   |   | Digging for DC/AC cable Laying |
| Prediminary Site Assessment       Image System Preparation         Demarcation and Site Cleaning       Image System Preparation         Engineering Lesign       Image System Preparation         Solar Far ets       Image System Preparation         Solar Far ets       Image System Preparation         AC/DC Cables       Image System Preparation         Transformer       Image System Preparation         AC/DC Cables       Image System Preparation         Transformer       Image System Preparation         Structure Making       Image System Preparation         Civil-Pile Pull out tests       Image System Preparation         Civil-Construction-drainage       Image System Preparation         Civil-Transformer Pad       Image System Preparation         MECH/CIVIL Shed of Inverters       Image System Preparation  |               |   |                                |
| Prediminary Site Assessment       Image: System Preparation         Land Leveling and Compaction       Image: System Preparation         Drainage System Preparation       Image: System Preparation         Solar Parets       Image: System Preparation         Solar Parets       Image: System Preparation         AC/DC Cables       Image: System Preparation         Transformer       Image: System Preparation         Team mobilization       Image: System Preparation         Structure Making       Image: System Preparation         Civil-Pic Pull out tests       Image: System Preparation         Civil-Construction-drainage       Image: System Preparation         Civil-Transformer Pad       Image: System Preparation         Structure Making       Image: System Preparation         Civil-Pic Pull out tests       Image: System Preparation         Structure Preparation       Image: System Preparation         Structure Making       Image: System Preparatin Preparatin Preparatin Preparation  |               | 1.800   |                                |
| Prediminary Site Assessment       Image: Second Site Cleaning         Demarcation and Site Cleaning       Image: Second Site Cleaning         Land Leveling and Compaction       Image: Second Site Cleaning         Engineering Cesign       Image: Second Site Cleaning         Solar Parets       Image: Second Site Cleaning         Structure       Image: Second Site Cleaning         AC/DC Catics       Image: Second Site Cleaning         Transformer       Image: Second Site Cleaning         LWMV Panel       Image: Second Site Cleaning         Team mobilization       Image: Second Site Cleaning         Structure Making       Image: Second Site Cleaning         Civil-Pilc Pull out tests       Image: Second Site Cleaning         Civil-Construction-drainage       Image: Second Site Cleaning         Structure       Image: Second Site Cleaning         Structure       Image: Second Site Cleaning         Structure Making       Image: Second Site Cleaning         Structure       Image: Second Site Cleaning         Structure       Image: Second Site Cleaning         Structure       Image: Second Site Clea   |               | <u> </u>  |                                |
|   |               |   |                                |
|   |               |   | Civil-Pile Pull out tests      |
|   |               | A reference of the second s<br>Second second s<br>Second second se | Structure Making               |
|   |               | [6]   | Team mobilization              |
|   |               | 1   | LV/MV Panel                    |
|   |               | 第二十二十二十二十二二十二十二十二十二十二十二十二十二十二十二十二十二十二十二   | Transformer                    |
|   |               | (1) (1) (1) (1) (1) (1) (1) (1) (1) (1)   | AC/DC Catiles                  |
|   |               |   | Structure -                    |
|   |               | the second of   | Inverters -                    |
|   |               |   | Solar Panels                   |
|   |               |   | Engineering Design             |
|   |               | · · · · · ·   | Drainage System Preparation    |
|   |               |   | Land Leveling and Compaction   |
| Prefiminary Site Assessment 28  | · · · ·       |   | Demarcation and Site Cleaning  |
|   |               |   | Prefiminary Site Assessment 器  |

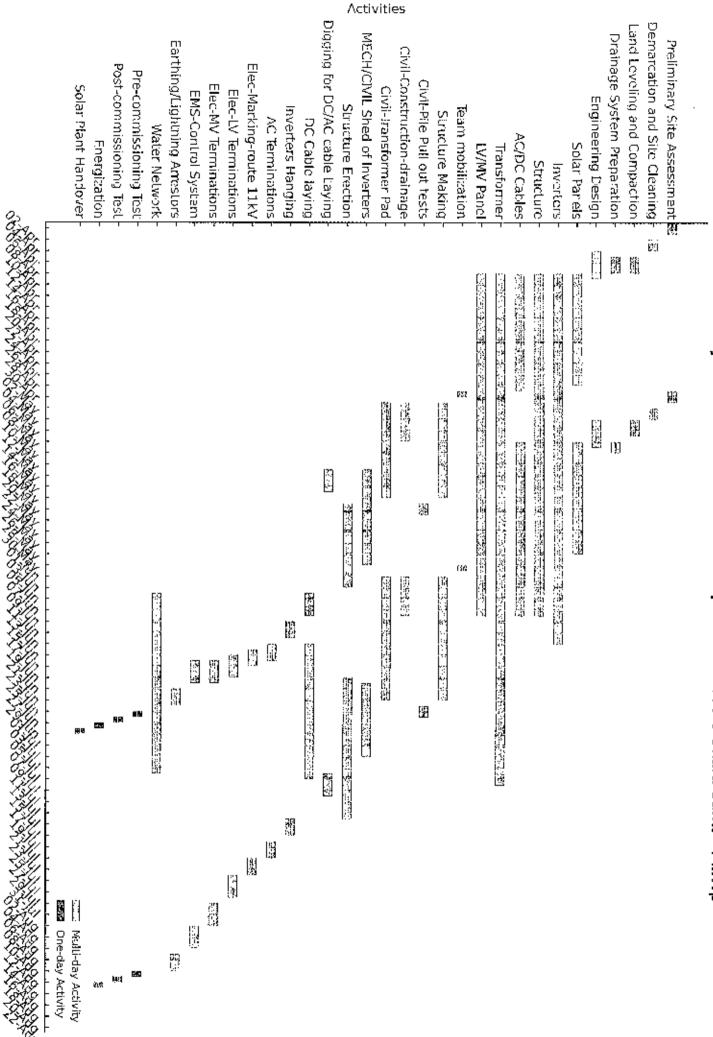




Activities

:

| One-day Activity  |  |  |
|---|--|--|
| - Multi-day Activity  |  | Solar Plant Handover                             |
| Ing   |  | Energization                                     |
| 1914  |  | Post-commissioning Test                          |
| 189   |  | Pre-commissioning Test                           |
|   |  | Water Network                                    |
| ·   |  | Earthing/Lightning Arrestors                     |
|   |  | EMS-Control System                               |
|   |  | Elec-MV Terminations -                           |
| The second second second second second second second second second second second second second second second se |  | Elec-LV Terminations                             |
|   |  | Elec-Marking-route 11kV                          |
| <u></u>   |  | AC Terminations                                  |
| ·   |  | inverters Hanging                                |
|   |  | DC Cable laying                                  |
|   |  | Digging for DC/AC cable Laying                   |
|   |  | A Structure Erection                             |
|   |  | $\dot{\mathcal{H}}$ MECH/CIVIL Shed of Inverters |
|   |  | Čívil-Transformer Fad                            |
|   |  | M Civil-Construction-drainage                    |
|   |  | Civil-Pile Pull out tests                        |
| •   |  | Structure Making -                               |
|   | [¥]  | Team mobilization -                              |
|   | いた。本国により開発がある。<br>建築のため、「開発のため」、「開催のようには、開催のため」、「開催の」、「開催の」、<br>「日本」の「日本」の「開発のため」、「開催の」、「「開催の」、「「開催の」、「「 | LV/MV Panel -                                    |
|   |  | Transformer -                                    |
|   | [199] 中国大学的学校,在1995年中国大学校的学校,1995年中国大学校的学校,1995年中国大学校会会。   | AC/DC Cables                                     |
|   | میں اور میں میں اور میں میں میں میں میں اور میں میں میں میں میں میں میں میں میں میں                      | Structure  |
| · · · ·   | 的人。 <b>就是这些错误,这些我们们就是这些,这些人,你就是这些人,这些人们的时候,这些人们的</b> 这些人,就是  | Inverters  |
|   | 「「「「」」「「」」「「」」「」」「」」「」」「」」「」」「」」「」」「」」「  | Sofar Panels                                     |
|   |  | Engineering Design                               |
| ·<br>·<br>·   |  | Drainage System Preparation                      |
|   |  | Land Leveling and Compaction                     |
| · · · · · · · · · · · · · · · · · · ·   |  | Demarcation and Site Cleaning                    |
| •   |  | Preisminary Site Assessment                      |



Date

Project Commencement and Completion Schedule Okara Cantt - 1 MWp