GHARO NEWGEN (PRIVATE) LIMITED

114CC-2, DHA Phase 6-C, Lahore. Ph: 042 38020444

Ref. No: GNPL/GAL/24-01 August 05, 2024

The Registrar
National Electric Power Regulatory Authority,
2 Floor, OPF Building, Sector G-5/2,
Islamabad

Subject: **Application for Grant of Electric Power Generation/Concurrence for 15 MW PV Solar Plant at Gharo Newgen (Private) Limited, Sindh, Pakistan**

Dear Sir,

I, Rana Uzair Nasim, CEO, being the duly authorized representative of Gharo Newgen (Private) Limited by virtue of Board Resolution dated June 17th, 2024 hereby apply to National Electric Power Regulatory Authority for the grant of a concurrence to Gharo Newgen (Private) Limited, pursuant to section 14(B)(5) of the Regulation of Generation, Transmission and Distribution of Electric Power Act, 1997.

I certify that the documents-in-support attached with this application are prepared and submitted in conformity with the provisions of the National Electric Power Regulatory Authority Licensing (Application, Modification, Extension and Cancellation) Procedure Regulations 2021 and undertake to abide by the terms and provisions of the aforementioned regulations. I further undertake and confirm that the information provided in the attached documents-in-support is true and correct to the best of my knowledge and belief.

A bank draft in sum of Rupees Five Hundred Thirty Nine Thousand, Seven Hundred and Sixty-Nine Only (PKR 539,769) being the license application fee calculated in accordance with Schedule II to the National Electric Power Regulatory Authority Licensing (Application, Modification, Extension and Cancellation) Regulations, 2021, is also attached herewith.

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

Sincerely,
For and on behalf of Gharo Newgen (Private) Limited

Rana Uzair Nasim
Chief Executive Officer

GHARO NEWGEN (PRIVATE) LIMITED

GHARO NEWGEN (PRIVATE) LIMITED

114-CC2, Phase-6C, DHA, Lahore. Ph: 042 38020444

EXTRACT OF RESOLUTIONS PASSED BY THE BOARD OF DIRECTORS OF M/S GHARO NEWGEN (PRIVATE) LIMITED (THE "COMPANY") IN A MEETING HELD ON JUNE 17, 2024 AT ITS REGISTERED OFFICE LOCATED AT 114-CC2, PHASE-6C, DHA, LAHORE

RESOLVED THAT the Company be and is hereby authorised to file application(s) before the National Electric Power Regulatory Authority ("**NEPRA**") in relation to the grant of concurrence by NEPRA (the "**Application(s)**"), so that the Company is authorized to set up a 15MWp solar PV generating facility located within the service territory of K-Electric) for the purpose of supplying electric power to K-Electric through the distribution system of the Gharo Grid Station located in Gharo, District Thatta.

FURTHER RESOLVED THAT Mr. Rana Nasim Ahmed, Director and Mr. Rana Uzair Nasim, Chief Executive Officer, (the "**Authorised Persons**") are duly authorized singly and severally to file, submit and present the Application(s) (along with all annexes), affidavits, and any documents in support thereof before NEPRA, sign the necessary documentation, pay the necessary filing fees, appear, or appoint a duly authorized representative to appear, and/or make any oral / written representations on behalf of the Company before NEPRA, and undertake or do any matter(s) / act(s) necessary for the filing, submission, processing, completion and finalization of the Application(s), or incidental thereto.

FURTHER RESOLVED THAT in addition to the Authorised Person, the associates and partners of RIAA Barker Gillette (formerly RIAALAW), including Mr. Adil Khalid Tirmizey and Mr. Minam Karim shall also have the aforementioned powers.

Certified that the above resolutions: (i) were duly passed on June 17, 2024 at a meeting of the board of directors of Gharo Newgen (Private) Limited held with the necessary quorum of directors; and (ii) has not been rescinded and remains in operation and that this is a true copy of the extract of the said resolutions.

GHARO NEWGEN (PRIVATE) LIMITED

Rana Uzair Nasim
Chief Executive Officer
Gharo Newgen (Private) Limited

GHARO NEWGEN (PRIVATE) LIMITED
114CC-2, DHA Phase 6-C, Lahore. Ph: 042 38020444

Ref. No: GNPL/GAL/24-01 August 05, 2024

The Registrar
National Electric Power Regulatory Authority,
2 Floor, OPF Building, Sector G-5/2,
Islamabad

Subject: **Statement issued pursuant to Regulation 3 (4)(h) of the National Electric Power Regulatory Authority Licensing (Application, Modification, Extension and Cancellation) Procedure Regulations 2021**

Dear Sir,

I, Rana Uzair Nasim, CEO, being the duly authorized representative of Gharo Newgen (Private) Limited, by virtue of Board Resolution dated June 17th 2024, hereby confirm that Gharo Newgen (Private) Limited has not been refused the grant of any license for the provision of any electric power services pursuant to the applicable provisions of the Regulation of Generation, Transmission and Distribution of Electric Power Act, 1997.

Sincerely,
For and on behalf of Gharo Newgen (Private) Limited

Rana Uzair Nasim
Chief Executive Officer

GHARO NEWGEN (PRIVATE) LIMITED

APPLICATION DETAILS

1. PROSPECTUS: APPLICANT COMPANY'S PROFILE

Gharo Newgen (Private) Limited (the "Company") is a special purpose company for the development of a 15MW solar power plant. This plant will be strategically located in the licensed service territory of K-Electric Limited ("K-Electric" or "KE"), which is a privately-owned power utility in Pakistan. K-Electric is solely responsible for provision of electricity to Karachi and its adjoining areas. The Company's initiative aligns with K-Electric's objective to diversify their generation mix and ensure the provision of cost-effective electricity to their end-consumers. The proposed solar project will be connected to the Gharo Grid Station in Gharo, District Thatta and will operate at an 11kV voltage. Their efforts will further support K-Electric's ongoing endeavors to provide sustainable and affordable power supply to their valued customers.

The project sponsors have a robust track record in the development, engineering, procurement, and construction (EPC), as well as operation and maintenance (O&M), of approximately 200 MW of installed projects. These projects encompass solar and biomass technologies within the country. The key sponsors' and CEO's profiles are as following:

Rana Nasim Ahmed

Mr. Rana Nasim Ahmed is the main sponsor of the Company and will retain a minimum of 51% shareholding in the Company. He is also the main sponsor of Harappa Solar (Private) Limited, an 18 MWp solar project commissioned in October 2017. Harappa Solar was the first private sector solar power producer in Pakistan and pioneered the use of a single-axis tracking system in the country. Additionally, Mr. Ahmed is also the main sponsor of Gharo Solar Limited, a 50 MWp solar project established in December 2019. Gharo Solar was the first solar power project in Pakistan with bifacial modules and the first within the K-Electric network to be financed by a foreign development finance institution (DFI).

Mr. Ahmed has vast industrial experience of more than two decades of managing four sugar mills to the highest international standards. He has spearheaded high-pressure cogeneration in the sugar industry by leading the development, construction, and operations of the first-ever 2 x 26.5 MW (53 MW total) bagasse-based project set up in 2014. These 53 MW biomass projects and two of the four sugar mills were set up as greenfield ventures on expedited timelines in self-EPC mode with multiple contractors, suppliers and consultants managed by Mr. Ahmed. Moreover, he has over fifteen years of experience managing equipment procurement and installation and leading commercial and operation and maintenance ("O&M") matters of 70 MW low-pressure, biomass power plants. Mr. Ahmed obtained his master's degree (with distinction) from the University of the Punjab and his MBA from Saint Louis University, USA.

Rana Uzair Nasim

Mr. Rana Uzair Nasim is the CEO of the Company. Mr. Nasim has successfully led and managed solar, biomass and industrial projects with capex of over USD 150 million. He is also serving as the CEO of Gharo Solar Limited and Harappa Solar (Private) Limited since their inception and is the primary point of contact for various stakeholders including local and foreign shareholders / lenders, regulatory and public-sector agencies, power purchasers, suppliers, and contractors. Mr. Nasim has first-hand experience of greenfield project conceptualization and execution and has worked across different areas including design, policy and tariff development, tendering, financing, insurance, negotiation of project concession documents etc. He has also contributed to several important policy and regulatory developments in the broader renewable energy sector in Pakistan. Mr. Nasim previously worked as a management consultant in New York with Oliver Wyman and Dalberg Global Development Advisors. He holds a BA in Economics and an MS in Management Science & Engineering from Stanford University, California, USA.

2. PROSPECTUS: RATIONALE & BUSINESS MODEL

The Project is consistent with KE' s objectives of diversifying generation mix and shall supply affordable electricity to KE' s end-consumers. The planned capacity of proposed Project is 15 MWp solar power plant with 12 MWac on-grid central inverters and it shall be connected with Gharo Grid Station in Gharo, District Thatta at 11kV.

Pursuant to the NEPRA (Electric Power Procurement) Regulations, 2022, the Company has negotiated procurement tariff with K-Electric (KE) that will decrease KE's basket price. According to KE's Power Acquisition Plan (PAP), the non-indexed basket price is expected to be approximately 8.7 cents/kWh for FY-2024. In contrast, the proposed first-year tariff of the project is 4.7984 cents/kWh. This significant difference demonstrates that the project's tariff is substantially lower than KE's basket price, leading to a clear reduction in KE's average power purchase price.

In addition to cost savings, the project offers several other benefits for K-Electric as mentioned below:

a. The land for the Project is already available to the Company, which means that the Company can ensure speedy execution and timely delivery of electricity through its Project.

b. The Project is strategically located in a developing industrial / commercial area where significant demand rise in upcoming years is forecasted. The co-location of the proposed Project with KE's 132/11 kV Gharo Grid station is an ideal combination for KE particularly since the interconnection shall be at 11 kV and it would enable most of the power to be dispersed locally. This approach would also help in reducing transmission line losses.

c. The Project is aligned with KE PAP and it will contribute 15 MWp of renewable energy in KE system.

3. TECHNICAL OVERVIEW

3.1. Technology

It is proposed to install a 15 MWp solar power plant with 12 MWac on-grid central inverters. The Project shall be interconnected with the KE network through an 11kV transmission lines. The following sections give an overview of the technical scheme and key components of the Project. Solar PV modules shall be used to harness solar energy and convert it to electric power. The PV modules shall be connected in series to form a string and then multiple strings shall feed to String Combiner Box.

The PV modules shall be installed on a horizontal single axis tracking system which shall have a built-in algorithm to track the sun. The aim is an optimized positioning of the module surface to the sun during the day and ultimately, increase the total solar irradiation onto the module surface. The tracking system shall be ground mounted and pile-type foundations shall be used for the purpose.

The PV modules shall generate DC power, which shall be converted to AC power through inverters. Since the Project shall feed electricity to the grid and therefore, on-grid type inverters shall be installed at the plant. Apart from simple AC/DC conversion, the inverter shall also condition the power and make electricity compliant with the grid code requirement.

AC/DC cables are the means of transportation of electricity from one point to another, for example, from string combiner boxes to inverters and then to inverter transformers and finally to 11kV substation. During the transfer of electricity, the losses are unavoidable, however sufficient sizing and consideration shall reduce the losses. Further, the conversion of electricity to high voltage i.e., 11kV /low current by transformers shall also help in loss reduction.

This is the grid connection interface, where the electric power shall be collected and exported to the grid network. The substation shall primarily consist of 11kV switchgear, control / protection system and AC/DC aux power system etc.

Monitoring of grid-connected solar power plants shall be conducted locally as well as remotely through the internet. The monitoring shall be performed 24/7 and shall pinpoint faults in individual components causing production loss.

Major components of utility-scale systems are:

- Solar Modules / Panels
- Module Mounting Structures (fixed or tracking)
- Solar Inverters
- Balance of Systems (BoS) comprising of
    - DC Cables
    - String Combiner Boxes
    - AC Cables
    - Transformers
    - HT Panels / RMU units

- SCADA & Monitoring System
- Earthing system
- Illumination system
- Module cleaning system
- AC / Ventilation System for inverter rooms

- Civil works including foundations, inverter rooms, leveling, grading, fencing, etc.
- Power evacuation systems include step-up transformers, switchyard, tariff metering arrangement, etc.

The scheme proposed for evacuation of power from the Gharo Newgen to KE grid comprises 11 kV circuits. In the Photovoltaic category, PV panels without concentrators are widely used. These panels are either with fixed tilt or manual seasonal tilt or single axis / dual axis tracking arrangements. Fixed tilt arrangements are in the majority; however, single axis trackers are also gaining in popularity due to the gain in generation over fixed tilt systems.

3.2. Site

The Project Site is located near the town of Gharo at Deh Ghairabad, Mirpur Sakro, District Thatta, Sindh approximately 6 km along the Sindh Coastal Highway and then approximately 1.25 km via connecting road from the Highway. The Site is about 55 km away from Jinnah International Airport, Karachi.

3.3. Interconnection

The electric power generated from the Generation Facility/Solar Power Plant of the Company shall be dispersed to the load center of K-Electric.

The proposed Interconnection Arrangement/Transmission Facility for dispersal of electric power comprises the direct 11 kV lines of approximately 7-8 km length to be laid from the 11 kV bus bar of the Generation Facility/Solar Power Plant to the Gharo Grid Station.

3.4. Commissioning & Expected Life

As per the standard energy purchase agreement ("EPA") the Project life and EPA term has been assumed as 25 years from COD and all equipment is being procured corresponding to the same.

3.5. Operation & Maintenance

Operation & Maintenance for a Solar PV Plant is relatively straightforward and less intensive compared to other power generation technologies. The operations shall be managed by either a third-party O&M consultant or an in-house technical and operational expert team, well-equipped with required capabilities. Most O&M functions shall be performed by permanent staff and the operation of the facility will be automated, supervised and controlled by SCADA.
The operation team shall operate and monitor the facility in accordance with Prudent Utility Practices, applicable standards and the manufacturers' recommendations.

- SCADA & Monitoring System
- Earthing system
- Illumination system
- Module cleaning system
- AC / Ventilation System for inverter rooms

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- Power evacuation systems include step-up transformers, switchyard, tariff metering arrangement, etc.

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The operation team shall operate and monitor the facility in accordance with Prudent Utility Practices, applicable standards and the manufacturers' recommendations.

Operations and Maintenance tasks shall include:

- Periodic cleaning of PV Panels (few times per month).
- Periodic operational checks and tests of equipment in accordance with OEM recommendations.
- Regular plant inspections.
- Routine maintenance services.
- Implement and regulate the facility's preventive and corrective maintenance program.
- Critical / non-critical reactive repairs.
- Plant security covering entire fenced area.
- General shift operations for coordinating plant operation, maintenance & liaison with power purchaser; and
- Maintain critical spares for plant & equipment.

3.6. Monitoring and facilities

Monitoring of system operation parameters shall be arranged locally and also from remote locations through internet. Weather monitoring station, for irradiance, DHI measurement, wind velocity & ambient temperature, String currents, Inverter Parameters, Transformer protections and temperature, HT Panel parameters, Export & import (auxiliary) energy and Perimeter Security through CCTVs & alert systems are hooked-up to SCADA system. Also, there will be a separate PLC based SCADA system for monitoring/controlling tracker system.

3.7. Site Description

1.	Name of Licensee	Gharo Newgen (Private) Limited
2.	Plant Location	Deh Ghairabad, Mirpur Sakro, District Thatta, Sindh
3.	Type of Generation	Solar
4.	Type of Technology	Single Axis Tracker with Bifacial Solar Modules
5.	System Type	Grid Tied
6.	Plant Capacity	15MWp

Site Coordinates:

The site coordinates are as follow:

Latitude (North)	Longitude (East)
24°42'58.0"N	67°34'09.5"E

4. Financial Overview

Project cost has been calculated after detailed analysis, evaluation and understanding of parameters that affect the development and operation of solar projects. The following table provides a breakdown of Project costs:

EPC Cost including Degradation	8,449,680
Non-EPC Cost	**1,002,934**
Insurance During Construction	32,700
Development Cost	318,522
Finance Fees & Charges	206,950
IDC	444,857
Total Project Cost (USD)	**9,452,614**

SECTION 2

COMPANY PROFILE

LIST OF ANNEXURES

ANNEXURE I	**CERTIFICATE OF INCORPORATION, FORM-1 & FORM29.**
ANNEXURE II	**MEMORANDUM/ARTICLES OF ASSOCIATION**
ANNEXURE III	**LAST FILED ANNUAL RETURNS**

ANNEXURE I

CERTIFICATE OF INCORPORATION, ACCOUNT MAINTENANCE CERTIFICATE, FORM-1 & FORM-29.

A068319

SECURITIES AND EXCHANGE COMMISSION OF PAKISTAN

SECP

COMPANY REGISTRATION OFFICE,
LAHORE

CERTIFICATE OF INCORPORATION

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

Corporate Unique Identification No. 0145593

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

Given under my hand at Lahore this Fifteenth day of January, Two Thousand and Twenty

Incorporation fee Rs. 11000.0/= only

(ASIF MUZAFFAR SHEIKH)
Joint Registrar
Lahore

NO.ARL/ 13645

Date. 15/1/2020

B 043588

SECURITIES AND EXCHANGE COMMISSION OF PAKISTAN

SECP

Company Registration Office
LAHORE

CERTIFICATE OF CONVERSION OF A PUBLIC COMPANY INTO PRIVATE COMPANY

[Under Section 50 of the Companies Act, 2017 (XIX of 2017)]

Corporate Universal Identification No. 0145593

I hereby certify that pursuant to the provisions of Section 46 of the Companies Act, 2017 (XIX of 2017), read with Regulation 11 of the Companies (General Provisions and Forms) Regulation, 2018 **"GHARO NEWGEN LIMITED"** has complied with the requirements precedent and incidental to the conversion of a Public Company into a Private Company. The said company stands converted into a Private Company with effect from 31-01-2022.

Given under my hand at Lahore this 22nd day of February, Two thousand and Twenty Two.

Fee Rs.330/-

(SHAHBAZ SARWAR)
Additional Registrar of Companies

No. ARL/ Dated:

askaribank

Issue Date: **Jul 26, 2024**

ACCOUNT MAINTENANCE CERTIFICATE

This is to certify that Mr. /Mrs. GHARO NEWGEN (PRIVATE) LIMITED bearing CNIC 67241024 is maintaining Current Account number PK61ASCM0001200100584115, titled GHARO NEWGEN (PRIVATE) LIMITED with Askari Bank Limited, Askari Corporate Tower Br Lahore since Dec 13, 2021.

This certificate is issued at the specific request of the customer without any risk, obligations and responsibility on the part of Askari Bank Limited.

Authorised Signature

Authorised Signature

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 ANY CHANGE THEREIN

FORM 29

PART-I

1 CUIN (Incorporation Number) 0145593

2 Name of Company GHARO NEWGEN (PRIVATE) LIMITED

3 Fee Payment Details

3 1 Challan Number E-2023-1690704 1 3 2 Amount 2000 0

PART-II

2 Particulars*:

2 1 New Appointment/Election

Present Name in Full (a)	NIC No. or Passport No. in case of Foreign National (b)	Father / Husband Name (c)	Usual Residential Address (d)	Designation (e)	Nationality** (f)	Business Occupation** * (if any) (g)	Date of Present Appointment or Change (h)	Mode of Appointement / change / any other remarks (i)	Nature of directorship (nominee/independent/additional/ other) (j)
Rana Uzair Nasim	3520189251217	Rana Nasim Ahmed	House # 76-B, Street # 4, Phase 5, DHA Lahore Punjab Pakistan	Chief Executive	Pakistan		27/10/2023	Appointed /	
Rana Nasim Ahmed	3520204645477	Faqir Muhammad Khan	House # 76-B, Street # 4, Phase 5, DHA Lahore Punjab Pakistan	Director	Pakistan	Businessman	27/10/2023	Appointed /	
Rana Uzair Nasim	3520189251217	Rana Nasim Ahmed	House # 76-B, Street # 4, Phase 5, DHA Lahore Punjab Pakistan	Director	Pakistan	Businessman	27/10/2023	Appointed /	
Musaddiq Rahim	3520219156175	Abdul Rahim	House # 8, Street # 2, Mohalla Abu Qasim, Street Jia Mousa, Shahdra Lahore Punjab	Director	Pakistan	Services	27/10/2023	Appointed /	

2 2 Ceasing of Officer/Retirement/Resignation

Present Name in Full (a)	NIC No. or Passport No. in case of Foreign National (b)	Father / Husband Name (c)	Usual Residential Address (d)	Designation (e)	Nationality** (f)	Business Occupation** * (if any) (g)	Date of Present Appointment or Change (h)	Mode of Appointement / change / any other remarks (i)	Nature of directorship (nominee/independent/additional/ other) (j)

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

Present Name in Full (a)	NIC No. or Passport No. in case of Foreign National (b)	Father / Husband Name (c)	Usual Residential Address (d)	Designation (e)	Nationality** (f)	Business Occupation** * (if any) (g)	Date of Present Appointment or Change (h)	Mode of Appointement / change / any other remarks (i)	Nature of directorship (nominee/independent/additional/other)

* 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 (j), and a copy of resolution from the nominating or appointing body be attached.

PART-III

3.1 Declaration:

I do hereby solemnly, and sincerely 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.

3.2 Name of Authorized Officer with designation/ Authorized Intermediary	Rana Uzair Nasim	Chief Executive
3.3 Signature	Electronically signed by Rana Uzair Nasim	
3.4 Date (DD/MM/YYYY)	21/11/2023	
3.5 Registration No of Authorized Intermediary, if applicable		

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

PART-I

(Please complete in typescript or in bold block capitals)

1.1 CUIN (Registration Number)	0145593
1.2 Name of the Company	GHARO NEWGEN (PRIVATE) LIMITED
1.3 Fee payment details	1.3.1 Challan No: [ ] 1.3.2 Amount: 1000.0
1.4 Form A made upto (dd mm yyyy)	27/10/2023
1.5 Date of AGM	27/10/2023

PART - II

Section A

2.1 Registered Office Address	MB 300, PHASE 6, DHA Cantonement Punjab 54810
2.2 Email Address	umar@harappapolar.com
2.3 Office Tel. No	04238020444
2.4 Office Fax No	
2.5 Principle line of business	--POWER GENERATION - ALLIED (OTHER)
2.6 Mobile No of Authorized officer (Chief Executive/ Director/ Company Secretary/ Chief Financial Officer)	03344477116

2.7 Authorized Share Capital

Classes and kinds of Shares	No. of Shares	Amount	Face Value
Ordinary Shares		1,000,000.00	

2.8 Paid up Share Capital

Classes and kinds of Shares	No. of Shares	Amount	Face Value
Ordinary Shares		10,000.00	

2.9 Particulars of the holding /subsidiary company, if any

Name of Company	Holding/Subsidiary	% Shares Held

2.10 Chief Executive

Name	Rana Uzair Nasim
Address	House # 76-B, Street # 4, Phase 5, DHA Lahore Punjab Pakistan
NIC No	3520189251217

Next Page

2.11 Chief Financial Officer

Name	Umar Nazir
Address	624-E, Street # 2, Nadirabad, Bedian Road, Lahore
NIC No	8110304246315

2.12 Secretary

Name	Musaddiq Rahim
Address	House # 8, Street # 2, Mohalla Abu Qasim, Street Jia Mousa, Shahdra, Lahore
NIC No	3520219156175

2.13 Legal Advisor

Name	
Address	
NIC No	

2.14 Particulars of Auditors

Name	
Address	

2.15 Particulars of Shares Registrar (if applicable)

Name	Rana Uzair Nasim
Address	MB 300, Phase 6, Sector H, DHA, Lahore
Email	raowaqasca@gmail.com

Section-B

2.16 List of Directors on the date Annual return is made

S#	Name of Director	Residential Address	Nationality	NIC (Passport No. if foreigner)	Date of appointment /election	Name of Member/Creditors nominating/appointing
1	Rana Nasim Ahmed	House # 76-B, Street # 4, Phase 5, DHA Lahore Punjab Pakistan	Pakistan	3520204645477	27/10/2023	
2	Rana Uzair Nasim	House # 76-B, Street # 4, Phase 5, DHA Lahore Punjab Pakistan	Pakistan	3520189251217	27/10/2023	
3	Musaddiq Rahim	House # 8, Street # 2, Mohalla Abu Qasim, Street Jia Mousa, Shahdra Lahore Punjab Pakistan	Pakistan	3520219156175	27/10/2023	

2.18 Transfer of shares (debentures) since last Form A was made

S#	Name of Transferor	Name of Transferee	No of Shares Transferred	Date of Registration of transfer
Members				
Debenture Holders				

PART-3

3.1 Declaration:
I do hereby solemnly, and sincerely 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.

3.2 Name of Authorized Officer with designation/ Authorized Intermediary	Rana Uzair Nasim	Chief Executive
3.3 Signatures	Electronically signed by Rana Uzair Nasim	
3.4 Registration No of Authorized Intermediary, if applicable		
	Day Month Year	
3.5 Date	21/11/2023	

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Previous Page

Form-21

THE COMPANIES REGULATIONS, 2024

[Section 21,220 & 449 and Regulations 30]

NOTICE OF SITUATION OF REGISTERED OFFICE ADDRESS OR ANY CHANGE THEREIN OR NOTICE OF ADDRESS AT WHICH BOOKS OF ACCOUNTS ARE MAINTAINED

PART I

1.1. CUIN (Registration Number) | 0 | 1 | 4 | 5 | 5 | 9 | 3 |

1.2. Name of the Company: GHARO NEWGEN (PRIVATE) LIMITED

1.3. Fee Payment Details 1.3.1. Challan No: 24011409 1.3.2. Amount: 1000

Notice of		Please tick the relevant box
Part-II	Situation of registered office or any change therein	✓
Part-III	Address at which books of accounts are maintained	

PART II

(Applicable in case of first time reporting of registered office address or any change therein)

2.1. The situation of registered office of the company was changed from *(state prevous address)*: MB 300, PHASE 6, DHA Cantonement Punjab 54810, Cantonement, Lahore, Punjab, Pakistan

2.2. The registered office of the Company is now situated at *(first time reporting or change in address to be mentioned here)*: 114-CC2, PHASE 6C, DHA, Lahore, Lahore, Punjab, Pakistan

(State full address with identifiable number / name of the premises or building and street , road and locality besides the name of the town and postal area, where applicable)

Telephone Number: +92 3418839755 Fax Number,if any:

Email Address: umar@harappasolar.com

2.3. With effect from

Day		Month		Year			
0	1	0	2	2	0	2	4

PART III

(Applicable in case of notice of address at which the books of Accounts are to be kept other than registered office)

3.1. The above named company hereby gives you notice pursuant to the second proviso to sub-section (1) of section 220 of the Companies Act, 2017 that the Board of Directors of the Company have decided to keep the books of account of the company at the place other than registered office.

3.2. Date of resolution of Board of directors

Day		Month		Year			

3.3. Address of place at which books of accounts to be kept

3.4. Date of shifting / maintaining of books of account at above said address

Day		Month		Year			

PART IV

4.1. **Declaration**

I do hereby solemnly and sincerely 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 , regulation, directives, circulars and notification whichever is applicable.

4.2. Name of the Authorized Officer with designation / Authorized Intermediary

Rana Uzair Nasim	Chief Executive, Director

4.3. Signatures

This is an electronically generated document and doesnt require a physical form

4.3. Registration No of Authorized Intermediary, if applicable

4.5. Date

Day	Month	Year
04	03	2024

Enclosure

1. Evidence of filling of Form 26 in case of change in registered office from one city in a province to another

2. Original challan or other evidence of payment of fee specified in Seventh Scheduleof the Act (not applicable in case of online filing)

ANNEXURE II

MEMORANDUM / ARTICLES OF ASSOCIATION

Short A/A

THE COMPANIES ACT, 2017 (XIX of 2017)

(PRIVATE COMPANY LIMITED BY SHARES)

Articles of Association

of

Gharo Newgen (Private) Limited

THE COMPANIES ACT, 2017 (XIX of 2017)

(Private Company Limited by Shares)

ARTICLES OF ASSOCIATION

OF

GHARO NEWGEN (PRIVATE) LIMITED

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

PRIVATE COMPANY

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

(1) No invitation shall be made to the public to subscribe for the shares or debentures of the Company.

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

(3) The right to transfer shares of the Company is restricted in the manner and to the extent herein appearing.

TRANSFER OF SHARES

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

DIRECTORS

4. The number of directors shall not be less than two or a higher number as fixed under the provisions of the Act. The following persons shall be the first directors of the Company and shall hold the office upto the date of First Annual General Meeting:

1. Rana Nasim Ahmed
2. Rana Uzair Nasim
3. Musaddiq Rahim

THE COMPANIES ACT, 2017 (XIX of 2017)

(COMPANY LIMITED BY SHARES)

MEMORANDUM

OF

ASSOCIATION

OF

GHARO NEWGEN (PRIVATE) LIMITED

THE COMPANIES ACT, 2017 (XIX of 2017)
(COMPANY LIMITED BY SHARES)

MEMORANDUM OF ASSOCIATION

OF

GHARO NEWGEN (PRIVATE) LIMITED

1. The name of the company is GHARO NEWGEN (PRIVATE) LIMITED (hereinafter referred to as the "Company").

2. The registered office of the Company will be situated in the Province of Punjab.

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

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

(iii) Notwithstanding anything contained in the foregoing sub-clauses of this clause nothing contained herein shall be construed as empowering the Company to undertake or indulge, directly or indirectly in the business of a Banking Company, Non-banking Finance Company (Mutual Fund, Leasing, Investment Company, Investment Advisor, Real Estate Investment Trust management company, Housing Finance Company, Venture Capital

Company, Discounting Services, Microfinance or Microcredit business), Insurance Business, Modaraba management company, Stock Brokerage business, forex, managing agency, business of providing the services of security guards or any other business restricted under any law for the time being in force or as may be specified by the Commission.

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

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

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

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

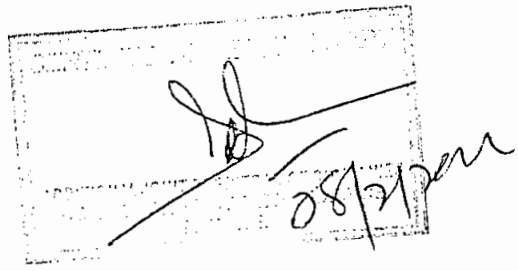
4. The liability of the members is limited.

5. The authorized capital of the Company is Rs. 1,000,000 (Rupees One Million only) divided into 100,000 (One Hundred Thousand) ordinary shares of Rs. 10 (Rupees Ten) each.

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

Name and surname (present & former) in full (in Block Letters)	NIC No. (in case of foreigner Passport No)	Father's/ Husband's Name in full	Nationality (ies) with any former Nationality	Occupation	Usual residential address in full or the registered/ principal office address for a subscriber other than natural person	Number of shares taken by each subscriber (in figures and words)	Signatures
Rana Nasim Ahmed	35202-0464547-7	Faqir Muhammad	Pakistani	Businessman	House # 76-B, Street # 4, Phase 5, DHA, Lahore	900 (Nine Hundred shares)	
Rana Uzair Nasim	35201-8925121-7	Rana Nasim Ahmed	Pakistani	Businessman	House # 76-B, Street # 4, Phase 5, DHA, Lahore	99 (Ninety Nine shares)	
Musaddiq Rahim	35202-1915617-5	Abdul Rahim	Pakistani	Service	House # 8, Street # 2, Mohalla Abu Qasim, Street Jia Mousa, Shahdra, Lahore	1 (One share)	
		Total number of shares taken (in figures and words)				1000 (One Thousand shares)	

Dated the 31st day of January, 2022



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

Name and surname (present & former) in full in Block Letters)	NIC No. (in case of foreigner Passport No)	Father's/ Husband's Name in full	Nationality(ies) with any former Nationality	Occupation	Usual residential address in full or the registered/ principal office address for a subscriber other than natural person	Number of shares taken by each subscriber (in figures and words)	Signatures
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		Total number of shares taken (in figures and words)				1000 (One Thousand shares)	

Dated the 31st day of January, 2022

Federal Board of Revenue
Revenue Division - Government of Pakistan

Online Verification System

Taxpayer Profile Inquiry

Printed On: 6/27/2024 3:10:32 PM

Registration No	6724102
Reference No	6724102-4
Registered for Sales Tax	No
Name	GHARO NEWGEN LIMITED
Category	Company formed and registered under the Companies Ordinance, 1984 or any other law repealed thereunder
PP/REG/INC No.	0145593
Email	mwa****har***asolar.com
Cell	00923**477**73
Address	MB 300, PHASE 6, DHA, Pakistan
Registered On	17-JAN-2020
Tax Office	CTO LAHORE
Registration Status	Income Tax: Active

Sr.	Business/ Branch Name	Business/ Branch Address	Principal Activity
1	GHARO NEWGEN (PRIVATE) LIMITED	MB 300, PHASE 6, DHA, Pakistan	010000-Importer/Exporter/Importer/Importer

ANNEXURE III

LAST FILED ANNUAL RETURNS

GHARO NEWGEN (PRIVATE) LIMITED
STATEMENT OF FINANCIAL POSITION
AS AT JUNE 30, 2023 (UN-AUDITED)

	Notes	30-Jun-23 Rupees	30-Jun-22 Rupees
ASSETS			
Current assets			
Other Receivables & Prepayments	1	52,500	350,000
Cash and bank balances	2	2,299,032	7,775
TOTAL ASSETS		2,351,532	357,775
EQUITY AND LIABILITIES			
SHARE CAPITAL AND RESERVES			
Authorised capital 10,000 (2022: 10,000) ordinary shares of Rs. 10 each		100,000	100,000
Issued, subscribed and paid up capital 1,000 (2022: 1,000) ordinary shares of Rs. 10 each fully paid in cash	3	10,000	10,000
Revenue reserve: Unappropriated loss		(687,236)	(51,225)
		(677,236)	(41,225)
Share deposit money			-
TOTAL EQUITY		(677,236)	(41,225)
LIABILITIES			
Current liabilities			
Creditors and accrued expenses	4	3,028,768	399,000
		3,028,768	399,000
TOTAL EQUITY AND LIABILITIES		2,351,532	357,775

The annexed notes from 1 to 7 form an integral part of these financial statements.

CHIEF EXECUTIVE **DIRECTOR**

GHARO NEWGEN (PRIVATE) LIMITED
INCOME STATEMENT
FOR THE PERIOD ENDED JUNE 30, 2023

	Notes	30-Jun-23 Rupees	30-Jun-22 Rupees
Pre-Operating expenses	5	(636,011)	(35,862)
Operating loss		(636,011)	(35,862)
Financial charges	6	-	(2,436)
Loss before taxation		(636,011)	(38,298)
Taxation		-	-
Loss after taxation		(636,011)	(38,298)

The annexed notes from 1 to 7 form an integral part of these financial statements.

CHIEF EXECUTIVE DIRECTOR

GHARO NEWGEN (PRIVATE) LIMITED
STATEMENT OF CHANGES IN EQUITY
AS AT JUNE 30, 2023 (UN-AUDITED)

	Issued, subscribed and paid up capital	Capital Reserve	Revenue reserve	Total equity
		Share deposit money	Unappropriated loss	
	Rupees	Rupees	Rupees	Rupees
Balance as at June 30, 2019	-	-	-	-
Share Deposit money	10,000	-		10,000
Loss for the period	-	-	-	-
Balance as at June 30, 2020	-	-	(12,927)	(12,927)
	10,000			
Share Deposit money		-	-	-
Loss for the period	-	-	-	-
Balance as at June 30, 2021	10,000	-	(12,927)	(12,927)
Share Deposit money	-	-		-
Loss for the period	-	-	(38,298)	(38,298)
Previous year adjustment				
Balance as at June 30, 2022	10,000	-	(51,225)	(41,225)
Share Deposit money	-	-		-
Loss for the period	-	-	(636,011)	(636,011)
Previous year adjustment				
Balance as at June 30, 2023	10,000	-	(687,236)	(677,236)

The annexed notes from 1 to 7 form an integral part of these financial statements.

CHIEF EXECUTIVE DIRECTOR

GHARO NEWGEN (PRIVATE) LIMITED
STATEMENT OF CASH FLOWS
FOR THE PERIOD ENDED JUNE 30, 2023

	Note	30-Jun-23 Rupees	30-Jun-22 Rupees
CASH FLOWS FROM OPERATING ACTIVITIES			
Loss before taxation		(636,011)	(38,298)
Adjustment for non-cash charges and other items:			
Depreciation		-	-
Financial charges	6	-	2,436
Operating loss before working capital changes		(636,011)	(35,862)
Effect on cash flows due to working capital changes:			
Increase in current liabilities:			
Short term advances		-	-
Other Receivables		297,500	-
Creditors and accrued expenses		2,629,768	8,000
Cash generated from / (used in) operations		2,291,257	(27,862)
Taxes paid		-	-
Finance cost paid	6	-	(2,436)
Net cash generated from / (used in) operating activities		2,291,257	(30,298)
CASH FLOWS FROM INVESTING ACTIVITIES			
Share Deposit money received		-	-
Payment for capital expenditures		-	-
Net cash used in investing activities		-	-
CASH FLOWS FROM FINANCING ACTIVITIES			
Issuance of ordinary shares		-	-
Net cash from financing activities		-	-
Net increase / (decrease) in cash and cash equivalents		2,291,257	(30,298)
Cash and cash equivalents at the beginning of the year		7,775	38,073
Cash and cash equivalents at the end of the year	2	2,299,032	7,775

The annexed notes from 1 to 7 form an integral part of these financial statements.

CHIEF EXECUTIVE DIRECTOR

SECTION 3

TECHNICAL DETAILS

(SCHEDULE-I)

Contents of Section-3(Schedule-I)

1. Site Coordinates.
2. Flow Diagram of PV Plant and Facility's System.
3. Single Line Diagram of Propose 15 MWp PV Plant.
4. Interconnection & Arrangement for Power.
5. Detail of Generation Facility & Solar Power Plant.
    - i. *General Information*
    - ii. *Equipment Details, Technology & Capacity*

SITE COORDINATES

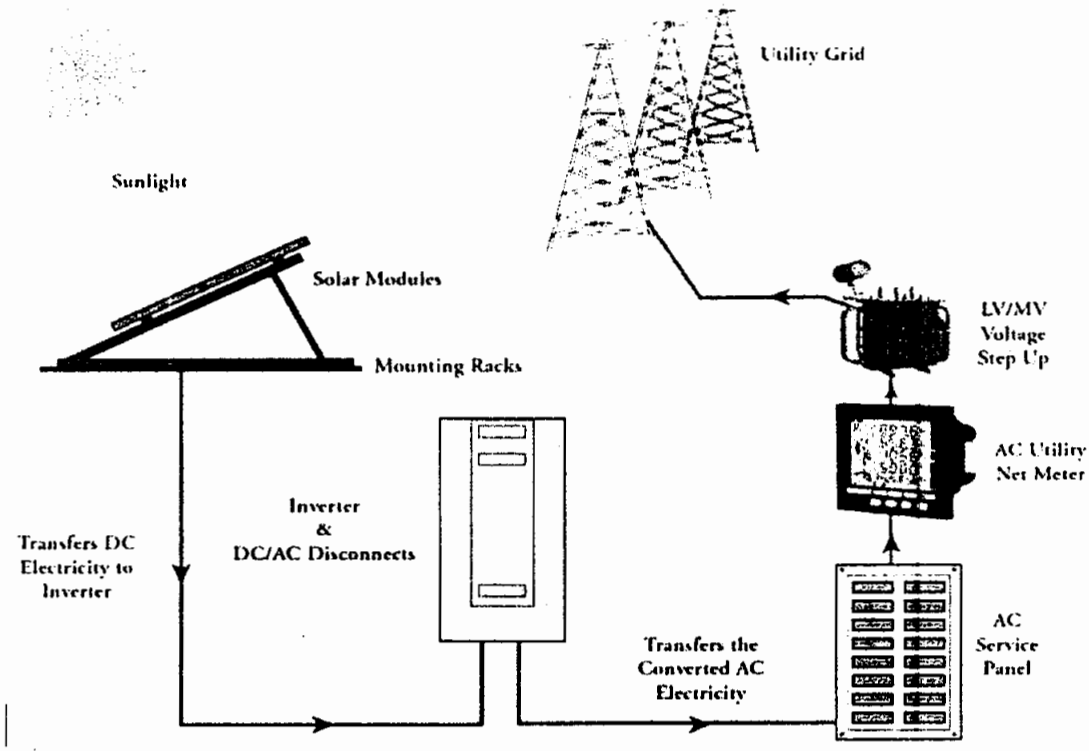
Site Coordinates:

The site coordinates are as follow:

Latitude (North)	Longitude (East)
24°42'58.0"N	67°34'09.5"E

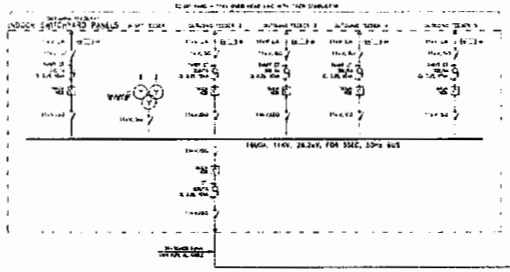
FLOW DIAGRAM OF PV PLANT

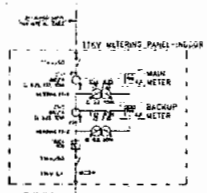
1. Flow Diagram of PV Plant and Facility's System:

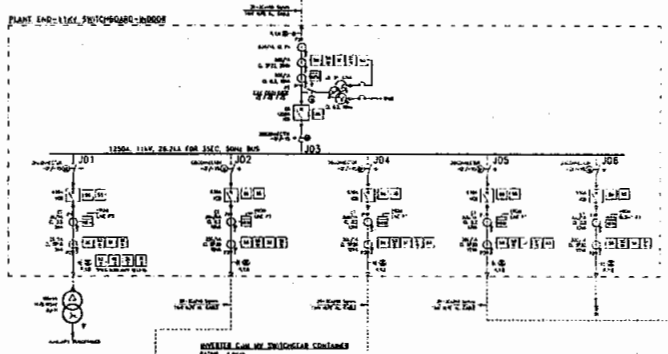


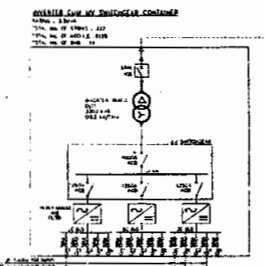
SINGLE LINE DIAGRAM OF PV PLANT

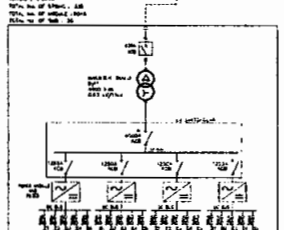
2. Single Line Diagram of Propose 15MWp PV Plant:

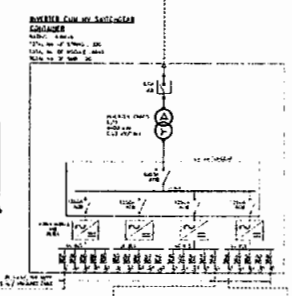


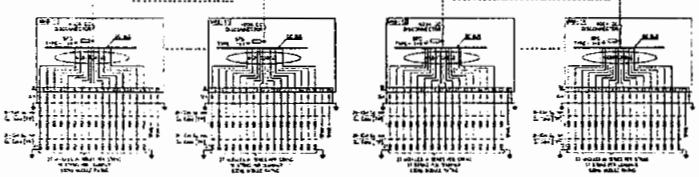


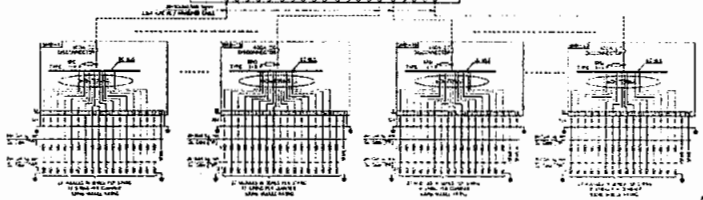


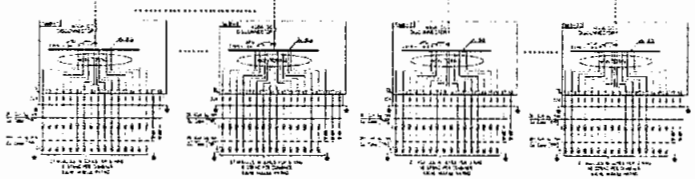












BOD OF EQUIPMENTS

DESCRIPTION	QUANTITY
SOLAR MODULE MAKE	610 Wp M SOLAR
TOTAL NUMBER OF MODULES	25614
TOTAL NUMBER OF STRING	534
TOTAL NUMBER OF STRING	480
DC CAPACITY	15 MWp
AC CAPACITY	12 MVA
INVERTER CUM TRANSFORMER	3 Nos
3.3MVA SUNGROW CONTAINER	1 No
4.4MVA SUNGROW CONTAINER	2 Nos

LEGEND:

- CURRENT TRANSFORMER / VOLTAGE TRANSFORMER
- METER / INDICATION
- DISCONNECTOR WITH INTEGRATED EARTHING SWITCH
- LIGHTNING ARRESTOR
- SPD
- DIGITAL PROJECTOR METER (EXPORT / IMPORT)
- MULTI FUNCTION METER
- ISOLATOR
- INDICATION LAMP
- FUSES

SUFFIX FOR RELAYING:

A	ALARM
BF	BF/R ELEMENT
E	EARTH FAULT
EMR	EMERGENCY
DC	DIRECT CURRENT
N	EARTH FAULT
TRAFO	TRANSFORMER
P	PUSHBUTTON
PR	PERIPHERAL UNIT
OF	OVER FREQUENCY
UF	UNDER FREQUENCY
Z	NO VOLT ELEMENT
X	AUXILIARY RELAY
LV	LOW VOLTAGE
HV	HIGH VOLTAGE
TS	TEMPERATURE SCANNER
CU	CENTRAL UNIT

CAB PANEL = CONTROL & RELAY PANEL

RELAYING:

NO	FUNCTION
26	APPARATUS THERMAL DEVICE
49	TRAFO THERMAL RELAY
50	INSTANTANEOUS PHASE OVER CURRENT RELAY
50N	INSTANTANEOUS EARTH FAULT RELAY
51	INVERSE TIME OVER CURRENT RELAY
51N	INVERSE TIME EARTH FAULT RELAY
60	PT FUSE FAILURE RELAY
63	BUCHHOLZ RELAY & OIL GUAGE RELAY
71	LEVEL SWITCH
86	MASTER TRIPPING/LOCKOUT RELAY
95	SUPERVISION RELAY FOR TRIP CIRCUIT

PRELIMINARY SLD

CONTROLLED COPY — UNCONTROLLED COPY

GHARO-2 SOLAR (PRIVATE) LIMITED
15 MWp DC/12MW AC

AVANT-GARDE ENGINEERS & CONSULTANTS (P) LTD.

OVERALL SINGLE LINE DIAGRAM

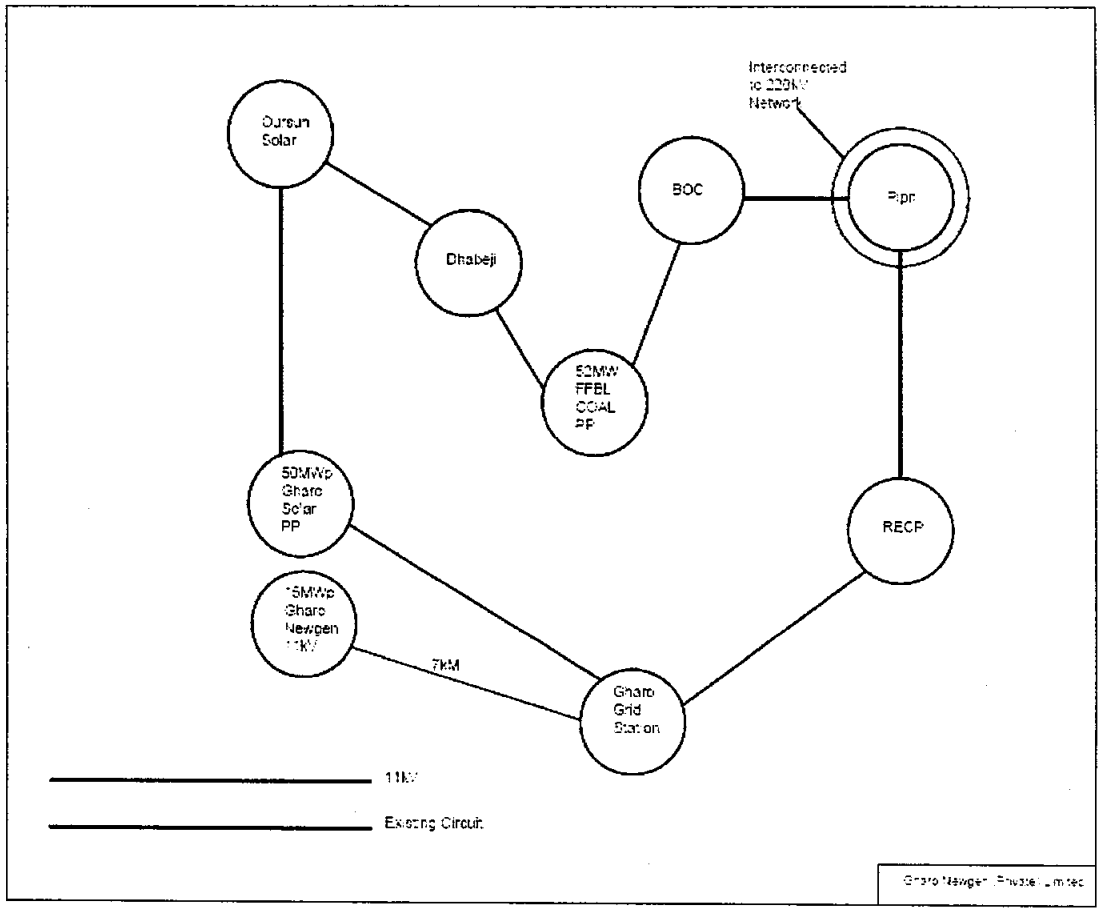
SIZE: A0 | THIS IS A CAD FILE – DO NOT MAKE ANY CORRECTIONS MANUALLY

INTERCONNECTION AND ARRANGEMENT FOR POWER

3. Interconnection & Arrangement for Power:

The electric power generated from the Generation Facility/Solar Power Plant of the Company shall be dispersed to the load center of K-Electric.

The proposed Interconnection Arrangement/Transmission Facility for dispersal of electric power comprises the direct 11 kV lines of approximately 7-8 km length to be laid from the 11 kV bus bar of the Generation Facility/Solar Power Plant to the Gharo Grid Station.



DETAIL OF GENERATION FACILITY & PV PLANT

4. Detail of Generation Facility & Solar Power Plant.

1. General Information.

(i).	**Name of the Company / License**	Gharo Newgen (Private) Limited
(ii).	**Registered/Business Office of the Company**	114CC2 DHA Phase 6 Lahore
(iii).	**Principal Office**	114CC2 DHA Phase 6 Lahore
(iv).	**Plant's Name & Location**	Gharo Newgen (Private) Limited in Gharo, Sindh, Pakistan
(v).	**Field Type**	Solar

2. Equipment Details. Technology & Capacity.

(a).	**Solar Panels-PV Modules**	
(i).	Type of Module	Mono crystalline bifacial N-type PV Module JAM72D42-630/LB
(ii).	Dimension of each Module	2465 mm X 1134 mm x 30 mm
(iii).	No. of Modules	23,814
(iv).	Weight of one Module	34.6 kg
(v).	Number of Solar Cells in each Module	144 (6x24) Cells
(vi).	Efficiency of Module	22.5%
(vii).	Maximum Power (Pmax)	630 W
(viii).	Power Tolerance at STC	3%
(ix).	Open Circuit Voltage (Voc)	52.47 V
(x).	Maximum Power Voltage (Vmp)	43.90 V
(xi).	Short Circuit Current (Isc)	15.21 A
(xii)	Maximum Power Current (Imp)	14.35 A
	PV Array	
(i).	Total No. of Strings	882
(ii).	Total Capacity	15 MWp DC
(iii).	Net Capacity Factor	22.85%
(b).	**Inverters**	

(i).	Maximum AC Power	12 MWac	
(ii).	Inverter Model	SG3300UD-MV / SG4400UD-MV	
(iii).	Manufacturer	SUNGROW	
(iv).	Maximum PV Input Voltage	1500V	
(v).	Number of Inverters	3	
(vi).	Inverter Max. Efficiency	99.00%	
(vii).	Max. PV Input Current	3x1400A / 4x1435A	
(viii).	MPP Voltage Range	895 V - 1500 V	

SECTION 4

SCHEDULE-II

Contents of Section-4(Schedule-11)

1. Installed Gross ISO Capacity Detail.
2. Technical Data Sheet of PV Modules.
3. Technical Data Sheet of PV Inverters.
4. PVSYST Simulation Report.

INSTALLED GROSS ISO CAPACITY DETAILS

1. **Installed Gross ISO Capacity Detail:**

1.	Total PV installed Capacity of Generation facility	15.0 MWp DC	
2.	Days per Year	365	
3.	PV Plant generating Capacity Annually (As per Simulation)	30,024.191 MWh	
4.	Net Capacity Factor	22.85%	

All the above figure are indicative as provided by the Licensee. The Net energy available to the Power Purchaser for dispatch will be determined through procedures contained in the Energy Purchase Agreement.

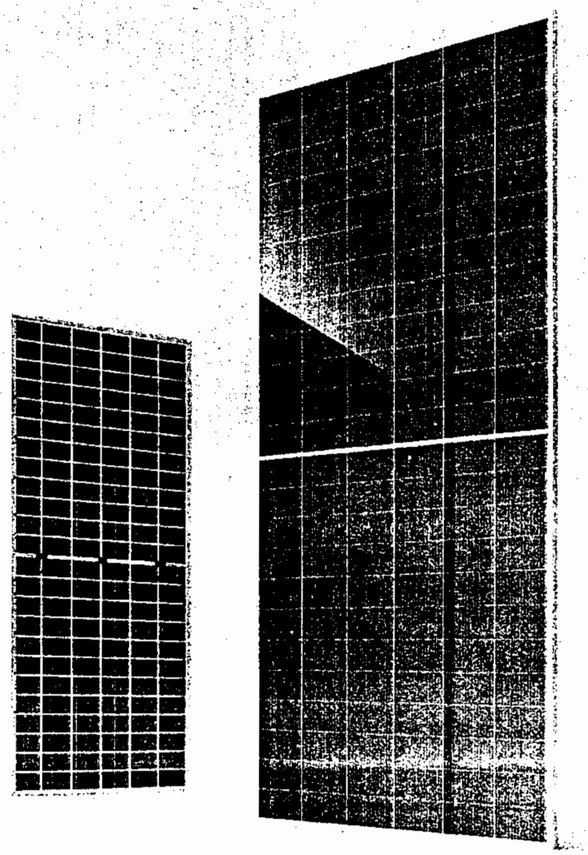
TECHNICAL DATA SHEET OF PV MODULES

Harvest the Sunshine

640W

JAM72D42 LB n-type Double Glass Bifacial Modules

JA SOLAR

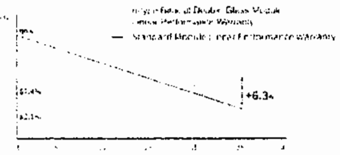


Premium Cells

n-Bycium+ 16BB	26% Up To
MBB Half-Cell Technology	Cell Conversion Efficiency

Premium Modules

- Higher power generation better LCOE
- n-type with very Lower LID
- Better Temperature Coefficient
- Better low irradiance response



- 12-year product warranty
- [illegible]-year linear power output warranty

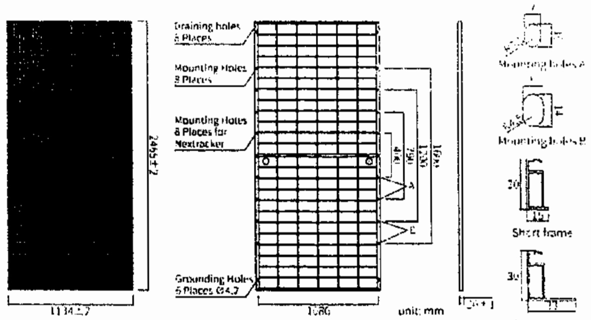
Comprehensive Certificates

- IEC 61215, [illegible]
- [illegible] management systems
- [illegible] management systems
- [illegible] Occupational health and safety management systems
- [illegible] Quality system [illegible] manufacturing

DEEP BLUE 4.0

JAM72D42 LB n-type Double Glass Bifacial Modules

DEEPBLUE 4.0 Pro



MECHANICAL PARAMETERS

Cell	Mono
Weight	34.6kg
Dimensions	2465±2mm×1134±2mm×30±1mm
Cable Cross Section Size	4mm² (IEC), 12 AWG(UL)
No. of cells	144(6×24)
Junction Box	IP68, 3 diodes
Connector	QC 4.10-35 / MC4-EVO2A
Cable Length (Including Connector)	Portrait: 300mm(+)/400mm(-) Landscape: 1500mm(+)/1500mm(-)
Front Glass/Back Glass	2.0mm/2.0mm
Packaging Configuration	36pcs/Pallet, 576pcs/40HQ Container

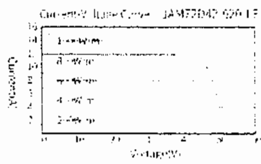
Remark: customized frame color and cable length available upon request

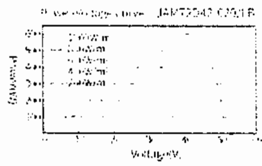
ELECTRICAL PARAMETERS AT STC

TYPE	JAM72D42 615/LB	JAM72D42 620/LB	JAM72D42 625/LB	JAM72D42 630/LB	JAM72D42 635/LB	JAM72D42 640/LB
Rated Maximum Power(Pmax) [W]	615	620	625	630	635	640
Open Circuit Voltage(Voc) [V]	51.87	52.07	52.27	52.47	[illegible]	[illegible]
Maximum Power Voltage(Vmp) [V]	43.31	43.51	43.71	43.90	44.10	[illegible]
Short Circuit Current(Isc) [A]	15.06	15.11	[illegible]	[illegible]	15.26	[illegible]
Maximum Power Current(Imp) [A]	14.20	14.25	14.30	14.35	14.40	14.45
Module Efficiency [%]	22.0	22.2	22.4	[illegible]	[illegible]	[illegible]
Power Tolerance	0~+3%					
Temperature Coefficient of Isc(α_Isc)	+0.045%/°C					
Temperature Coefficient of Voc(β_Voc)	-0.250%/°C					
Temperature Coefficient of Pmax(γ_Pmp)	-0.290%/°C					
STC	Irradiance 1000W/m², cell temperature 25°C, AM1.5G					

Remark: [illegible]
[illegible]

CHARACTERISTICS





ELECTRICAL CHARACTERISTICS WITH 10% SOLAR IRRADIATION RATIO

TYPE	JAM72D42 615/LB	JAM72D42 620/LB	JAM72D42 625/LB	JAM72D42 630/LB	JAM72D42 635/LB	JAM72D42 640/LB
Rated Max Power(Pmax) [W]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Open Circuit Voltage(Voc) [V]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Max Power Voltage(Vmp) [V]	[illegible]	[illegible]	[illegible]	[illegible]	44.10	[illegible]
Short Circuit Current(Isc) [A]	[illegible]	[illegible]	[illegible]	[illegible]	16.45	[illegible]
Max Power Current(Imp) [A]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Irradiation Ratio (rear/front)	10%					

[illegible]

OPERATING CONDITIONS

Maximum System Voltage	[illegible]
Operating Temperature	[illegible]
Maximum Series Fuse Rating	[illegible]
Maximum Static Load, Front	[illegible]
Maximum Static Load, Back	[illegible]
NOCT	[illegible]
Bifaciality	[illegible]
Safety Class	Class II
Fire Performance	[illegible]

JA SOLAR

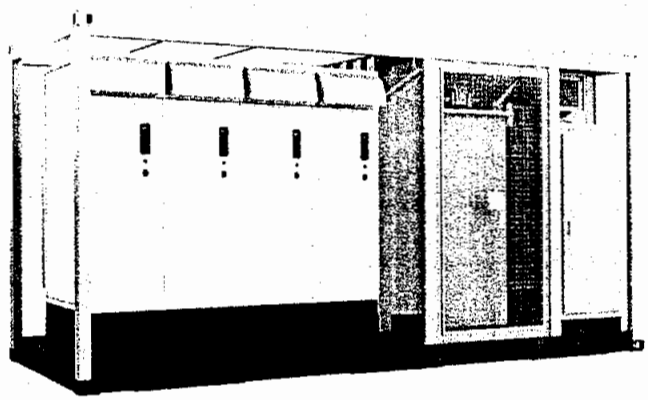
Headquarters No.8 Building, Nuode Center, No.1 Courtyard, East Auto Museum Road, Fengtai District, Beijing
Tel: +86 10 6361 1888 Fax: +86 10 6361 1999
E-mail: [illegible] www.jasolar.com

Version No.: Global EN [illegible]

TECHNICAL DATA SHEET OF PV INVERTERS

SG3300UD-MV
SG4400UD-MV

Turnkey Station for 1500 Vdc System MV Transformer Integrated



HIGH YIELD

- Advanced three-level technology, max. inverter efficiency 99%
- Effective cooling, full power operation at 45 ℃

SMART O&M

- Integrated zone monitoring and MV parameters monitoring function for online analysis and trouble shooting
- Modular design, easy for maintenance

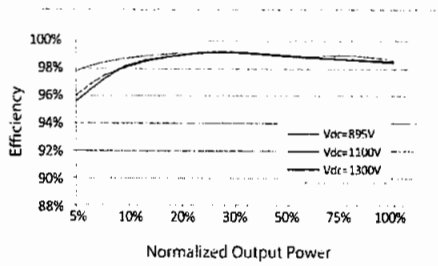
SAVED INVESTMENT

- Low transportation and installation cost due to 20-foot container design
- DC 1500V system, low system cost
- Integrated MV transformer, switchgear, and LV auxiliary power supply
- Q at night function optional

GRID SUPPORT

- Compliance with standards: IEC 61727, IEC 62116, IEC 62271-202, IEC 62271-200, IEC 60076
- Low/High voltage ride through (L/HVRT)
- Active & reactive power control and power ramp rate control

EFFICIENCY CURVE



SUNGROW
Clean power for all

Type Designation	SG3300UD-MV	SG4400UD-MV
Input (DC)		
Max. PV input voltage	1500 V	
Min. PV input voltage / Startup input voltage	895 V / 905 V	
MPP voltage range	895 - 1500 V	
No. of independent MPP inputs	3	4
No. of DC inputs	15(optional: 18/21 inputs negative grounding)	20(optional: 24/28 inputs negative grounding)
Max. PV input current	3 * 1400 A	4 * 1435 A
Max. DC short-circuit current	3 * 3528 A	4 * 3528 A
PV array configuration	Negative grounding or floating	
Output (AC)		
AC output power	3300 kVA @ 45 °C 3399 kVA @ 40 °C 3795 kVA @ 22.5 °C	4400 kVA @ 45 °C 4532 kVA @ 40 °C 5060 kVA @ 22.5 °C
Max. inverter output current	3 * 1160 A	4 * 1160 A
Max. AC output current	219.2 A	292.2 A
AC voltage range	10 kV - 35 kV	
Nominal grid frequency / Grid frequency range	50 Hz / 45 - 55 Hz, 60 Hz / 55 - 65 Hz	
Harmonic (THD)	< 3 % (at nominal power)	
Power factor at nominal power / Adjustable power factor	> 0.99 / 0.8 leading - 0.8 lagging	
Feed-in phases / AC connection	3 / 3	
Efficiency		
Inverter max. efficiency / Inverter European efficiency	99.0 % / 98.8 %	
Transformer		
Transformer rated power	3300 kVA	4400 kVA
Transformer max. power	3795 kVA	5060 kVA
LV / MV voltage	0.63 kV / (10 - 35) kV	
Impedance	7 % (0 ~ ± 10 %) @ 3300 kVA	8 % (0 ~ ± 10 %) @ 4400 kVA
Transformer vector	Dy11	
Transformer cooling type	ONAN	
Oil type	Mineral oil (PCB free) or degradable oil on request	
Protection & Function		
DC input protection	Load break switch + fuse	
Inverter output protection	Circuit breaker	
AC MV output protection	Circuit breaker	
Surge protection	DC Type II / AC Type II	
Grid monitoring / Ground fault monitoring	Yes / Yes	
Insulation monitoring	Yes	
Overheat protection	Yes	
Q at night function	Optional	
General Data		
Dimensions (W*H*D)	6058 * 2896 * 2438 mm	
Weight	17.5 T	20 T
Degree of protection	Inverter: IP65 / Others: IP54	
Auxiliary power supply	5 kVA (optional: max. 40 kVA)	
Operating ambient temperature range	-35 to 60 °C (> 45 °C derating)	
Allowable relative humidity range	0 - 100 %	
Cooling method	Temperature controlled forced air cooling	
Max. operating altitude	1000 m (standard) / > 1000 m (optional)	
Display	LED indicators, WLAN + WebHMI	
Communication	Standard: RS485, Ethernet; Optional: optical fiber; MPLC	
Compliance	CE, IEC 62109, IEC 61727, IEC 62116, IEC 60068, IEC 61683, IEC62271-202, VDE-AR-N 4110:2018, VDE-AR-N 4120:2018, EN 50549-2, UNE 206007-1:2015, P.O.12.3, UTE C15-712-1:2013	
Grid support	Q at night (Optional), L/HVRT, active & reactive power control and power ramp rate control	

PVSYST
PHOTOVOLTAIC SOFTWARE

Version 7.3.1

PVsyst - Simulation report

Grid-Connected System

Project: 15MW GNL Project Central Inverter

Variant: New simulation variant

Tracking system with backtracking

System power: 15.00 MWp

Gharo - Pakistan

Gharo Solar Limited

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Project summary

Geographical Site
Gharo
Pakistan

Situation

Latitude	24.72 °N
Longitude	67.57 °E
Altitude	7 m
Time zone	UTC+5

Project settings
Albedo 0.20

Meteo data
Gharo
SolarGIS Monthly aver. , period not spec. - Synthetic

System summary

Grid-Connected System
Simulation for year no 1

Tracking system with backtracking

PV Field Orientation
Orientation
Tracking plane, horizontal N-S axis
Axis azimuth 0 °

Tracking algorithm
Astronomic calculation
Backtracking activated

Near Shadings
Linear shadings

System information

PV Array

Nb. of modules	23814 units
Pnom total	15.00 MWp

Inverters

Nb. of units	3 units
Pnom total	12.10 MWac
Pnom ratio	1.240

User's needs
Unlimited load (grid)

Results summary

Produced Energy	30024191 kWh/year	Specific production	2001 kWh/kWp/year	Perf. Ratio PR	82.39 %
Apparent energy	31731086 kVAh				

Table of contents

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General parameters, PV Array Characteristics, System losses 3
Near shading definition - Iso-shadings diagram 6
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CO_2 Emission Balance 12

General parameters

Grid-Connected System

Tracking system with backtracking

PV Field Orientation

Orientation		Tracking algorithm		Backtracking array	
Tracking plane, horizontal N-S axis		Astronomic calculation		Nb. of trackers	322 units
Axis azimuth	0 °	Backtracking activated		**Sizes**	
				Tracker Spacing	5.50 m
				Collector width	2.46 m
				Ground Cov. Ratio (GCR)	44.8 %
				Phi min / max.	-/+ 55.0 °
				Backtracking strategy	
				Phi limits for BT	-/+ 63.2 °
				Backtracking pitch	5.50 m
				Backtracking width	2.47 m

Models used

Transposition	Perez
Diffuse	Perez, Meteonorm
Circumsolar	separate

Horizon	Near Shadings	User's needs
Free Horizon	Linear shadings	Unlimited load (grid)

Bifacial system

Model: 2D Calculation unlimited trackers

Bifacial model geometry		Bifacial model definitions	
Tracker Spacing	5.50 m	Ground albedo	0.20
Tracker width	2.46 m	Bifaciality factor	45 %
GCR	44.8 %	Rear shading factor	5.0 %
Axis height above ground	2.10 m	Rear mismatch loss	10.0 %
		Shed transparent fraction	0.0 %

Grid injection point

Power factor

Cos(phi) (lagging)	0.950

PV Array Characteristics

Array #1 - PV Array

PV module		Inverter	
Manufacturer	JA Solar	Manufacturer	Sungrow
Model	JAM72D42-630/LB	Model	SG3300UD
(Custom parameters definition)		(Custom parameters definition)	
Unit Nom. Power	630 Wp	Unit Nom. Power	3300 kWac
Number of PV modules	5940 units	Number of inverters	1 unit
Nominal (STC)	3742 kWp	Total power	3300 kWac
Modules	220 Strings x 27 In series	Operating voltage	895-1500 V
At operating cond. (50°C)		Max. power (=>22°C)	3795 kWac
Pmpp	3479 kWp	Pnom ratio (DC:AC)	1.13
U mpp	1087 V	Power sharing within this inverter	
I mpp	3201 A		

PV Array Characteristics

Array #2 - Sub-array #2

PV module		**Inverter**	
Manufacturer	JA Solar	Manufacturer	Sungrow
Model	JAM72D42-630/LB	Model	SG4400UD
(Custom parameters definition)		(Custom parameters definition)	
Unit Nom. Power	630 Wp	Unit Nom. Power	4400 kWac
Number of PV modules	17874 units	Number of inverters	2 units
Nominal (STC)	11.26 MWp	Total power	8800 kWac
Modules	662 Strings x 27 In series	Operating voltage	895-1500 V
At operating cond. (50°C)		Max. power (=>22°C)	5060 kWac
Pmpp	10.47 MWp	Pnom ratio (DC:AC)	1.28
U mpp	1087 V	Power sharing within this inverter	
I mpp	9632 A		

Total PV power		**Total inverter power**	
Nominal (STC)	15003 kWp	Total power	12100 kWac
Total	23814 modules	Number of inverters	3 units
Module area	66568 m²	Pnom ratio	1.24

Array losses

Array Soiling Losses
Loss Fraction 3.0 %

Thermal Loss factor
Module temperature according to irradiance
Uc (const) 29.0 W/m²K
Uv (wind) 0.0 W/m²K/m/s

LID - Light Induced Degradation
Loss Fraction 1.0 %

Module Quality Loss
Loss Fraction -0.7 %

Module mismatch losses
Loss Fraction 0.7 % at MPP

Strings Mismatch loss
Loss Fraction 0.4 %

Module average degradation
Year no 1
Loss factor 2 %/year

Mismatch due to degradation
Imp RMS dispersion 0.4 %/year
Vmp RMS dispersion 0.4 %/year

IAM loss factor
ASHRAE Param.: IAM = 1 - bo (1/cosi -1)
bo Param. 0.07

DC wiring losses

Global wiring resistance 1.4 mΩ
Loss Fraction 1.5 % at STC

Array #1 - PV Array		**Array #2 - Sub-array #2**	
Global array res.	5.6 mΩ	Global array res.	1.9 mΩ
Loss Fraction	1.5 % at STC	Loss Fraction	1.5 % at STC

System losses

Unavailability of the system
Time fraction 0.8 %
2.9 days,
5 periods

Auxiliaries loss
constant (fans) 42.0 kW
0.0 kW from Power thresh.

AC wiring losses

Inv. output line up to MV transfo

Inverter voltage	630 Vac tri
Loss Fraction	0.40 % at STC

Inverters: SG3300UD, SG4400UD

Wire section (3 Inv.)	Copper 3 x 3 x 2500 mm²
Average wires length	68 m

MV line up to Injection

MV Voltage	11 kV
Average each inverter	
Wires	Alu 3 x 300 mm²
Length	1300 m
Loss Fraction	0.61 % at STC

AC losses in transformers

MV transfo

Medium voltage	11 kV

One transfo parameters

Nominal power at STC	4.91 MVA
Iron Loss (24/24 Connexion)	8.54 kVA
Iron loss fraction	0.17 % at STC
Copper loss	57.01 kVA
Copper loss fraction	1.16 % at STC
Coils equivalent resistance	3 x 0.94 mΩ

Operating losses at STC (full system)

Nb. identical MV transfos	3
Nominal power at STC	14.73 MVA
Iron loss (24/24 Connexion)	25.63 kVA
Copper loss	171.04 kVA

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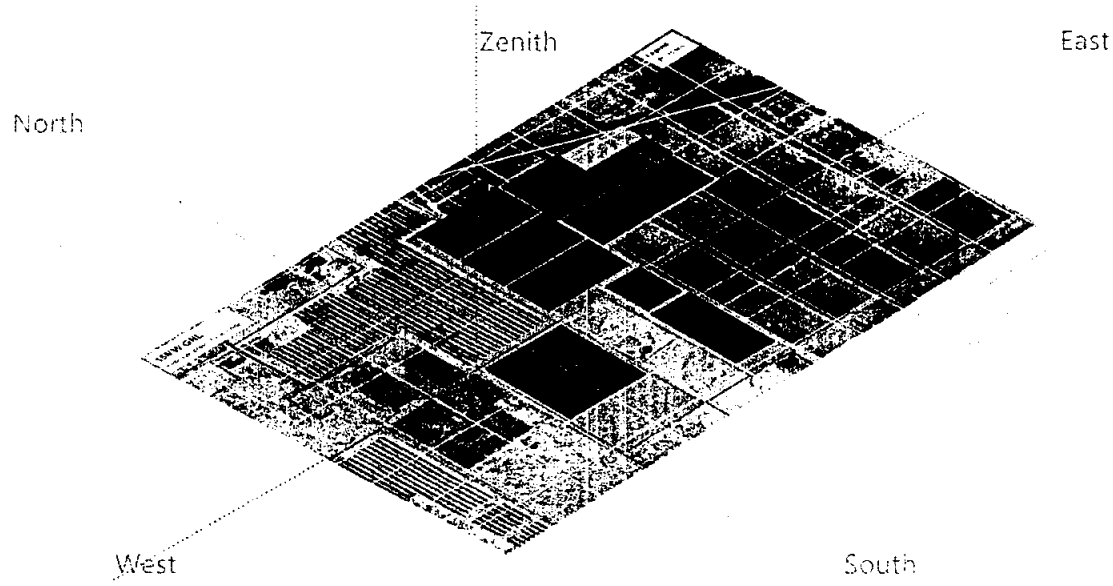
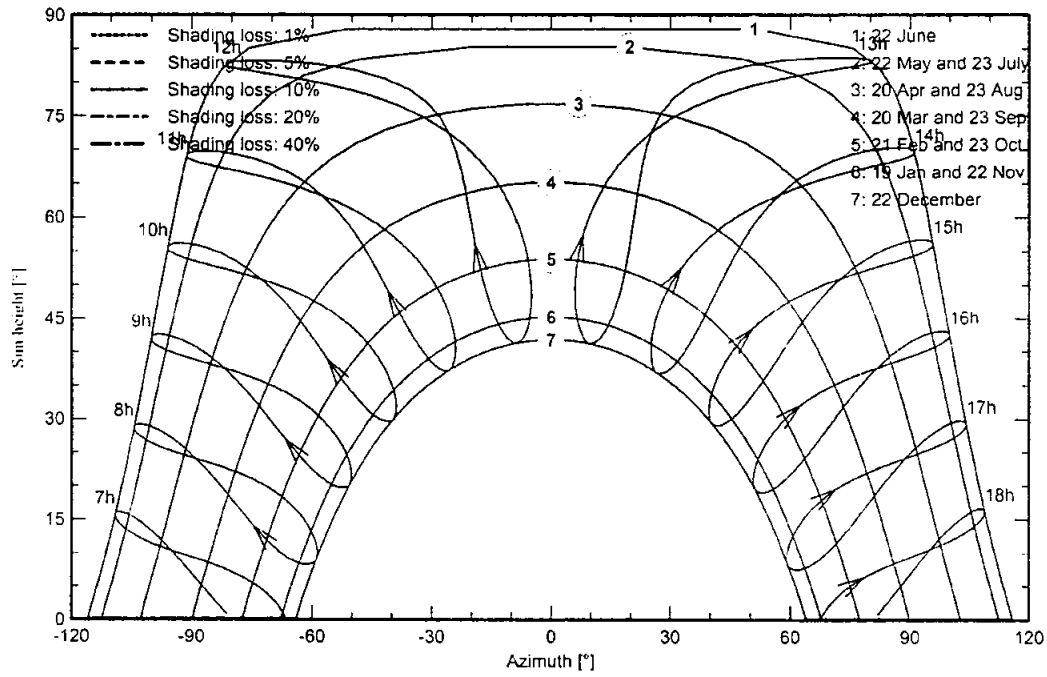
Near shadings parameter

Perspective of the PV-field and surrounding shading scene



Iso-shadings diagram

Orientation #1



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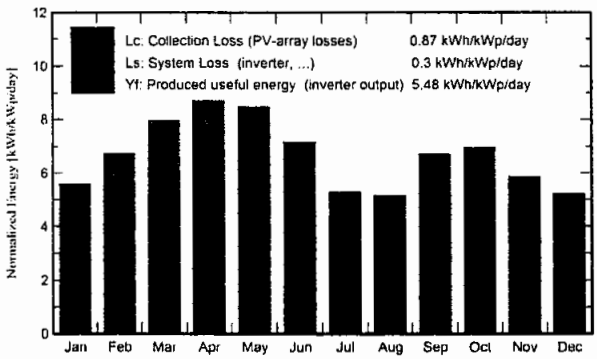
Main results

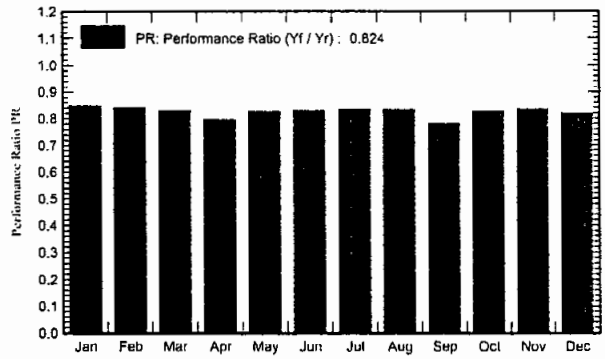
System Production

Produced Energy	30024191 kVAh/year	Specific production	2001 kWh/kWp/year
Apparent energy	31731086 kVAh/year	Performance Ratio PR	82.39 %

Normalized productions (per installed kWp)



Performance Ratio PR



Balances and main results

	GlobHor kWh/m²	DiffHor kWh/m²	T_Amb °C	GlobInc kWh/m²	GlobEff kWh/m²	EArray kWh	E_Grid kWh	PR ratio
January	137.2	52.0	19.10	173.6	160.3	2306758	2210800	0.849
February	150.3	54.3	22.00	188.5	175.8	2483945	2381232	0.842
March	196.9	72.8	26.10	247.1	232.1	3213291	3079572	0.831
April	212.7	83.3	29.20	261.5	246.8	3366047	3126050	0.797
May	218.4	100.7	30.90	262.8	247.5	3395278	3257077	0.826
June	186.7	102.6	31.50	215.2	201.5	2792791	2680656	0.830
July	148.1	101.2	30.20	164.7	152.4	2150412	2060213	0.834
August	143.6	94.8	29.10	160.1	148.4	2094962	2003727	0.834
September	166.3	83.9	29.20	201.4	188.2	2626230	2354973	0.779
October	172.6	65.8	29.00	216.0	201.8	2790303	2677152	0.826
November	139.5	54.3	25.20	175.9	162.7	2295177	2202406	0.835
December	129.6	49.0	20.39	162.1	149.1	2143484	1990333	0.819
Year	2001.9	914.7	26.84	2428.9	2266.6	31658679	30024191	0.824

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		

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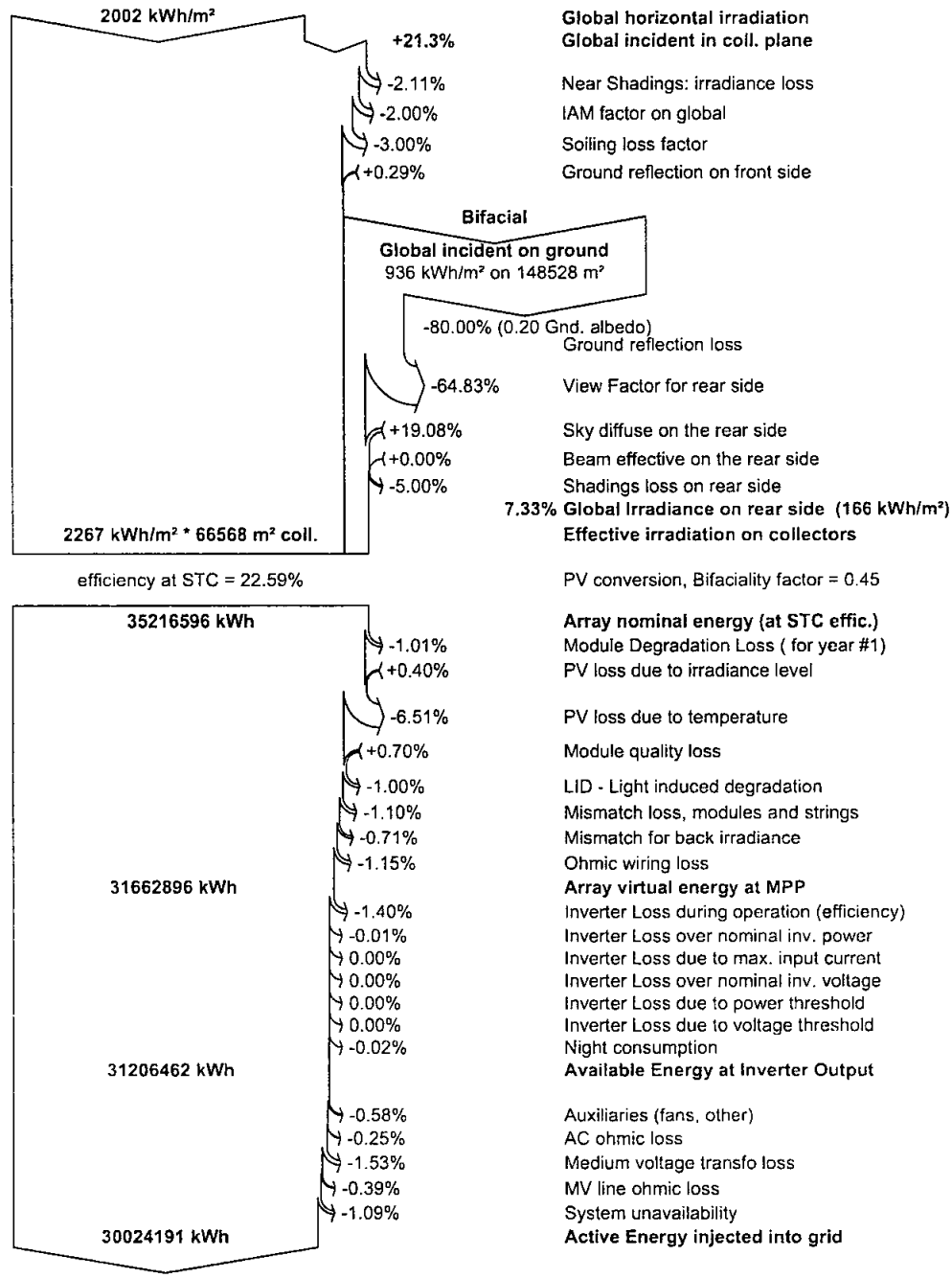
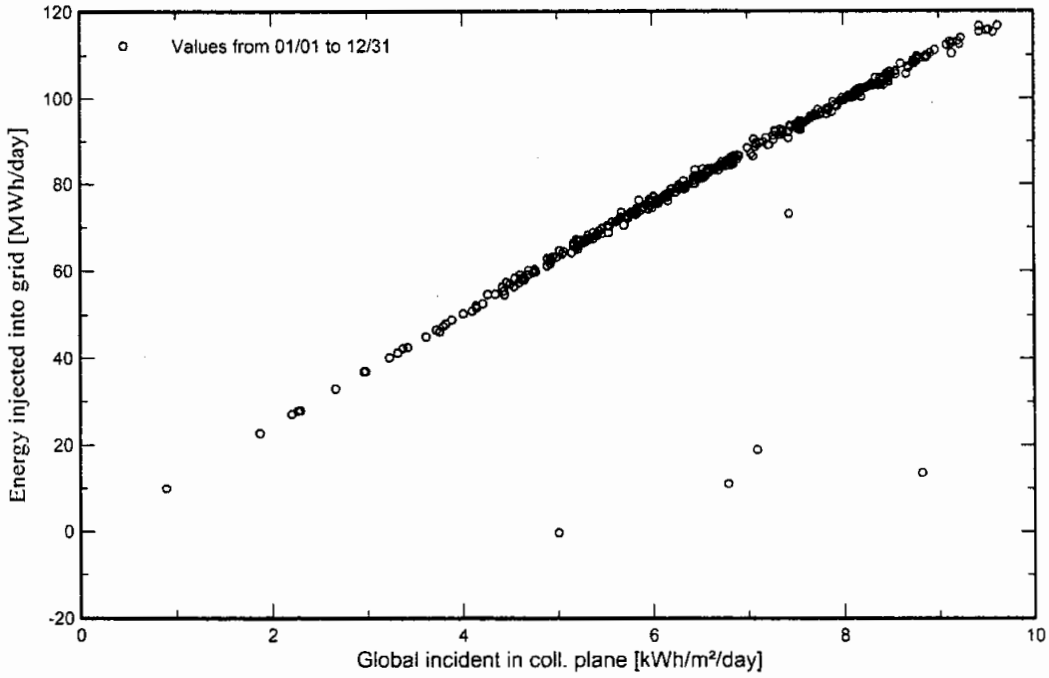
Loss diagram

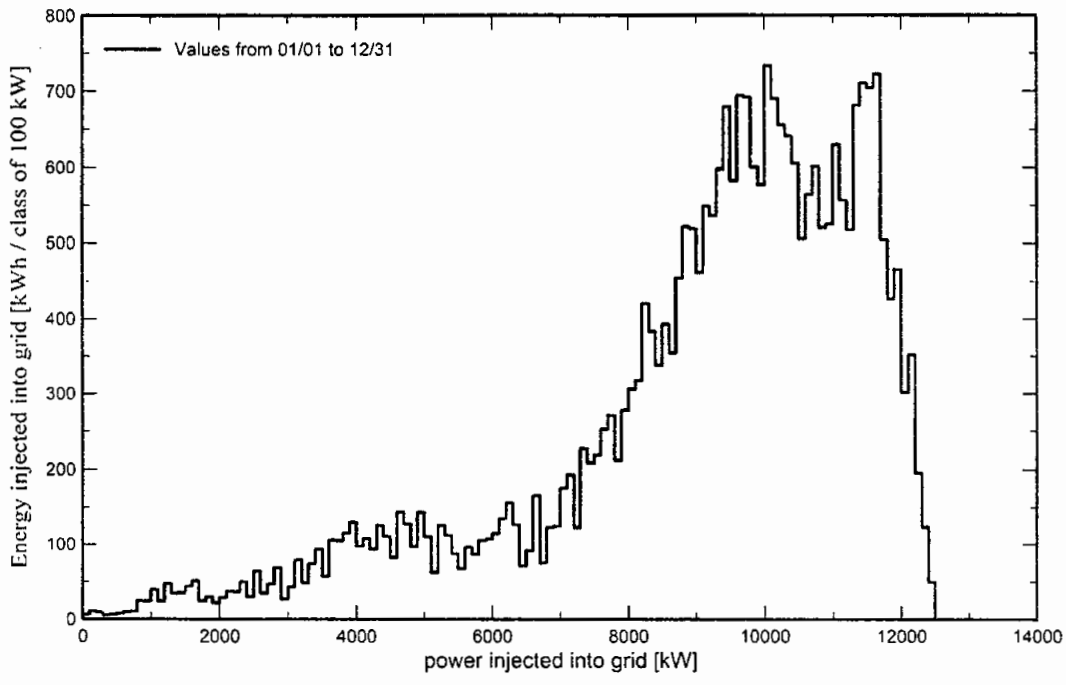


Predef. graphs

Daily Input/Output diagram



System Output Power Distribution



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P50 - P90 evaluation

Meteo data

Source	SolarGIS Monthly aver. , period not spec.
Kind	Not defined
Year-to-year variability(Variance)	-1.0 %
Specified Deviation	

Global variability (meteo + system)

Variability (Quadratic sum)	2.1 %

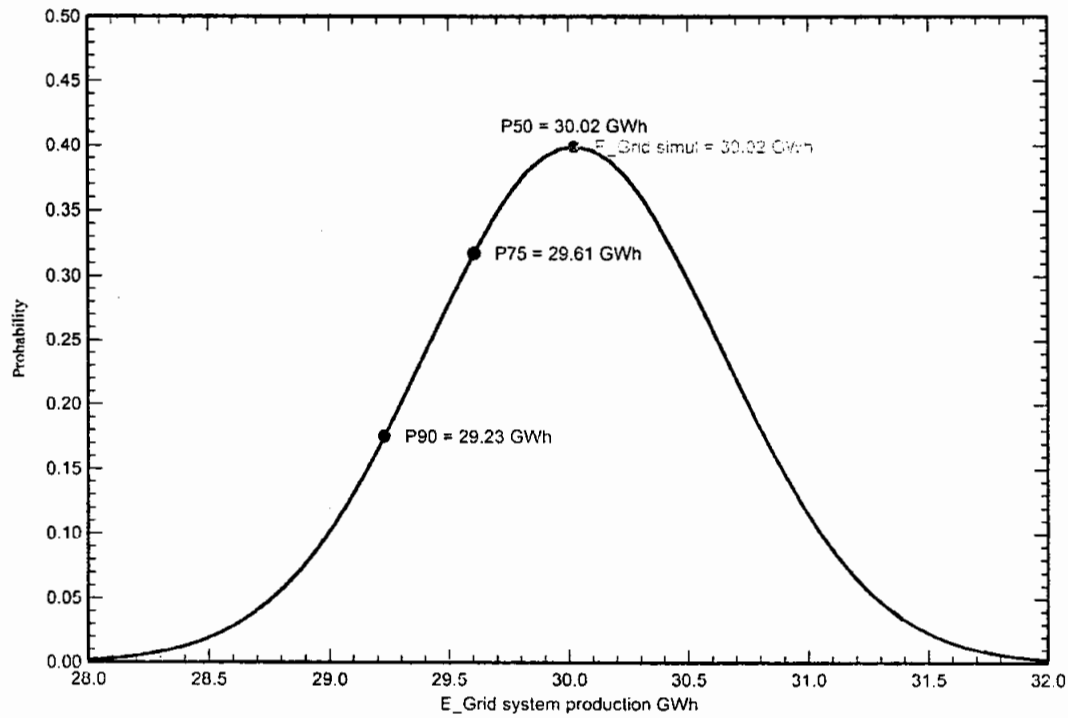
Simulation and parameters uncertainties

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	0.62 GWh
P50	30.02 GWh
P90	29.23 GWh
P75	29.61 GWh

Probability distribution



Single-line diagram

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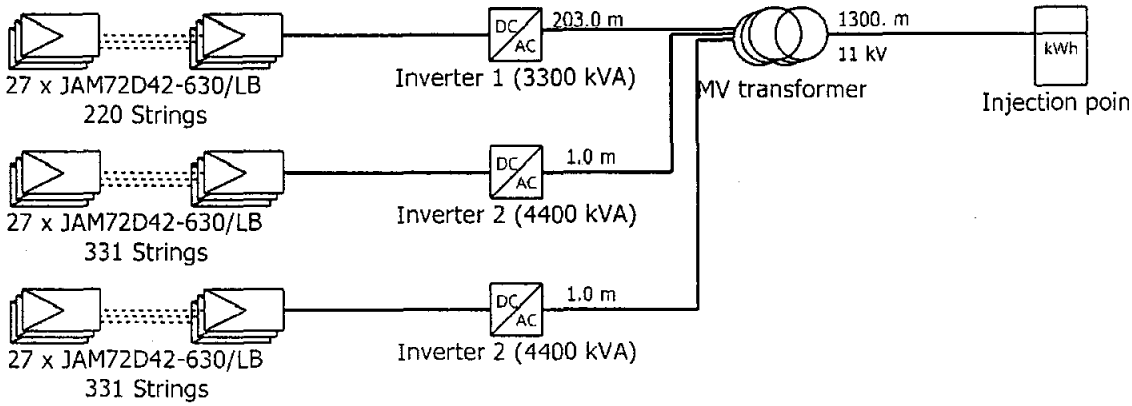


PV module	JAM72D42-630/LB
Inverter 1	SG3300UD
Inverter 2	SG4400UD
String	27 x JAM72D42-630/LB

	15MW GNL Project Central Inver ter	
	VC0 : New simulation variant	07/26/24

PVsyst V7.3.1
VC0, Simulation date:
07/26/24 16:26
with v7.3.1

CO_2 Emission Balance

Total: 318489.9 tCO_2

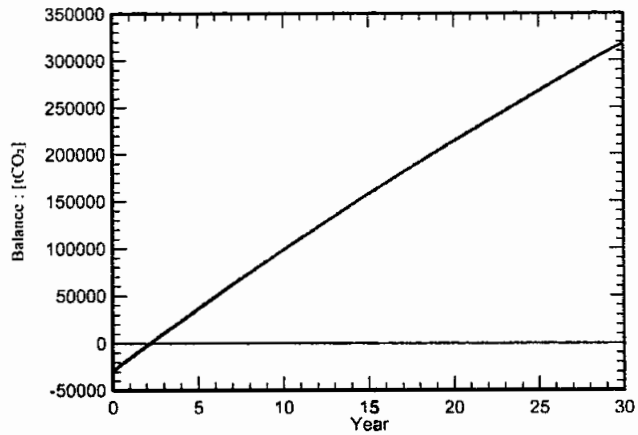
Generated emissions

Total: 29290.31 tCO_2
Source: Detailed calculation from table below:

Replaced Emissions

Total: 400823.0 tCO_2
System production: 30024.19 MWh/yr
Grid Lifecycle Emissions: 445 gCO_2/kWh
Source: IEA List
Country: Pakistan
Lifetime: 30 years
Annual degradation: 1.0 %

Saved CO_2 Emission vs. Time



System Lifecycle Emissions Details

Item	LCE	Quantity	Subtotal
			[$kgCO_2$]
Modules	1686 kgCO2/kWp	15241 kWp	25689156
Supports	2.97 kgCO2/kg	1209600 kg	3590274
Inverters	294 kgCO2/	37.0	10880

15 MWp Gharo Newgen Solar Project

Deh Ghairabad, Mirpur Sakro, District Thatta, Sindh

August 2024

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1 Project Background

Gharo Newgen (Private) Limited (the "Company") is a special purpose company for the development of a 15MWp solar power plant. This plant will be strategically located in the licensed service territory of K-Electric Limited (the "K-Electric") which is a privately-owned power utility in Pakistan. K-Electric is solely responsible for provision of electricity to Karachi and its adjoining areas. The Company's initiative aligns with K-Electric's objective to diversify their generation mix and ensure the provision of cost-effective electricity to their end-consumers. The proposed solar project will be connected to the Gharo Grid Station in Gharo, District Thatta and will operate at an 11kV voltage. Their efforts will further support K-Electric's ongoing endeavors to provide sustainable and affordable power supply to their valued customers.

The project sponsors have a robust track record in the development, engineering, procurement, and construction (EPC), as well as operation and maintenance (O&M), of approximately 200 MW of installed projects. These projects encompass solar and biomass technologies within the country. The key sponsors' and CEO's profiles are as following: The key sponsors' and CEO's profiles are as following:

Rana Nasim Ahmed

Mr. Rana Nasim Ahmed is the main sponsor of the Company and will retain a minimum of 51% shareholding in the Company. He is also the main sponsor of Harappa Solar (Private) Limited, an 18 MWp solar project commissioned in October 2017. Harappa Solar was the first private sector solar power producer in Pakistan and pioneered the use of a single-axis tracking system in the country. Additionally, Mr. Ahmed is the main sponsor of Gharo Solar Limited, a 50 MWp solar project established in December 2019. Gharo Solar was the first power project in Pakistan with bifacial modules and the first within the K-Electric network to to be financed with a foreign development finance institution (DFI).

He also has minority shareholding in a listed sugar sector conglomerate in Pakistan. Mr. Ahmed has vast industrial experience of more than two decades of managing four sugar mills to the highest international standards. He has spearheaded high-pressure cogeneration in the sugar industry by leading the development, construction, and operations of the first-ever 2 x 26.5 MW (53 MW total) bagasse-based IPPs set up in 2014. These 53 MW biomass projects and two of the four sugar mills were set up as Greenfield ventures on expedited timelines in self-EPC mode with multiple contractors, suppliers and consultants managed by Mr. Ahmed.

Moreover, he has over fifteen years of experience managing equipment procurement and installation and leading commercial and operation and maintenance ("O&M") matters of 70 MW low-pressure, biomass and solar power plants. Mr. Ahmed obtained his master's degree (with distinction) from the University of the Punjab and his MBA from Saint Louis University, USA.

Rana Uzair Nasim

Mr. Nasim is the CEO of Gharo Newgen (Private) Limited. He has successfully led and managed solar, biomass and small hydro projects with capex of over USD 150 million. He is also serving as the CEO of Gharo Solar Limited and Harappa Solar (Pvt) Limited since their inception and is the primary point of contact for various stakeholders including local and foreign shareholders / lenders, regulatory and public-sector agencies, power purchasers, suppliers, and contractors.

He has first-hand experience of Greenfield project conceptualization and execution and has worked across different areas including design, policy and tariff development, tendering, financing, insurance, negotiation of project concession documents etc. He has also contributed to several important policy and regulatory developments in the broader renewable energy sector in Pakistan.

Mr. Nasim previously worked as a management consultant in New York with Oliver Wyman and Dalberg Global Development Advisors. He holds a BA in Economics and an MS in Management Science & Engineering from Stanford University, California, USA.

2 Power Market

2.1 Structure of Power Sector in Pakistan

Historically, the power sector in Pakistan has been owned and operated by government entities, primarily the Water and Power Development Authority ("WAPDA") until the drive to unbundle started in the early 1990s. Since then, the sector has evolved much with private sector involvement primarily in generation and more recently on the model of a fully vertically integrated utility company. The generation, transmission, distribution and retail supply of electricity in Pakistan is presently undertaken by a number of public and private sector entities comprising of one (1) national transmission company; ten (10) regional public sector-owned distribution companies; four (4) public sector thermal generation companies; one (1) public sector hydropower generation company and many Independent Power Producers. These entities enable the supply of power to the entire country except for Karachi. The metropolitan city of Karachi and some of its surrounding areas are supplied power by K-Electric, which is the only vertically integrated utility owned by the private sector responsible for the generation, transmission and distribution of electricity in its region.

Moreover, CPPA, previously residing within NTDC, has been converted into a legal, independent body acting as a central counterparty to power purchase transactions. The present form of the power structure in Pakistan is presented below:

2.2 Electricity Generation

In July 2023, power generation in Pakistan reached 14,839 GWh (19,945MW), showing a 4.9% increase from the previous year. This was a significant improvement from July 2022, when power generation was at 14,151 GWh (19,020MW). The rise in power generation was mainly due to a higher contribution from Re-gasified Liquid Natural Gas (RLNG) of 37.7%, followed by coal with 21%, and hydel with 11%.

Pakistan Power Generation Capacity

As on 30th June	2018	2019	2020	2021	2022	2023
Thermal	24,021	25,670	25,244	25,098	24,010	26,983
Hydropower	8,713	9,761	9,861	9,915	10,452	10,593
Nuclear	1,467	1,467	1,467	2,612	3,345	3,575
Renewables	1,779	2,247	2,147	2,147	2,725	2,598
Total	**35,980**	**39,145**	**38,719**	**39,772**	**40,532**	**43,749**

All figures in MW; Source: NEPRA State of Industry Report, 2023

The primary source of electricity generation in July 2023 was hydel, making up 37.2% of the power mix and surpassing all other sources. RLNG followed closely with 19.7% of the overall generation, while coal accounted for 14.7% of the power share. Nuclear energy contributed 14.2% of the total energy mix, while wind, solar, and bagasse generation made up 3.7%, 0.5%, and 0.3% respectively. Electrical energy generated in recent years by fuel type is presented in the table below:

Pakistan Energy Generation by Source

As on 30th June	2017-18	2018-19	2019-20	2020-21	2021-22	2022-23
Thermal	92,012	89,402	80,826	88,678	93,270	71,900
% Share	68.87%	65.24%	60.21%	61.76%	0.00%	52.09%
Hydel	28,069	33,096	38,699	38,800	35,546	35,274
% Share	21.01%	24.15%	28.83%	27.02%	23.07%	25.56%
Nuclear	9,050	9,136	9,898	11,090	18,294	24,055
% Share	6.77%	6.67%	7.37%	7.72%	11.87%	17.43%
Import	555	487	514	498	514	479
% Share	0.42%	0.36%	0.38%	0.35%	0.33%	0.35%
Renewables	3,907	4,918	4,305	4,522	6,432	6,321
% Share	2.92%	3.59%	3.21%	3.15%	4.18%	4.58%
Total	**133,593**	**137,039**	**134,242**	**143,588**	**154,056**	**138,029**

All figures in GWh; Source: NEPRA State of Industry Report, 2023

Pakistan is actively transitioning to cleaner energy, emphasizing nuclear power, renewables, and solar energy. With over 50 years of nuclear power experience and six plants producing 3,500 MW (12% of total power), the country seeks to reduce reliance on thermal fossil fuels

(61% of power generation). Global support for nuclear energy, termed a "Nuclear Resurgence," aligns with Pakistan's capacity.

Policies like the National Power Policy 2013, Power Generation Policy 2015, Alternative and Renewable Energy Policy 2019, and National Electricity Policy 2021 outline a roadmap for clean energy investments, including solar. These policies aim to cut dependence on imported fuels, fostering public-private partnerships. Pakistan's commitment to clean energy signifies a strategic move towards a more sustainable and environmentally friendly power sector. Thermal generation breakdown in the country in recent years is given in the table below:

Pakistan Energy Generation by Source (Thermal Fuel Mix)

	2017-18	2018-19	2019-20	2020-21	2021-22	2022-23
Gas + RLNG	50,842	58,824	46,950	49,678	47,488	41,834
% share of thermal generation	55.25%	65.80%	58.09%	56.02%	50.91%	58.18%
FO + HSD	28,947	13,854	7,909	10,998	18,722	8,094
% share of thermal generation	31.46%	15.50%	9.79%	12.40%	20.07%	11.26%
Coal	12,225	16,725	25,966	28,001	27,060	21,972
% share of thermal generation	13.29%	18.71%	32.13%	31.58%	29.01%	30.56%
Total	**92,014**	**89,403**	**80,825**	**88,677**	**93,270**	**71,900**

All figures in GWh; Source: PSS/NTDC/KE

Due to this skewed energy mix, it has now become imperative upon the power sector in Pakistan to move towards generation technologies that are sustainable and rely on indigenous resources.

2.3 Demand and Supply of Electricity

In Pakistan, since 2020, there has been a positive trend in the overall supply of electricity. The country has been able to achieve a surplus supply which peaked in 2023 at a surplus of 6,097 MWh.

However, if we dig deep and specifically review the performance of electricity suppliers within KE's network, there is still a shortfall that is appearing. Moreover, it is expected to remain at the same level in the next year as well. The following tables highlights KE's historic demand and supply gap and projected figures for the near future:

Historical Power Supply and Demand in NTDC system

Year	Generation Capability	Peak Demand	Surplus/(Deficit)
2019	24,565	25,627	(1,062)
2020	27,780	26,252	1,528
2021	27,819	28,253	(434)

2022	27,748	24,564	3,184
2023	30,574	23,679	6,895

All figures in MW; Source: NEPRA State of Industry Report, 2023

Projected Power Supply and Demand in NTDC System

Year	Planned Generation Capability	Projected Peak Demand	Surplus/(Deficit)
2024	33,953	27,302	6,651
2025	38,854	29,675	9,179
2026	40,595	31,227	9,368
2027	41,865	32,753	9,112
2028	43,180	34,438	8,742

All figures in MW; Source: NEPRA State of Industry Report, 2023

Historical Power Supply and Demand of K-Electric System

Year	Generation Capability	Peak Demand	Surplus/(Deficit)
2019	3,196	3,530	(334)
2020	3,202	3,604	(402)
2021	3,424	3,604	(180)
2022	3,383	3,670	(287)
2023	3,409	3,654	(245)

All figures in MW; Source: NEPRA State of Industry Report, 2023

Projected Power Supply and Demand in K-Electric System

Year	Planned Generation Capability	Projected Peak Demand	Surplus/(Deficit)
2024	3,678	3,879	(201)
2025	4,377	4,070	307
2026	4,426	4,252	174
2027	4,857	4,367	490

2.4 Key Organizations

2.4.1 National Electric Power Regulatory Authority ("NEPRA")

NEPRA Act, Rules & Regulations

NEPRA, the National Electric Power Regulatory Authority, plays a vital role in regulating the power sector. It is responsible for granting licenses, determining tariffs, monitoring compliance with quality standards, and resolving consumer complaints. NEPRA exercises its powers under the NEPRA Act, Rules, and Regulations, and reviews its own decisions to

ensure fair and informed decision-making. Through meticulous scrutiny and engagement with stakeholders, including consumers, NEPRA gathers valuable data and insights for well-informed decision-making in the public interest.

2.4.2 K-Electric ("KE")

KE is a privately-owned power utility which is solely responsible for provision of electricity to Karachi and its adjoining areas. Since privatization, KE has made continued investments in generation capacity, improving its fleet efficiency, and launching transmission and distribution enhancement programs.KE produces electricity from its own generation units with an installed capacity of 2,817 MW, and in addition, has arrangements with external power producers for around 1,668 MW which includes 1,100 MW from the National Grid.As of June 2023, KE has an installed capacity of 4,485 MW which is primarily dependent on imported RLNG, RFO and coal. Approximately, 98% of KE's energy requirements are met by thermal plants whereas its renewable energy share only stands at 2%. As a result, KE and its customers are facing the challenge of rising fuel prices due to the global increase in fuel prices and significant rupee devaluation. Due to the significant growth in Karachi's population and setting up of special economic zones and industrial parks, it is anticipated that KE's power demand has reached around 4,168 MW. To meet the increasing demand and rationalize its generation cost, KE plans to induct approximately 673 MW renewable plants by FY 2026 as per KE PAP. The planned projects will help KE to diversify its fuel mix benefiting consumers and the economy at large.

3 Applicable Framework & Policy

The Company intends to sell power to KE pursuant to Regulation 30 of the NEPRA (Electric Power Procurement) Regulations, 2022. Subsequently, the Company has successfully negotiated with K-Electric. As a result, KE had included the Project in its Power Acquisition Programme for FY 2024 – 2030 ("PAP") which have been approved by the Authority vide its order having reference no. NEPRA/R/Advisor(CTBCM)/LAS-22/PAP(K.E)/7271-75 dated May 17, 2024.

4 Solar Power

4.1 Solar PV Power Generation

As of 2024, Pakistan is making significant developments in its energy sector by prioritizing solar power. The country is advancing its solar energy initiatives with an ambitious plan aimed at deploying 9 GW of solar power by 2030. This plan includes 6 GW from large-scale projects, 2 GW from medium-scale projects, and 1 GW from rooftop solar installations. Currently, Pakistan's total installed electricity capacity stands at 42,131 MW, with renewable sources contributing 6.8% of this capacity. This shift reflects a strategic emphasis on developing indigenous and renewable energy resources.

As of 2024, global solar photovoltaic (PV) capacity has continued to expand significantly. The total cumulative capacity has now exceeded 1,300 gigawatts (1.3 terawatts), up from 1,177 gigawatts in 2022. This growth reflects a consistent annual addition of around 250 gigawatts of new capacity, with 2023 and 2024 both seeing substantial contributions to this increase.

China remains the dominant player in the solar PV market, leading with a cumulative capacity of over 350 gigawatts, while the United States follows with approximately 140 gigawatts. Regions like Chile and Honduras continue to stand out for their high percentage of electricity consumption covered by solar power, driven by ongoing investments and supportive policies. The sector has also benefited from technological advancements, including improved efficiency of photovoltaic cells, the introduction of bifacial panels, and better energy storage solutions, all contributing to the growth and effectiveness of solar power worldwide.

4.2 Project Site and Location

The Project Site is located near the town of Gharo at Deh Ghairabad, Mirpur Sakro, District Thatta, Sindh approximately 6 km along the Sindh Coastal Highway and then approximately 1.25 km via connecting road from the Highway. The Site is about 55 km away from Jinnah International Airport, Karachi.

Site Coordinates:

The site coordinates are as follow:

Latitude (North)	Longitude (East)
24°42'58.0"N	67°34'09.5"E

5 Plant Type and Technology

5.1 Technology Overview

It is proposed to install a 15 MWp solar power plant with 12 MWac on-grid inverters. The Project shall be interconnected with the KE network through an 11kV transmission line. A conceptual diagram is provided below:

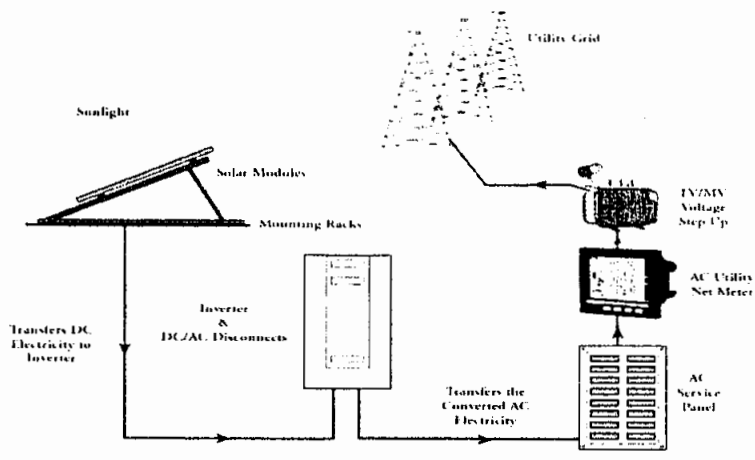


Figure 1 - Conceptual diagram of Technology used.

The final selection of the equipment shall be based on detailed technical and financial feasibility. The following sections give an overview of the technical scheme and key components of the Project.

5.2 Solar PV Modules

Solar PV modules shall be used to harness solar energy and convert it to electric power. The PV modules shall be connected in series to form a string and then multiple strings shall feed to String Combiner Box.

At present, Mono Crystalline Bifacial Technology is prevalent market technology, however the Company shall evaluate all bankable technological options available in the market. The final selection shall be based on the best yield and the lowest cost of electricity.

5.3 Mounting Structure

The PV modules shall be installed on a horizontal single axis tracking system which shall have a built-in algorithm to track the sun. The aim is an optimized positioning of the module surface to the sun during the day and ultimately, increase the total solar irradiation onto the module surface. The tracking system shall be ground mounted and pile-type foundations shall be used for the purpose.

5.4 Inverters

The PV modules shall generate DC power, which shall be converted to AC power through inverters. Since the Project shall feed electricity to the grid and therefore, on-grid type inverters shall be installed at the plant. Apart from simple AC/DC conversion, the inverter shall also condition the power and make electricity compliant with the grid code requirement.

5.5 Inverter Transformers

A simple yet highly efficient and integral component not only on solar farms but in general, all transmission and distribution networks are transformers. The transformer shall take the output from the inverters and step-up the power to 11kV voltage. The higher voltage enables electricity to be transmitted economically over large distances with minimum loss of energy.

5.6 Cables

AC/DC cables are the means of transportation of electricity from one point to another, for example, from string combiner boxes to inverters and then to inverter transformers and finally to 11kV substation. During the transfer of electricity, the losses are unavoidable, however sufficient sizing and consideration shall reduce the losses. Further, the conversion

of electricity to high voltage i.e., 11kV /low current by transformers shall also help in loss reduction

5.7 11kV Substation

This is the grid connection interface, where the electric power shall be collected and exported to the grid network. The substation shall primarily consist of 11kV switchgear, control / protection system and AC/DC aux power system etc.

5.8 Monitoring

Monitoring of grid-connected solar power plants shall be conducted locally as well as remotely through the internet. An expert control room shall be established at the plant which shall enable the operator to real-time monitoring of the solar plant. The monitoring shall be performed 24/7 and shall pinpoint faults in individual components causing production loss.

5.9 General Design

Solar PV plants can be designed for any capacity right from a fraction of kW rating for roof top installation to hundreds of MW capacity for ground mounted plants by repeating modular blocks. The schematic below depicts the typical configuration of a utility-scale solar plant.

Major components of utility-scale systems are:

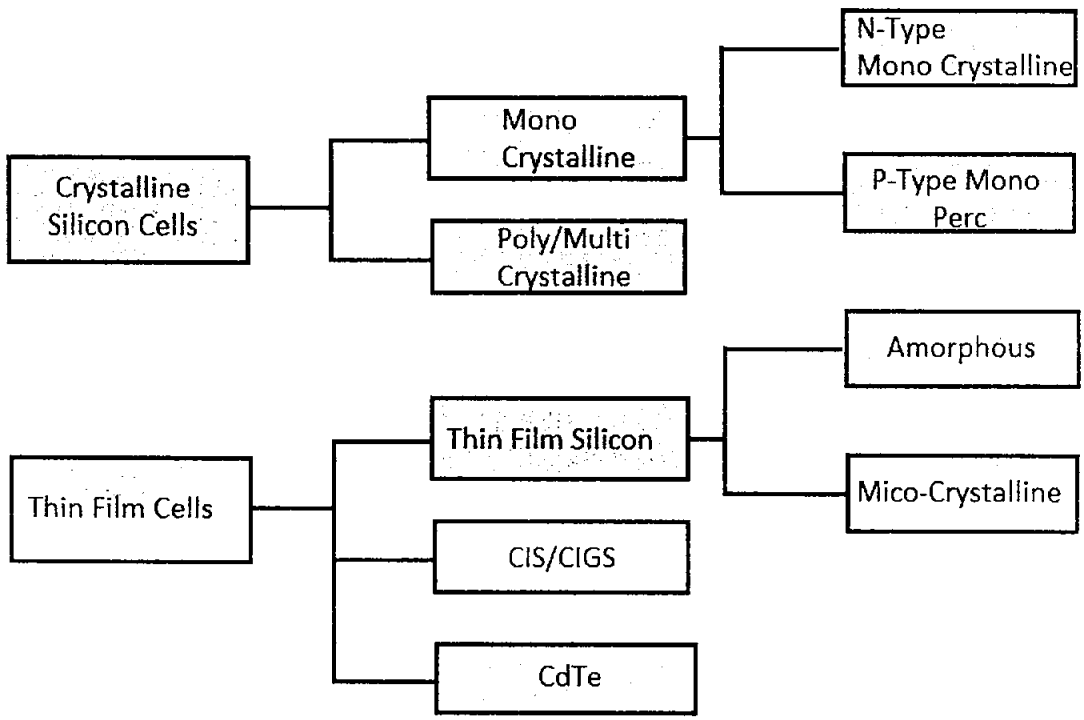
- Solar Modules / Panels
- Module Mounting Structures (fixed or tracking)
- Solar Inverters
- Balance of Systems (BoS) comprising of
    - DC Cables
    - String Combiner Boxes
    - AC Cables
    - Transformers
    - HT Panels / RMU units
    - SCADA & Monitoring System
    - Earthing system
    - Illumination system
    - Module cleaning system
    - AC / Ventilation System for inverter rooms
- Civil works including foundations, inverter rooms, leveling, grading, fencing, etc.
- Power evacuation systems include step-up transformers, switchyard, tariff metering arrangement, etc.

The scheme proposed for evacuation of power from the Gharo Newgen to KE grid comprises 11 kV circuits.

In the Photovoltaic category, PV panels without concentrators are widely used. These panels are either with fixed tilt or manual seasonal tilt or single axis / dual axis tracking arrangements. Fixed tilt arrangements are in the majority; however, single axis trackers are also gaining in popularity due to the gain in generation over fixed tilt systems.

In PV plants, two broad types of panels are used:

- (Mono crystalline) bifacial panels, which will have cells in series/parallel assembled in each module / panel.
- Thin film panels, made by depositing extremely thin layers of photosensitive materials in nano-micrometer range on a substrate (mostly glass). Amorphous Silicon (a-Ci) / micromorph silicon (A-Si/μC-Si), Cadmium Telluride (CdTe), Cadmium Indium Selenide (CIS) / Cadmium Indium Gallium Selenide (CIGS) are different types in thin film technology.



- Bifacial modules represent a promising technology for increasing PV system's lifetime generated electricity. Their core innovation is the ability to capture and utilize light from both sides of the modules.

6 Design and Specifications of the Plant

It is proposed to install 15MWp capacity Solar PV plant with Bifacial solar PV modules with single axis trackers and central inverters. The tracker will be with tilt angle +/- 55

Deg. Generated power shall be stepped-up to 11kV through inverter transformers and then connecting the output to KE Grid, as shown in the attached Single Line Diagram.

6.1 PV Modules

It is proposed to consider an average of 630Wp Mono Crystalline bifacial modules, from Tier-1 PV module manufacturers (Longi Solar or JA Solar or equivalent). The modules shall be protected by high transmission tempered glass covered on both sides with anodized aluminum alloy frames. Serially connected cells shall be terminated to IP65 junction boxes at bottom with 4 and 6 sq.mm multi-strand copper cables. Positive & Negative terminals shall be terminated with MC4 connectors, for making module interconnections.

Design Parameters:

Typical parameters of the modules (Based on JA Solar technical data sheet):

Electrical Parameters	JAM72D42-630/LB
Maximum Power (Pmax)	630 Watt
Module Type	Mono Crystalline, Bifacial
Module Efficiency	22.5%
Maximum Power Current (Imp)	14.35A
Maximum Power Voltage (Vmp)	43.9V
Short Circuit Current (Isc)	15.21A
Open Circuit Voltage (Voc)	52.47V
Operating Temperature	-40 °C to + 85 °C

6.2 Solar Inverters and Auxiliaries

6.2.1 Solar Inverters

Solar inverters represent critical equipment in the Solar PV plant, as the reliability and performance of the inverters greatly influences the overall plant generation. It is proposed to use 3 Central Inverters, out of three (3) central Inverter two (2) Inverters have a nominal rated capacity of 4.4MW and One (1) Inverter have a rated capacity of 3.3MW. Negative earthing in inverters & Anti-PID kits shall be planned to counter PID effect for the modules. Inverters are expected to be from Sungrow or equivalent and shall

meet the performance requirements stipulated in the national Grid Code for Solar Power Plants and requirements of K-Electric.

Parameters (typical) of the proposed inverter:

Input (DC)

Description	Data
Max. DC power	3.3MW, 4.4MW
Max. input voltage	1500 V
MPP voltage range for nominal power	895V - 1500V

Output (AC)

Description	Data
Rated normal power	3399 kVA @ 40 °C, 4532kVA @ 40°C
Nominal AC voltage	3 / PE, 630 V
AC frequency / range	45-55 Hz
Max. output current	219.2A, 292.2A

6.2.2 PV DC Cabling

The modules will be connected with DC cables, in series & parallel combinations and hooked-up to Inverters. A total of 882 strings (27modules per string) shall be connected with the inverters of capacity 12MW.

6.2.3 Inverter Transformers

It is proposed to use twin secondary oil filled transformers for stepping up the power generated from PV system, by connecting one LT panel per Primary. The transformers intended for connecting to the Solar Inverters shall confirm to IEC:60076. The transformers will be as per the following specification:

Parameter	Data
Number of transformers and rating	2 Nos. of 4.4 MVA & 1 Nos. of 3.3MVA
Cooling	ONAN
Ratio	11/0.63-0.63 kV
Transformer Vector	Dy11
Impedance	7% , 8%

6.2.4 HT Panels

It is proposed to provide 11 kV Main Switchgear at Plant Main Control building and One (1) RMU near the inverter station which will connect two (2) inverter transformers while the 2nd RMU panel will be coupled with MV Switch Gear Total, three (3) no's of outdoor inverter stations are planned with outdoor 11kV two RMU panels which will be connected to the main 11kV switchboard in control room. Brief parameters of 11 kV switchboards shall be as given below:

Parameter	Data
Rated Voltage	11 kV, 3 Phase, 50 Hz
Maximum Voltage	12 kV
Power frequency Voltage	28 kV rms
Impulse withstand Voltage	75 kV peak
Short time rating	26.2 kA for 3 Sec
Maximum bus bar temperature	85 Deg. C

6.2.5 Power Evacuation System

Power evacuation to the National grid through plant metering yard shall be planned, by providing outgoing feeders from the main 11 kV bus bar.

6.3 Monitoring System and SCADA

Monitoring of system operation parameters shall be arranged locally and also from remote locations through internet. Weather monitoring station, for irradiance, DHI measurement, wind velocity & ambient temperature, String currents, Inverter Parameters, Transformer protections and temperature, HT Panel parameters, Export & import (auxiliary) energy and Perimeter Security through CCTVs & alert systems are hooked-up to SCADA system. Also, there will be a separate PLC based SCADA system for monitoring/controlling tracker system.

6.4 Module Cleaning System

Module cleaning system shall be envisaged for spraying the soft water over the modules manually by providing storage tanks, water pumps, high pressure piping network & valves. This cleaning process is to be carried out periodically depending upon the intensity of dust deposition over the PV modules. As an alternative, automated cleaning system shall also be evaluated and considered depending on techno commercial viability.

6.5 A/C and Ventilation System

Suitable Air Conditioning or Ventilation (Wet or Dry pressurized) system shall be envisaged for the Inverter & control rooms.

6.6 Water Source

The raw water for the plant is required for meeting the module cleaning requirements (after treatment, if required) will be drawn from Bore wells.

6.7 Civil and Structural Works

The proposed single axis tracker will have 1 module stacked vertically in portrait orientation, one string comprising 27 modules connected in series (individual tracker dimension will be 93.14m x2.4 m) and distance between trackers will be 5.5 Mtrs (Ground Coverage Ratio, GCR of 44.8 %). The Tracker will be with tilt angle of +/- 55 Deg.

Main columns of these tracker steel panel tables will be with galvanized MS hot rolled sections / GI cold formed sections / Magnelis or equivalent, while the rafters cross bracing & purlins will be with GI cold formed sections / galvanized / Magnelis steel tubes or equivalent. Structural materials foundation bolts, fastening bolts, screws, nuts, washers shall conform to the relevant International Standards. All mild steel members (inner & outer surface area) will be electro galvanizing/hot dip galvanizing and will be further painted to meet the corrosion category of C5.

6.8 Firefighting System

The function of fire-fighting system is to supply water to the main risk areas of the solar power plant.

The fire protection system is required for early detection, containment and suppression of fires. A comprehensive fire protection system shall be provided to meet the above objective and all statutory and insurance requirements of the National Fire Protection Association (NFPA).

The fire-fighting system shall consist of the following:

6.8.1 Portable Fire Extinguishers

Dry Chemical Powder, CO_2 and foam-type extinguisher system shall be provided. The equipment shall be designed as per NFPA 10.

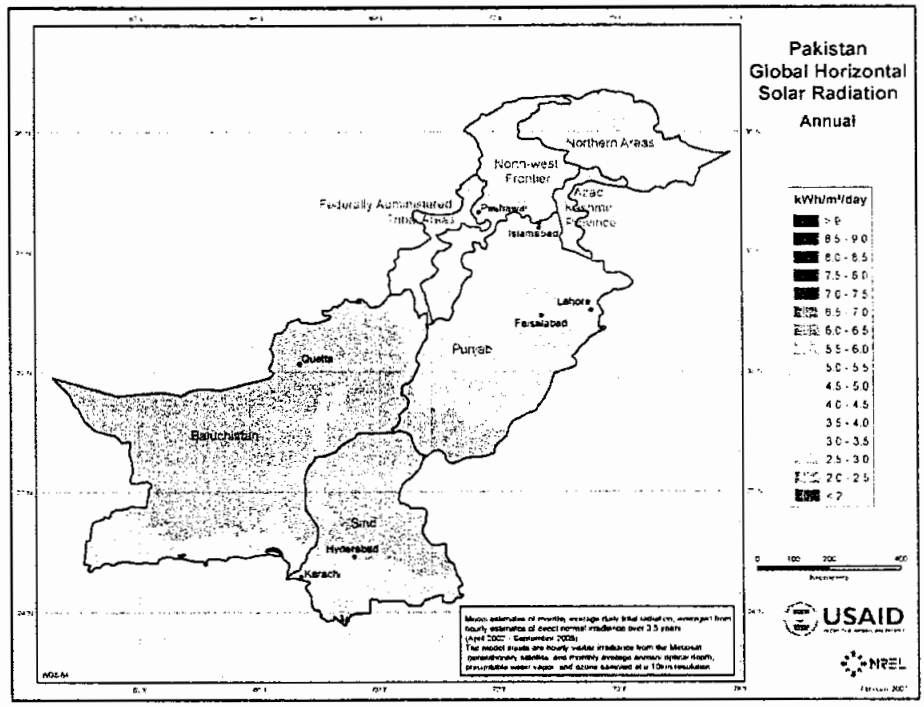
6.8.2 Fire Alarm & Detection System

Fire detection system for the solar power plant will provide early detection of fire and raise alarm. A comprehensive fire protection system shall be planned to meet the above objective and meet all statutory and insurance requirements of the National Fire Protection Association (NFPA). A multitude of systems will be provided to combat various types of fires in different areas of the plant and all such systems for various areas shall form a part of a centralized protection system for the entire plant. Fire alarm system detection system shall be provided in following areas:

- Firm alarm and signaling in all electrical/instrumentation panel rooms.
- Manual call points and Electric Horns in outdoor areas.

7 Meteorological & Climate Data, Yield & Variability Analysis

Pakistan lies in an area of one of the highest solar insolation suitable for solar technology. The immense solar resource remains largely untapped. The solar irradiation map of the region showing the average insolation (Global Horizontal Irradiance in kWh/m2/day) values is given here below:



The Company has used weather data inputs from Solargis and Metenorm due to its better precision and high time resolution. Under World Bank program, the Solargis data has been validated at 9 different locations in Pakistan, resulting low uncertainty and more dependability on the data. The average irradiance data (GHI) based on long term analysis is given below for quick reference:

Month	Global Horizontal Irradiance Data (KWh/m2)	
	Meteonorm 8.1	Solargis
Jan	124.9	137.2
Feb	136.9	150.3
Mar	180.0	196.9
April	195.2	212.7
May	204.8	218.4
June	181.8	186.7
July	142.0	148.1
Aug	138.5	143.6
Sept	156.4	166.3
Oct	154.3	172.6
Nov	130.7	139.5
Dec	117.7	129.6
Total	**1863.2**	**2001.9**

Figure 2 - Average Irradiance Data

7.1 Projected Yield for Solar

As part of the project feasibility, the Company intends on performing a bankable energy yield assessment for the Project. The results of the initial yield assessment are provided in Annex C. The Project is expected to produce 30.024 million units during the first year of production.

7.2 Solar Irradiation

Pakistan lies in an area of one of the highest solar insolation suitable for solar technology. The immense solar resource remains largely untapped. The solar radiation maps of the region (Source: NREL) show the average insolation (Global Horizontal Irradiance in KWh/Sq.M/day) values, as below:

Description	Data
Northern parts of Baluchistan	5.5-6.5 KWh/Sq.M
Central & East Baluchistan, Southern parts of Punjab & North & North- East parts of Sindh	5.0-5.5 KWh/Sq.M
Major parts of Punjab (other than north-west zone), Central parts of Baluchistan & Sindh	4.5-5.0 KWh/Sq.M

Site selection and planning of PV power plants requires reliable solar resource data. The solar resource of location is usually characterized by the values of the global horizontal irradiation, direct normal irradiation and diffuse horizontal irradiation as defined below:

7.2.1 Global Horizontal Irradiation (GHI)

GHI is the total solar energy received on a unit area of horizontal surface. It includes energy from the sun that is received in a direct beam and from all directions of the sky when radiation is scattered off the atmosphere (diffuse irradiation). The yearly sum of the GHI is of particular relevance for PV power plants, which are able to make use of both the diffuse and beam components of solar irradiance.

7.2.2 Direct Normal Irradiation (DNI)

DNI is the total solar energy received on a unit area of surface directly facing the sun at all times. The DNI is of particular interest for solar installations that track the sun and for concentrating solar technologies as concentrating technologies can only make use of the direct component of irradiation.

7.2.3 Diffuse Horizontal Irradiation (DHI)

DHI is the energy received on a unit area of horizontal surface from all directions when radiation is scattered off the atmosphere or surrounding area.
Variability and characteristics of solar radiation are influenced by a number of factors. Many reasons, such as day-night cycle, seasonal cycle, and shading by cloud formations or surrounding terrain, are quite obvious. Others are not so easy to track e.g. content of water vapor and aerosols in the atmosphere, thickness of ozone layer, etc. In the past only, simple observations were possible.

7.2.4 Solar Irradiation Data through Solargis:

The Solargis database is a high-resolution database recognized as the most reliable and accurate source of solar resource information. The data is calculated using in-house developed algorithms that process satellite imagery and atmospheric and geographical inputs.

Solar GIS Satellite based data is on hourly basis and most appropriate data to represent the irradiation profile. Hence, the values from Solar GIS are considered as higher accuracy than other owing to the following points:

- Hourly data series, as other GHI data from Meteonorm and other sources under are of monthly series.
- Solar GIS methodology enhances accuracy of predicted irradiance data to better match terrestrial irradiance measured by the ground-based station.
- Particularly, the higher spatial resolution leads to the ability of distinguish irradiance level within small geographical boundary while half hourly temporal resolution and daily average atmospheric optical depth inputs can estimate irradiance in line with the dynamic variation in diurnal atmospheric condition.
- Solargis recently validated its resource data for Pakistan with on-ground measurements. The project was supported by the World Bank.

Solar irradiation data for the proposed site made available in Solargis is given below:

Months	Global Horizontal Irradiation kWh/m2	Ambient Temperature °C	Global Inclined Irradiation kWh/m2
January	137.2	19.1	173.6
February	150.3	22	188.5
March	196.9	26.1	247.1
April	212.7	29.2	261.5
May	218.4	30.9	262.8

June	186.7	31.5	215.2
July	148.1	30.2	164.7
August	143.6	29.1	160.1
September	166.3	29.2	201.4
October	172.6	29	216
November	139.5	25.2	175.9
December	129.6	20.39	162.1
Total	**2001.9**	**26.84**	**2428.9**

Solargis data file for project location is attached with this report as Annexure-4 for reference.

For computation of yield analysis, solar irradiance and other values from Solargis have been considered in this report.

7.3 Solar Yield Analysis using PVsyst:

The PVsyst software, widely being used by most of the developers, has been used to ascertain yield and performance of the systems / options considered in this report.

Yield from the Solar system varies depending on the following factors:

- Direct Irradiance
- Tilt and Facing of the module with respect to Sun.
- Selection of Solar PV Technology and Make of the module.
- Inverter Type and Make
- Cable sizing and cable losses
- Grid availability.

7.3.1 Losses considered for Yield Calculation:

PVSYST calculates the direct current (DC) electricity generated from the modules in hourly time steps throughout the year. This direct current is converted to alternating current (AC) in an inverter. A number of losses occur during the process of converting irradiated solar energy into AC electricity. Some of these losses are calculated within the PVSYST software, whilst others are assumed figures based on the performance of similar PV plants. The losses are described in the following subsections.

(a) Incident Angle Losses

The incidence angle loss or "Incidence Angle Modifier" (IAM) accounts for losses in radiation penetrating the front glass of the PV modules due to angles of incidence other than perpendicular. This loss is derived from the ratio of direct and diffuse radiation, sun angles and the tilt of the modules.

(b) Low Irradiance Loss

The conversion efficiency of a PV module reduces at low light intensities. This causes a loss in the output of a module compared with the standard conditions at which the modules are tested (1000 W/Sq.M). This "low irradiance loss" depends on the characteristics of the module and the intensity of the incident radiation.

(c) Module Temperature

The characteristics of a PV module are determined at standard temperature conditions of 25°C. For every 1°C temperature rise above 25°C there is reduction in performance of modules. This temperature dependent performance differs for different PV technologies.

(d) Module Quality

Most PV modules do not match exactly the manufacturer's nominal specifications. Modules are sold with a nominal peak power and a given tolerance within which the actual power is guaranteed to lie. In practice PV modules usually lie below the nominal power but within the tolerance.

(e) Module Mismatch

Due to the inherent inaccuracy of the silicon photovoltaic cell manufacturing process, PV modules, expected to have the same electrical features, will not be identical. This (relatively small) heterogeneity among modules is at the basis of the mismatch loss. The mismatch loss depends both on the specific PV modules used for the project and on the procedure followed to assemble the modules on site.

(f) DC Cable Resistance

Electrical resistance in the wires between the power available at the modules and at the terminals of the array gives rise to ohmic losses (I^2R).

(g) Inverter Performance

The inverters used at any PV plant convert from DC power into AC power with a maximum efficiency of 99%. The same is reflected in the Inverter datasheet. However, depending on the inverter load, they will not always operate at maximum efficiency.

(h) Soiling

In order to produce maximum energy on any given day, it is best to keep the panels clean at all times. The cleaning of modules will depend on the rainfall and cleaning strategy defined in the O&M contract; thus, it may not be possible to keep the panels clean all the time. Unless a particularly robust cleaning strategy is employed, the soiling loss for horizontally mounted modules may be expected to be higher than modules that are inclined, as inclined modules will benefit more from the cleaning effect of rainwater run-off.

(i) Degradation

The performance of a PV module can decrease over time. The degradation rate is typically higher in the first year upon initial exposure to light and then stabilizes. The extent of degradation and the process by which it occurs varies between module technologies.

The initial degradation occurs due to depreciation in the cell, which are activated on exposure to light. The subsequent degradation occurs at the module level and may be caused by:

- Effect of the environment on the surface of the module e.g. pollution
- Mechanical stress and dampness on the contacts
- Cell contact breakdown
- Wiring degradation
- Factors affecting the degree of degradation include the quality of materials used in manufacture, the manufacturing process, and also the O&M regime employed at the site.

7.3.2 PVsyst Inputs

The following table indicated the inputs considered for the PVsyst analysis:

Description	Values
Site Co-Ordinate	24°42'58.0"N+67°34'09.5"E
Plane Tilt	+/- 55Deg
Pitch	5.5Mtrs
Collector Band Width	2.47 Mtrs
Meteo Data	Solargis - 2001.9kWh/m2

7.3.3 Loss Distribution in PVSYST simulation

The following table gives the extract of loss distribution in yield simulation –

Consideration - JA 630 Wp Mono Bifacial Module / GCR: 44.8% / Tracker elevation: 0.6 m. 1P arrangement / Sungrow 4.4MVA & 3.3MVA inverter

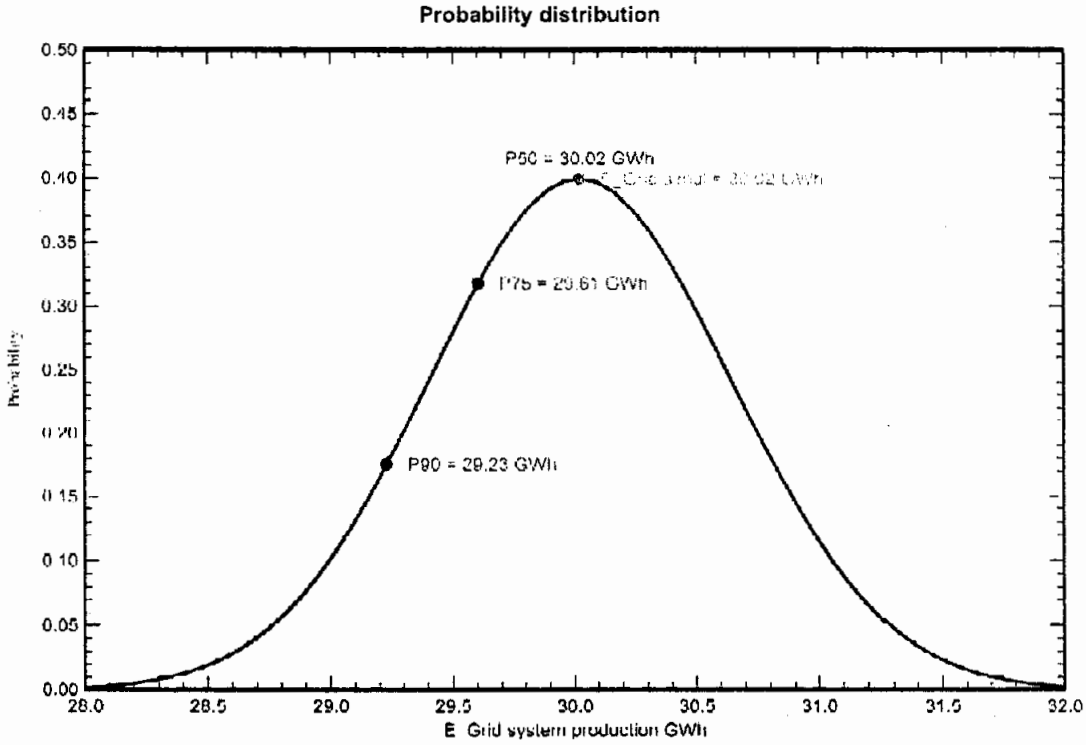
Description	Loss – Using Solar GIS
Horizontal Global Irradiation	2002 kWh/m2
Global incident in coll. Plane	(+)21.3%
Near Shading	(-)2.11%
IAM Factor	(-)2.00%
Soiling Loss Factor	(-) 3.0%
Ground Reflection from Front Side	(+)0.29%
PV Loss due to Irradiance Level	(+)0.4%
PV Loss due to Temperature	(-)6.51%
Light Induced Degradation	(-) 1.0%
Module Quality Loss	(+) 0.7%
Mismatch	(-)1.1%
Mismatch for Back Irradiance	(-)0.71%
Ohmic Wiring Loss	(-)1.15%
Inverter Loss during Operation	(-)1.4%
Inverter Loss over nominal inverter power	(-)0.01%
AC Ohmic Loss	(-)0.25%
External Transformer Loss	(-)1.53%
Auxiliaries (fans, others)	(-)0.58%
System Unavailability	(-)1.09%
Energy Injected into Grid, for 15002.82 kWp modules	30024191 kWh
Performance Ratio (After the Losses)	82.39%

7.3.4 Probabilistic evaluation of forecast production using Solargis:

The forecast generation by solar power plants is mainly dependent on the Meteo data used for the simulation, which has natural variation due to change in weather patterns from year to year. Additional uncertainty results from variation in system parameters (module degradation, soiling etc.). Simulations for solar generation can be expressed in terms of different probabilities of exceedance e.g. P50, P75, P90. Typically, either P75 or P90 is used for risk / financial analysis or the P50 value is used with conservative assumptions for system losses.

Description	Data (Solargis)
Year-Year variability variance	-1.0%
Deviation of System Parameters Uncertainties	
PV module modelling/parameters	1.0%
Inverter efficiency uncertainty	0.5%
Soiling and Mismatch uncertainties	1.0%
Degradation uncertainty	1.0%
Global Variability (Meteo+System) Variance	2.1% (Quadratic Sum)
Annual Production Probability	P50 – 30.024 GWh P75 – 29.610 GWh P90 – 29.230 GWh

Probability Graph – Solargis



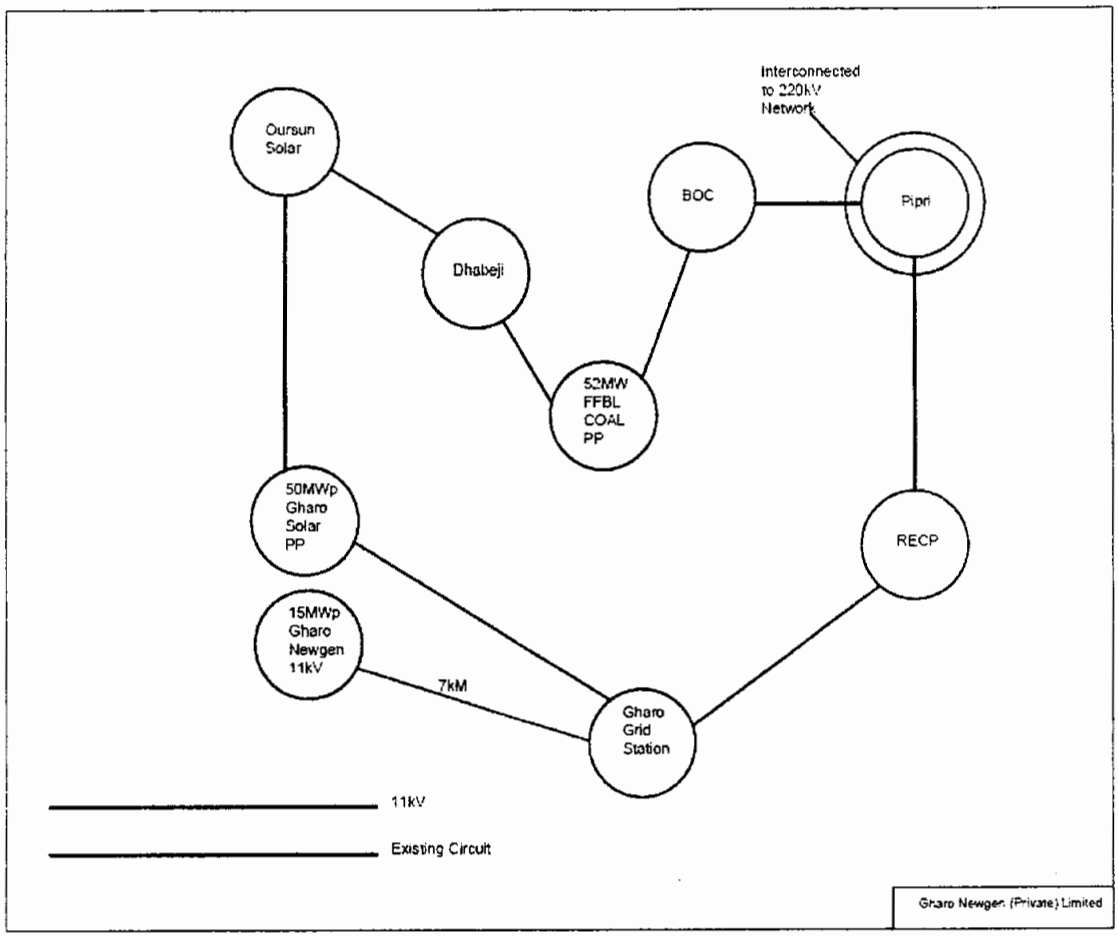
Note: PVsyst analysis report for the above arrangement and yield is attached with this report as Annexure-

8 Grid Interconnection

8.1 Interconnection Arrangement

The electric power generated from the Generation Facility/Solar Power Plant of the Company shall be dispersed to the load center of K-Electric.

The proposed Interconnection Arrangement/Transmission Facility for dispersal of electric power comprises the direct 11 kV lines of approximately 7-8 km length to be laid from the 11 kV bus bar of the Generation Facility/Solar Power Plant to the Gharo Grid Station.



9 Operations and Maintenance (O&M)

Operation & Maintenance for a Solar PV Plant is relatively straightforward and less intensive compared to other power generation technologies. The operations shall be managed by either a third-party O&M consultant or an in-house technical and operational expert team, well-equipped with required capabilities. Most O&M functions shall be performed by permanent staff and the operation of the facility will be automated, supervised and controlled by SCADA.

The operation team shall operate and monitor the facility in accordance with Prudent Utility Practices, applicable standards and the manufacturers' recommendations.

Operations and Maintenance tasks shall include:

- Periodic cleaning of PV Panels (few times per month).
- Periodic operational checks and tests of equipment in accordance with OEM recommendations.
- Regular plant inspections.
- Routine maintenance services.

- Implement and regulate the facility's preventive and corrective maintenance program.
- Critical / non-critical reactive repairs.
- Plant security covering entire fenced area.
    - General shift operations for coordinating plant operation, maintenance & liaison with power purchaser; and
    - Maintain critical spares for plant & equipment.

10 Key Operating Assumptions

The following sections provide a summary of the general, project cost, operating and financing assumptions related to the Project. The feasibility has been prepared following a detailed discussion of these assumptions with Project sponsors. The proceeding sections discuss the following assumptions:

- Plant Generation
- General & Timeline
- Project Cost
- Financing Assumptions
- Project Tariff & Revenue
- Financial / Economic Analysis

11 Plant Generation Parameters

Key generation parameters as per PVsyst simulations are summarized below. The value for plant factor of 22.85% has been assumed for financial projections.

Expected Generation at Different Probabilities

Probability Level	Generation (MWh)	Plant Factor
P50	30,024	22.85%
P75	29,610	22.53%
P90	29,230	22.24%

11.1 Project Timeline

A construction period of 8 months following financial close has been assumed for the Project. Financial Close is targeted in January 2025 with a target Project commercial operations date **("COD")** of September 2025. A schedule of activities and key milestones is provided in table below.

Project Timeline

Period	*Tasks*
July 2022 to June 2023	✓ Incorporation of Project Company
	✓ Identification of Project land and initial yield study
	✓ Land acquisition
July 2023 to June 2024	✓ Inclusion in KE Power Acquisition Program (PAP)
	✓ Approval of Project in PAP by the Authority (NEPRA)
July 2024 to November 2024	... Contractor/supplier negotiation and selection
	... Tariff submission and approval
	... Concurrence application and approval
	... EPA finalization with KE and NEPRA approval
	☒ Lenders' due diligence
December 2024	☒ Financial Close
January 2025	☒ Commencement of works and supply
August 2025	☒ Project Commissioning

✓ Completed ... In Progress ☒ To be initiated

11.2 Project Life

As per the standard energy purchase agreement ("EPA") the Project life and EPA term has been assumed as 25 years from COD and all equipment is being procured corresponding to the same.

11.3 Project Cost

The break-down of the estimated Project Cost is provided below in table. The project cost is based on an estimated PKR/USD exchange rate of PKR 300/USD.

Estimated Project Cost

Estimated Project Cost	USD million	PKR million
EPC Cost	8.1	2,430
Other Costs	1.074	322.2
Duties & Taxes	1.026	307.829
Project Cost	**10.2**	**3,060**
EPC Cost per MW	0.540	
Project Cost per MW	0.677	

11.4 Project Financing

The Project financing will be based on a debt-to-equity ratio of 80:20. Under the base case financial projections, debt is assumed to be 100% foreign financed. The lenders have been selected and financial terms have been negotiated. Foreign debt shall be

repaid in 14 years after COD amortized over the period through fixed annuity-based installments.

Key parameters of the Project funding are provided in table below:

Project Funding

Project Cost	PKR 3,060 million
Debt	PKR 2,448 million
Equity	PKR 612 million
Lending Rate (Foreign)	SOFR (4.5%) plus Margin (4.5%) (Total 9.0% fixed)
Repayment Period	14 years

11.5 Project Tariff

Key Assumptions for Tariff

Description	Basis
EPC cost per MW	USD 540,000
Project Cost per MW	USD 676,771
Construction Period	8 months
Exchange rate (PKR/USD)	300.0
Plant Factor	22.85%
Expected Annual Generation	30,024,900 MWh
Assumed Degradation per annum	0.40%
O&M Cost per annum	USD 12,500 per MW
Debt to equity ratio	80:20
Return on Equity (IRR based)	13.0%
Loan Repayment Period	14 years
Repayment Frequency	Quarterly
Foreign Debt Cost	SOFR (4.5%) plus 4.5% (Total 9.0% fixed)

Based on the above assumptions the respective tariff components along with relevant indexations are provided in table below:

Tariff Details

Description	Tariff Components PKR per kWh		Indexation
	Year 1-14	Year 15-25	
O&M	1.9004	1.9004	US CPI, Local CPI, PKR/USD Parity

Description	Tariff Components PKR per kWh Year 1-14	Year 15-25	Indexation
Return on Equity	2.6667	2.6667	PKR/USD Parity
Insurance	0.4105	0.4105	N/A
Debt Servicing Component	9.9157		KIBOR, SOFR, PKR/USD Parity
Total Tariff	14.8933	4.9776	
Levelized Tariff	12.9489		

11.6 Project Revenue

The Project shall be exclusively selling all energy generated to K-Electric Limited under a 25-year Energy Purchase Agreement ("EPA"). The EPA shall be based on the tariff determined by NEPRA, which shall be adjusted on a quarterly basis as per the above-mentioned indexation mechanism. The financial projections summarized below show that the Project is expected to generate positive earnings before interest, taxes and depreciation (EBITDA) and net profits throughout its life and have favorable financial ratios.

Projected Financial Statements

	Year 1	Year 5	Year 10	Year 15	Year 20
Balance Sheet (PKR in Million)					
Fixed Assets	2,771	2,196	1,621	1,045	470
Receivables	191	66	107	59	97
Total Assets	**2,962**	**2,262**	**1,728**	1,104	567
Long Term Debt	2,705	3,268	2,343	-	-
Working Capital	54	100	165	-	-
Paid Up Capital	620	620	620	620	620

Retained Earnings	(417)	(1,727)	(1,400)	483	(54)
Total Liabilities & Equity	**2,962**	**2,262**	**1,728**	**1,104**	**567**
Cashflow Statement					
Cashflow from Operating Activities	214	387	895	510	886
Cashflow from Financing Activities	(110)	(283)	(727)	-	-
Cashflow during the year	**104**	**103**	**168**	**510**	**886**
Key Ratios					
Interest Coverage Ratio (Times)	1.76	2.35	4.99	-	-
Debt Service Coverage Ratio (Times)	1.21	1.20	1.20	-	-
Loan Life Coverage Ratio (Times)	1.25	1.42	1.91	-	-
Project Life Coverage Ratio (Times)	1.80	2.05	2.75	-	-

12 Annexure-1: Plant Layout

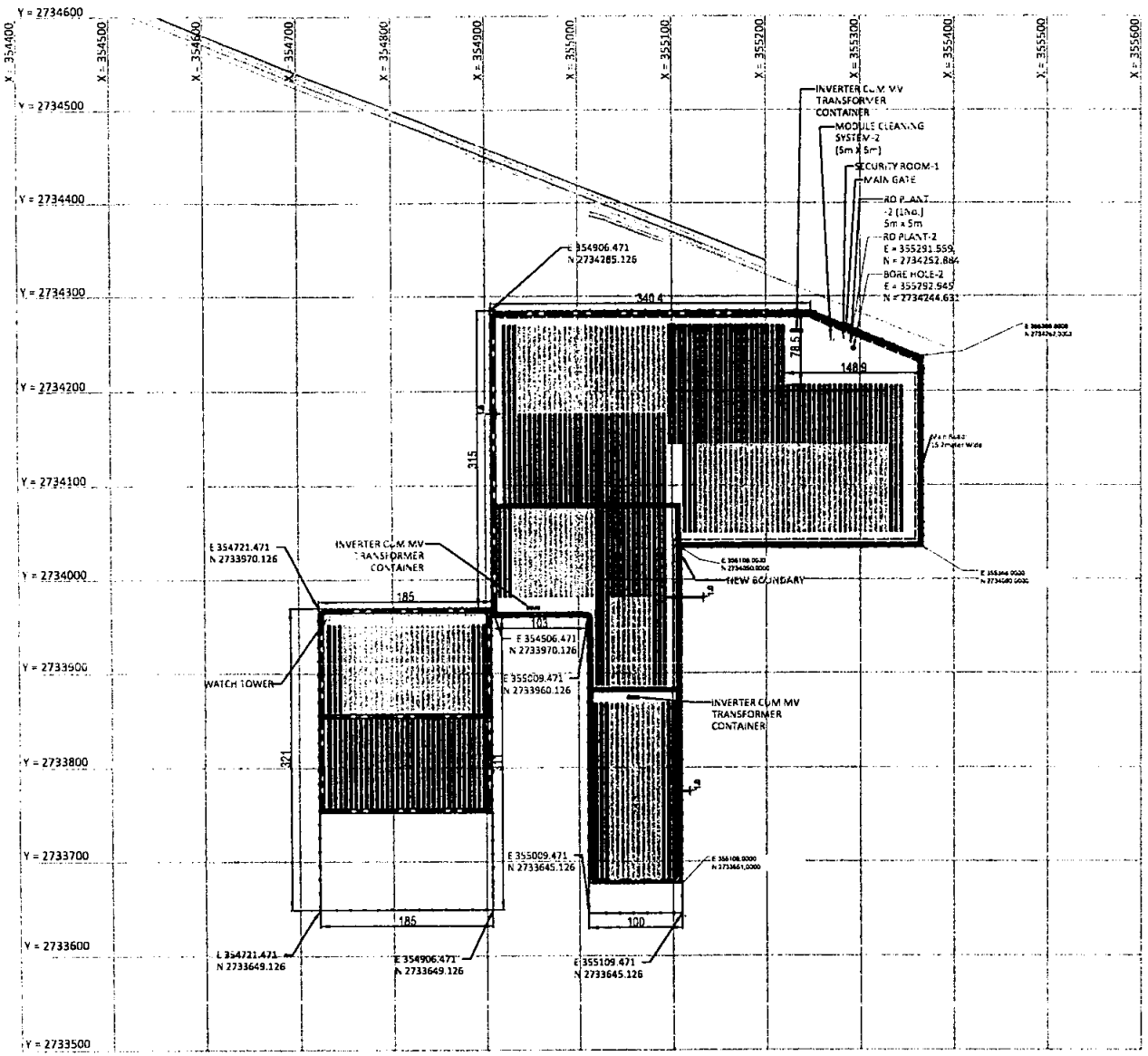
Attached in PDF format as separate file.

13 Annexure-2: Single Line Diagram

Attached in PDF format as separate file.

14 Annexure-3: PV Syst Simulation

Attached in PDF format as separate file.



GHARO 50MW SOLAR POWER PLANT				
STRUCTURE	TYPE: TRACKER		TILT: 60°	
PV MODULES	TYPE: JA SOLAR 630 WE B-FAC A_N-TYPE		POWER: 630 Wp	NUMBER: 23814
STRINGS	PV MODULES PER STRING: 27		NUMBER: 882	
INVERTERS	TYPE: SUNGROW CENTRAL INVERTER WITH INVERTER TRANSFORMER		POWER: 3.3 MW 4.4 MW	NUMBER: 1 2
GEOMETRIC DATA	AZIMUTH: 0	PITCH: 55	PV PLANT PERIMETER: 3696	PV PLANT AREA: 62 ACRES
TOTAL PEAK POWER INSTALLED:			15	kWp
TOTAL NOMINAL POWER INSTALLED:			12	kVA

LEGEND	DESCRIPTION	
	GH-2 BOUNDARY	
	GNL BOUNDARY	
	TRACKER 1Px81 TRACKER 1Px54	
	BITUMEN ROAD (6mtrs wide)	
	WBM ROAD (4mtrs wide)	
	RO PLANT (5m X 5m)	
	MODULE CLEANING SYSTEM (10m X 10m)	
	WATCH TOWER	
	ERECTION METRIAL STORAGE AREA	
	51 Nos. OF EXTERIOR TRACKER	(1P X 81)
	135 Nos. OF EDGE TRACKER	(1P X 81)
	62 Nos. OF INTERIOR TRACKER	(1P X 81)
	06 Nos. OF EXTERIOR TRACKER	(1P X 54)
	63 Nos. OF EDGE TRACKER	(1P X 54)

S No	DESCRIPTION	DETAILS
1.	TRACKING TYPE	HORIZONTAL SINGLE AXIS TRACKER, WITH INDEPENDENT TRACKER ROW
2.	TRACKING RANGE	UP TO 120° (± 60°)
3.	MAXIMUM SLOPES	NORTH-SOUTH DIRECTION 15% - EAST-WEST DIRECTION 30%
4.	MODULE CONFIGURATIONS	CONFIGURABLE, 1 STRING 1P27/2 STRINGS 1P54/3STRINGS 1P81 WITH 1,500V

S No.	DESCRIPTION	UNIT
1.	RATED MAXIMUM POWER (PMAX) [W]	630
2.	OPEN CIRCUIT VOLTAGE(VOC) [V]	52.47
3.	MAXIMUM POWER VOLTAGE(VMP) [V]	43.90
4.	SHORT CIRCUIT CURRENT(ISC) [A]	15.21
5.	MAXIMUM POWER CURRENT(IMP) [A]	14.35
6.	MODULE EFFICIENCY (%)	22.5

S No.	DESCRIPTION	UNIT
1.	RATED MAX POWER(PMAX) [W]	680
2.	OPEN CIRCUIT VOLTAGE(VOC) [V]	52.47
3.	MAX POWER VOLTAGE(VMP) [V]	43.90
4.	SHORT CIRCUIT CURRENT(ISC) [A]	16.43
5.	MAX POWER CURRENT(IMP) [A]	15.50

A
08.06.2024

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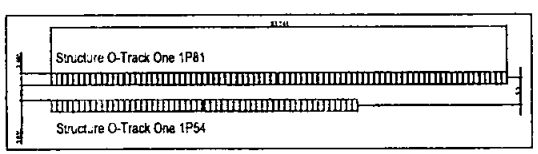


REV. NO.	DATE	DESCRIPTION	DV BY	CHD BY	APPD. BY
2	06.08.2024	THE PANEL WP CHANGED TO 630Wp INSTEAD OF 620Wp	TM	FAK	BM
1	04.07.2024	UPDATED AS PER INVERTER CONFIGURATION	FAK	FAK	BM
0	19.06.2024	INITIAL SUBMISSION	DV	FAK	BM

REVISIONS

ALL DIMENSIONS ARE IN mm UNLESS OTHERWISE SPECIFIED SIZE: A2 THIS IS A CAD FILE – DO NOT MAKE ANY CORRECTIONS MANUALLY

CUSTOMER: GHARO SOLAR-2 (PRIVATE) LIMITED

PROJECT: 15MWp SOLAR POWER PLANT

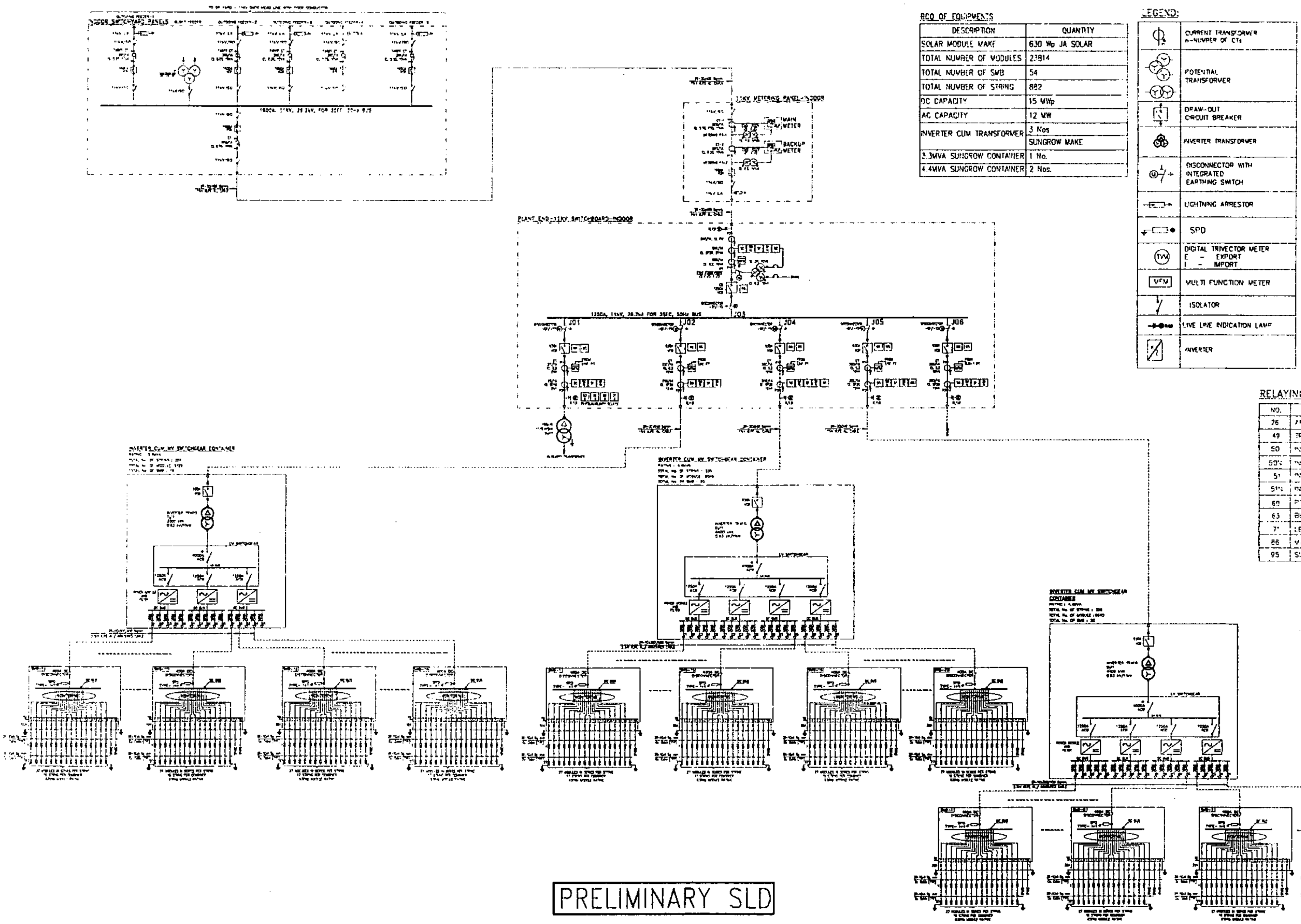
AVANT-GARDE ENGINEERS & CONSULTANTS (FZC.), Sharjah, UAE.

	NAME	SIGN	DATE	NO OF SHEETS
DRAWN	DV	-SD-	19.06.2024	1
CHKD	FAK	-SD-	19.06.2024	
APPD	BM	-SD-	19.06.2024	

DEPT: EL | FIRST ANGLE PROJECTION | SCALE: 1:4500 | WEIGHT (kg) | REF. ASSY. DRG. NO | USER NO

CODE: 900 | TITLE: SOLAR PV ARRAY LAYOUT | DRAWING NO: 2-2024355-900-0602 | REV

CAD DRAWING NO: 2024355060?



BOQ OF EQUIPMENTS

DESCRIPTION	QUANTITY
SOLAR MODULE MAKE	630 Wp JA SOLAR
TOTAL NUMBER OF MODULES	23814
TOTAL NUMBER OF SMB	54
TOTAL NUMBER OF STRING	882
DC CAPACITY	15 MWp
AC CAPACITY	12 MW
INVERTER CUM TRANSFORMER	3 Nos
	SUNGROW MAKE
3.3MVA SUNGROW CONTAINER	1 No.
4.4MVA SUNGROW CONTAINER	2 Nos.

LEGEND:

	CURRENT TRANSFORMER n-NUMBER OF CTs
	POTENTIAL TRANSFORMER
	DRAW-OUT CIRCUIT BREAKER
	INVERTER TRANSFORMER
	DISCONNECTOR WITH INTEGRATED EARTHING SWITCH
	LIGHTNING ARRESTOR
	SPD
TVM	DIGITAL TRIVECTOR METER E - EXPORT I - IMPORT
MFM	MULTI FUNCTION METER
	ISOLATOR
	LIVE LINE INDICATION LAMP
	INVERTER

SUFFIX FOR RELAYING:

D	NEUTRAL DISPLACEMENT
dF	dF/dt ELEMENT
E	ROTOR EARTH FAULT
LBB	LOCAL BREAKER BACKUP
DC	DIRECT CURRENT
N	EARTH FAULT
TRAFO.	TRANSFORMER
B	BUSBAR PROTECTION
PU	PERIPHERAL UNIT
O/F	OVER FREQUENCY
U/F	UNDER FREQUENCY
Z	NO VOLT ELEMENT
X	AUXILIARY RELAY
LV	LOW VOLTAGE
HV	HIGH VOLTAGE
TS	TEMPERATURE SCANNER
CU	CENTRAL UNIT
C&R PANEL - CONTROL & RELAY PANEL	

RELAYING:

NO.	FUNCTION
26	APPARATUS THERMAL DEVICE
49	TRAFO THERMAL RELAY
50	INSTANTANEOUS PHASE OVER CURRENT RELAY
50N	INSTANTANEOUS EARTH FAULT RELAY
51	INVERSE TIME OVER CURRENT RELAY
51N	INVERSE TIME EARTH FAULT RELAY
60	PT FUSE FAILURE RELAY
63	BUCHHOLZ RELAY & OIL SURGE RELAY
71	LEVEL SWITCH
86	MASTER TRIP/ LOCKOUT RELAY
95	SUPERVISION RELAY FOR TRIP CIRCUIT

REV NO	DATE	DESCRIPTION	REV BY	CHD BY	APPD BY
2	[illegible]	SLD UPDATED AS PER MODULE CAPACITY CHANGE	TM	FAK	[illegible]
1	[illegible]	SLD UPDATED AS PER INVERTER CONFIGURATION	FAK	FAK	[illegible]
0	[illegible]	INITIAL SUBMISSION	FAK	FAK	[illegible]

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GHARO-2 SOLAR (PRIVATE) LIMITED

15 MWp DC/12MW AC

AVANT-GARDE ENGINEERS & CONSULTANTS (FZC.),SHARJAH,UAE

AVANT-GARDE ENGINEERS & CONSULTANTS (FZC.) Sharjah, UAE.

TITLE: OVERALL SINGLE LINE DIAGRAM

DRAWING NO: 0-2024355-9CC-3603 | REV: 2

SIZE: A0

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Version 7.3.1

PVSYST
PHOTOVOLTAIC SOFTWARE

PVsyst - Simulation report

Grid-Connected System

Project: 15MW GNL Project Central Inverter

Variant: New simulation variant

Tracking system with backtracking

System power: 15.00 MWp

Gharo - Pakistan

Gharo Solar Limited

PVsyst V7.3.1
VC0, Simulation date:
07/26/24 16:26
with v7.3.1

Project summary

Geographical Site	Situation		Project settings	
Gharo	Latitude	24.72 °N	Albedo	0.20
Pakistan	Longitude	67.57 °E		
	Altitude	7 m		
	Time zone	UTC+5		

Meteo data
Gharo
SolarGIS Monthly aver. , period not spec. - Synthetic

System summary

Grid-Connected System
Simulation for year no 1

Tracking system with backtracking

PV Field Orientation

Orientation		Tracking algorithm
Tracking plane, horizontal N-S axis		Astronomic calculation
Axis azimuth	0 °	Backtracking activated

Near Shadings
Linear shadings

System information

PV Array		Inverters	
Nb. of modules	23814 units	Nb. of units	3 units
Pnom total	15.00 MWp	Pnom total	12.10 MWac
		Pnom ratio	1.240

User's needs
Unlimited load (grid)

Results summary

Produced Energy	30024191 kWh/year	Specific production	2001 kWh/kWp/year	Perf. Ratio PR	82.39 %
Apparent energy	31731086 kVAh				

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General parameters

Grid-Connected System

Tracking system with backtracking

PV Field Orientation

Orientation	
Tracking plane, horizontal N-S axis	
Axis azimuth	0 °

Tracking algorithm	
Astronomic calculation	
Backtracking activated	

Backtracking array	
Nb. of trackers	322 units
Sizes	
Tracker Spacing	5.50 m
Collector width	2.46 m
Ground Cov. Ratio (GCR)	44.8 %
Phi min / max.	-/+ 55.0 °
Backtracking strategy	
Phi limits for BT	-/+ 63.2 °
Backtracking pitch	5.50 m
Backtracking width	2.47 m

Models used

Transposition	Perez
Diffuse	Perez, Meteonorm
Circumsolar	separate

Horizon
Free Horizon

Near Shadings
Linear shadings

User's needs
Unlimited load (grid)

Bifacial system

Model	2D Calculation unlimited trackers

Bifacial model geometry	
Tracker Spacing	5.50 m
Tracker width	2.46 m
GCR	44.8 %
Axis height above ground	2.10 m

Bifacial model definitions	
Ground albedo	0.20
Bifaciality factor	45 %
Rear shading factor	5.0 %
Rear mismatch loss	10.0 %
Shed transparent fraction	0.0 %

Grid injection point

Power factor	
Cos(phi) (lagging)	0.950

PV Array Characteristics

Array #1 - PV Array

PV module	
Manufacturer	JA Solar
Model	JAM72D42-630/LB
(Custom parameters definition)	
Unit Nom. Power	630 Wp
Number of PV modules	5940 units
Nominal (STC)	3742 kWp
Modules	220 Strings x 27 In series
At operating cond. (50°C)	
Pmpp	3479 kWp
U mpp	1087 V
I mpp	3201 A

Inverter	
Manufacturer	Sungrow
Model	SG3300UD
(Custom parameters definition)	
Unit Nom. Power	3300 kWac
Number of inverters	1 unit
Total power	3300 kWac
Operating voltage	895-1500 V
Max. power (=>22°C)	3795 kWac
Pnom ratio (DC:AC)	1.13
Power sharing within this inverter	

PV Array Characteristics

Array #2 - Sub-array #2

PV module

Manufacturer	JA Solar
Model	JAM72D42-630/LB
(Custom parameters definition)	
Unit Nom. Power	630 Wp
Number of PV modules	17874 units
Nominal (STC)	11.26 MWp
Modules	662 Strings x 27 In series
At operating cond. (50°C)	
Pmpp	10.47 MWp
U mpp	1087 V
I mpp	9632 A

Inverter

Manufacturer	Sungrow
Model	SG4400UD
(Custom parameters definition)	
Unit Nom. Power	4400 kWac
Number of inverters	2 units
Total power	8800 kWac
Operating voltage	895-1500 V
Max. power (=>22°C)	5060 kWac
Pnom ratio (DC:AC)	1.28
Power sharing within this inverter	

Total PV power

Nominal (STC)	15003 kWp
Total	23814 modules
Module area	66568 m²

Total inverter power

Total power	12100 kWac
Number of inverters	3 units
Pnom ratio	1.24

Array losses

Array Soiling Losses
Loss Fraction 3.0 %

Thermal Loss factor
Module temperature according to irradiance
Uc (const) 29.0 W/m²K
Uv (wind) 0.0 W/m²K/m/s

LID - Light Induced Degradation
Loss Fraction 1.0 %

Module Quality Loss
Loss Fraction -0.7 %

Module mismatch losses
Loss Fraction 0.7 % at MPP

Strings Mismatch loss
Loss Fraction 0.4 %

Module average degradation
Year no 1
Loss factor 2 %/year

Mismatch due to degradation
Imp RMS dispersion 0.4 %/year
Vmp RMS dispersion 0.4 %/year

IAM loss factor
ASHRAE Param.: IAM = 1 - bo (1/cosi -1)
bo Param. 0.07

DC wiring losses

Global wiring resistance 1.4 mΩ
Loss Fraction 1.5 % at STC

Array #1 - PV Array

Global array res.	5.6 mΩ
Loss Fraction	1.5 % at STC

Array #2 - Sub-array #2

Global array res.	1.9 mΩ
Loss Fraction	1.5 % at STC

System losses

Unavailability of the system
Time fraction 0.8 %
2.9 days,
5 periods

Auxiliaries loss
constant (fans) 42.0 kW
0.0 kW from Power thresh.

AC wiring losses

Inv. output line up to MV transfo

Inverter voltage	630 Vac tri
Loss Fraction	0.40 % at STC

Inverters: SG3300UD, SG4400UD

Wire section (3 Inv.)	Copper 3 x 3 x 2500 mm²
Average wires length	68 m

MV line up to Injection

MV Voltage	11 kV
Average each inverter	
Wires	Alu 3 x 300 mm²
Length	1300 m
Loss Fraction	0.61 % at STC

AC losses in transformers

MV transfo

Medium voltage	11 kV

One transfo parameters

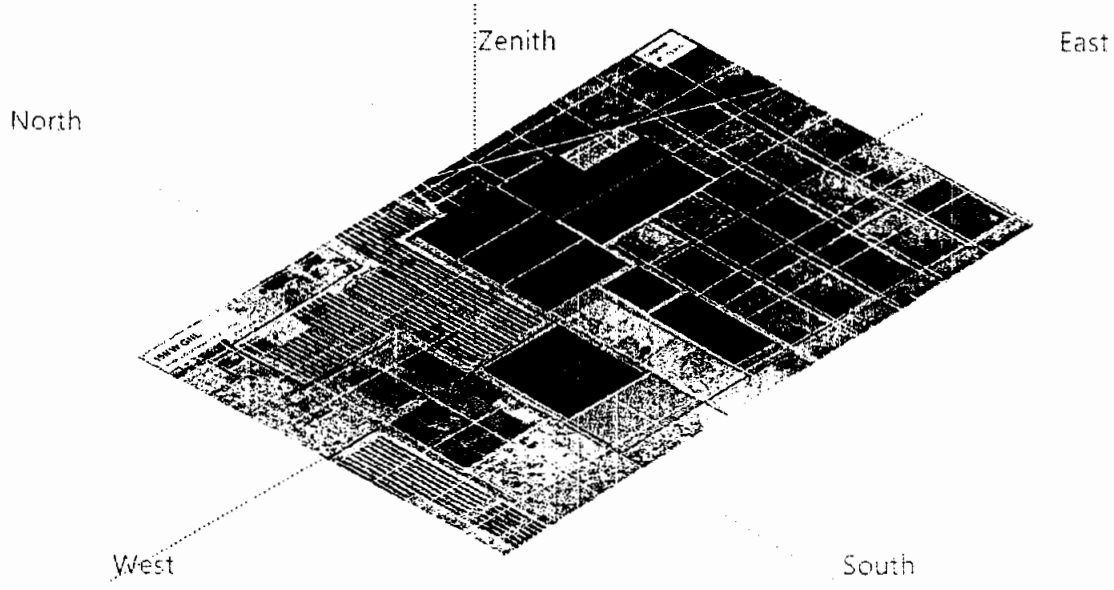
Nominal power at STC	4.91 MVA
Iron Loss (24/24 Connexion)	8.54 kVA
Iron loss fraction	0.17 % at STC
Copper loss	57.01 kVA
Copper loss fraction	1.16 % at STC
Coils equivalent resistance	3 x 0.94 mΩ

Operating losses at STC (full system)

Nb. identical MV transfos	3
Nominal power at STC	14.73 MVA
Iron loss (24/24 Connexion)	25.63 kVA
Copper loss	171.04 kVA

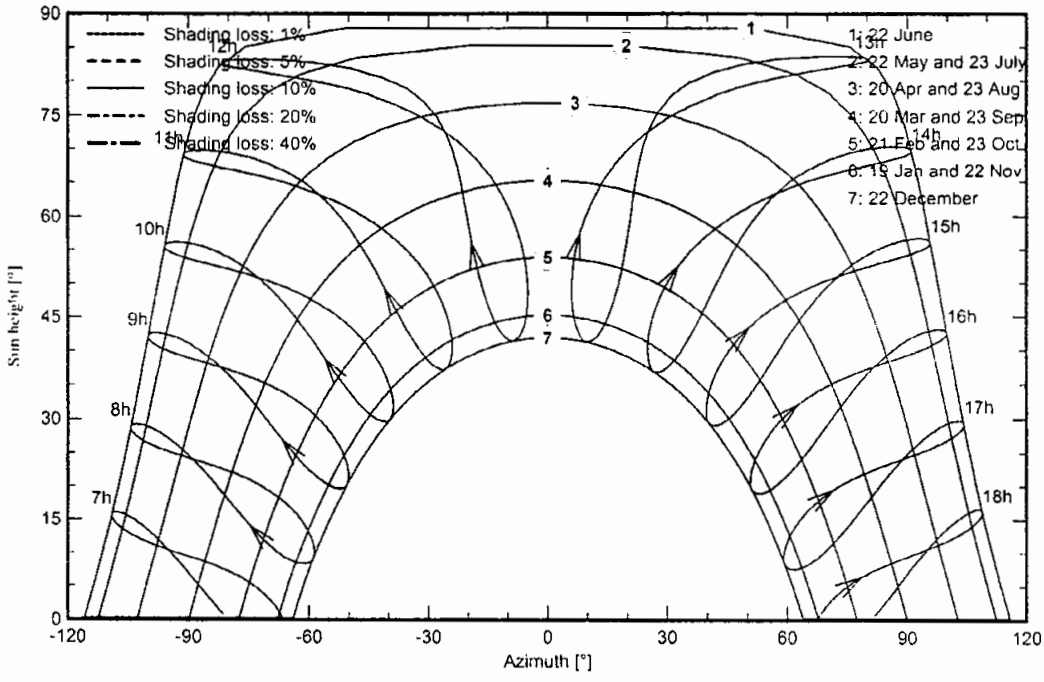
Near shadings parameter

Perspective of the PV-field and surrounding shading scene



Iso-shadings diagram

Orientation #1

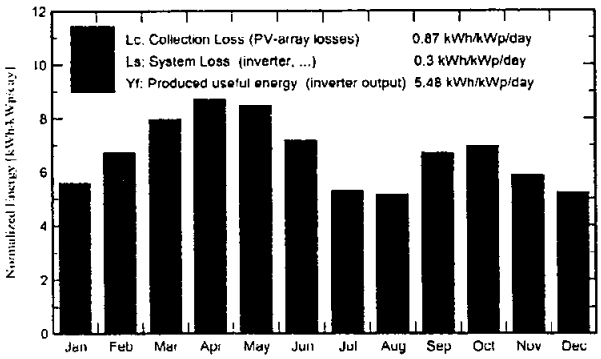


Main results

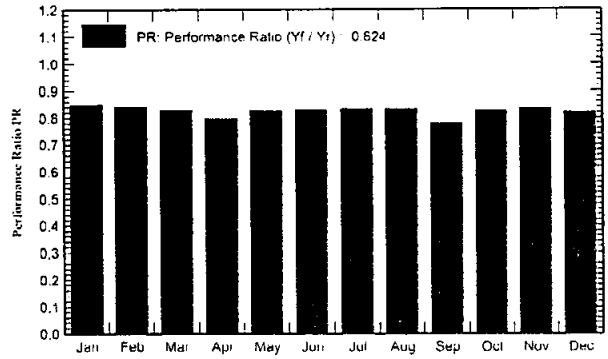
System Production

Produced Energy	30024191 kVAh/year	Specific production	2001 kWh/kWp/year
Apparent energy	31731086 kVAh/year	Performance Ratio PR	82.39 %

Normalized productions (per installed kWp)



Performance Ratio PR



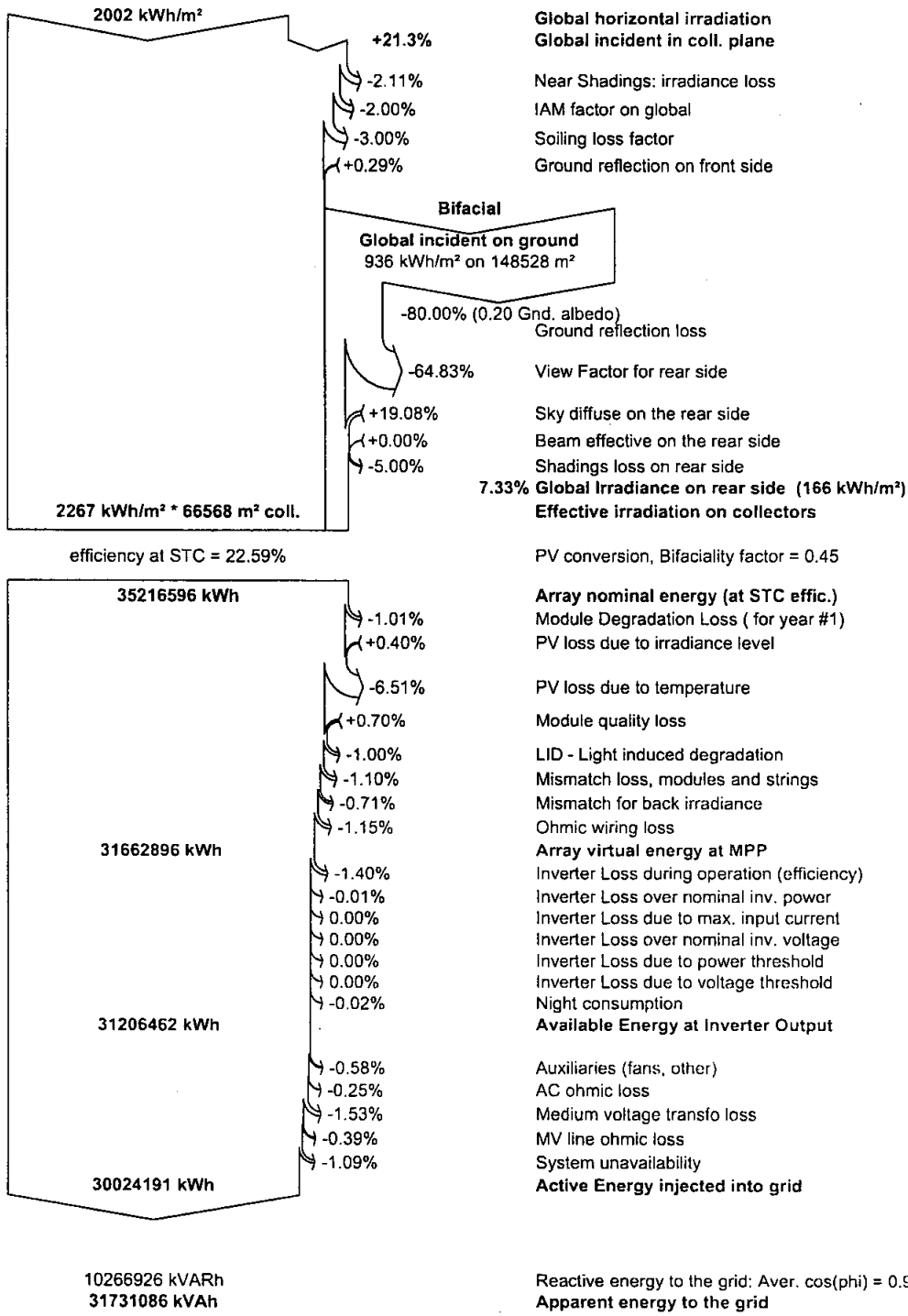
Balances and main results

	GlobHor kWh/m²	DiffHor kWh/m²	T_Amb °C	GlobInc kWh/m²	GlobEff kWh/m²	EArray kWh	E_Grid kWh	PR ratio
January	137.2	52.0	19.10	173.6	160.3	2306758	2210800	0.849
February	150.3	54.3	22.00	188.5	175.8	2483945	2381232	0.842
March	196.9	72.8	26.10	247.1	232.1	3213291	3079572	0.831
April	212.7	83.3	29.20	261.5	246.8	3366047	3126050	0.797
May	218.4	100.7	30.90	262.8	247.5	3395278	3257077	0.826
June	186.7	102.6	31.50	215.2	201.5	2792791	2680656	0.830
July	148.1	101.2	30.20	164.7	152.4	2150412	2060213	0.834
August	143.6	94.8	29.10	160.1	148.4	2094962	2003727	0.834
September	166.3	83.9	29.20	201.4	188.2	2626230	2354973	0.779
October	172.6	65.8	29.00	216.0	201.8	2790303	2677152	0.826
November	139.5	54.3	25.20	175.9	162.7	2295177	2202406	0.835
December	129.6	49.0	20.39	162.1	149.1	2143484	1990333	0.819
Year	2001.9	914.7	26.84	2428.9	2266.6	31658679	30024191	0.824

Legends

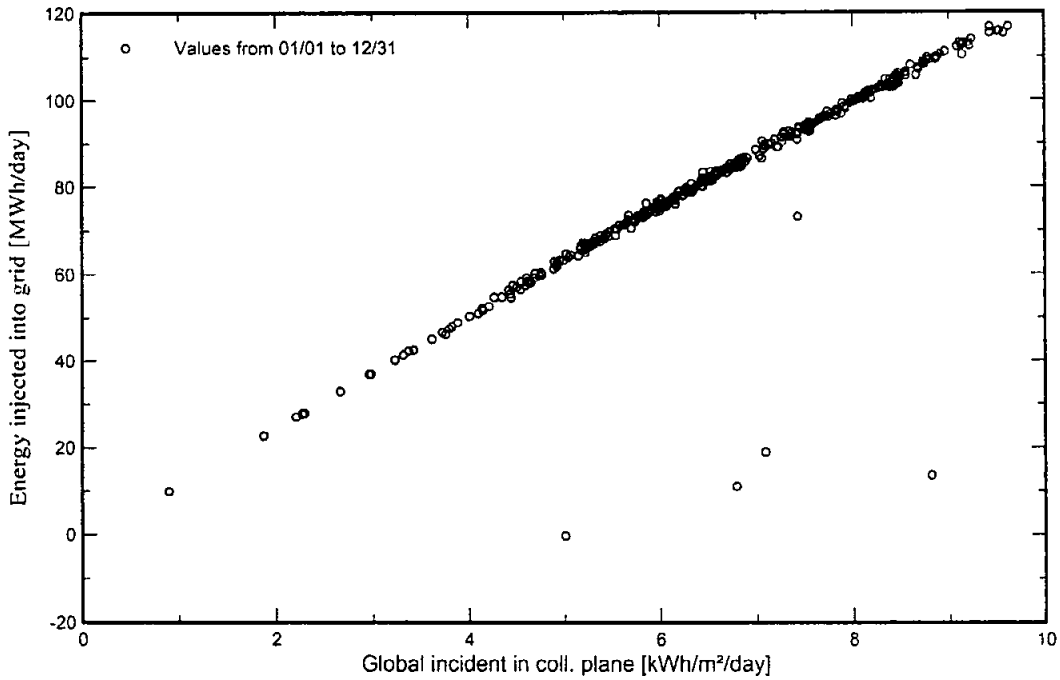
GlobHor	Global horizontal irradiation	EArray	Effective energy at the output of the array
DiffHor	Horizontal diffuse irradiation	E_Grid	Energy injected into grid
T_Amb	Ambient Temperature	PR	Performance Ratio
GlobInc	Global incident in coll. plane		
GlobEff	Effective Global, corr. for IAM and shadings		

Loss diagram

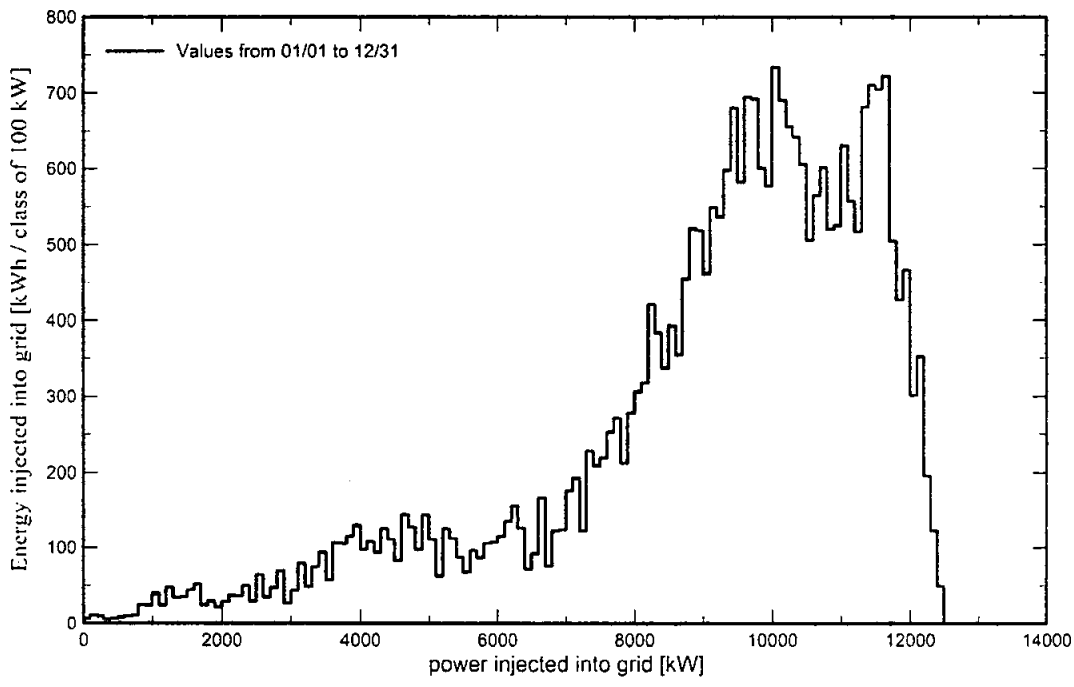


Predef. graphs

Daily Input/Output diagram



System Output Power Distribution



P50 - P90 evaluation

Meteo data

Source	SolarGIS Monthly aver. , period not spec.
Kind	Not defined
Year-to-year variability(Variance)	-1.0 %
Specified Deviation	

Global variability (meteo + system)

Variability (Quadratic sum)	2.1 %

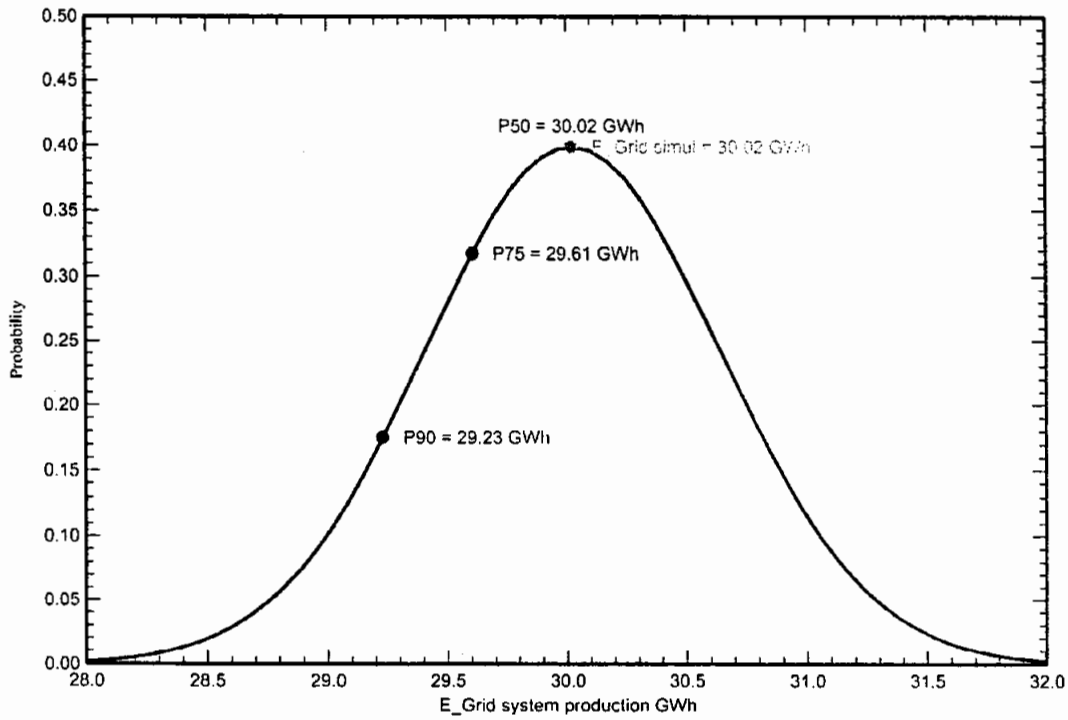
Simulation and parameters uncertainties

PV module modelling/parameters	1.0 %
Inverter efficiency uncertainty	0.5 %
Soiling and mismatch uncertainties	1.0 %
Degradation uncertainty	1.0 %

Annual production probability

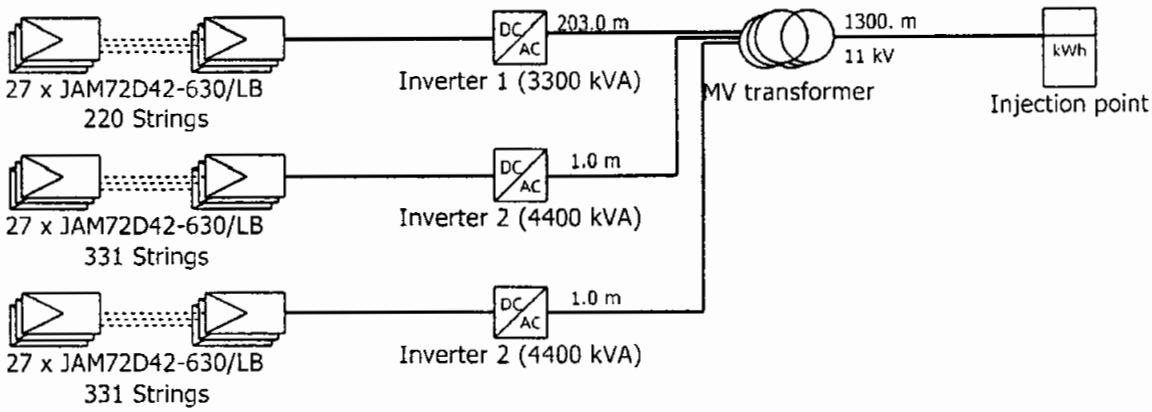
Variability	0.62 GWh
P50	30.02 GWh
P90	29.23 GWh
P75	29.61 GWh

Probability distribution



Single-line diagram

PVsyst V7.3.1
VC0, Simulation date:
07/26/24 16:26
with v7.3.1



PV module	JAM72D42-630/LB
Inverter 1	SG3300UD
Inverter 2	SG4400UD
String	27 x JAM72D42-630/LB

	15MW GNL Project Central Inver ter	
	VC0 : New simulation variant	07/26/24

PVsyst V7.3.1
VC0, Simulation date:
07/26/24 16:26
with v7.3.1

CO_2 Emission Balance

Total: 318489.9 tCO_2

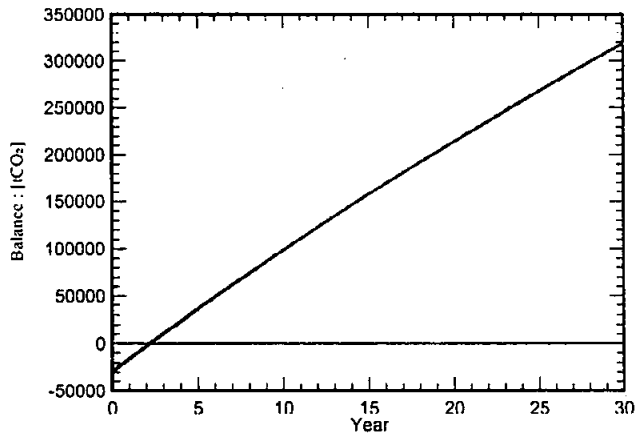
Generated emissions

Total: 29290.31 tCO_2
Source: Detailed calculation from table below:

Replaced Emissions

Total: 400823.0 tCO_2
System production: 30024.19 MWh/yr
Grid Lifecycle Emissions: 445 gCO_2/kWh
Source: IEA List
Country: Pakistan
Lifetime: 30 years
Annual degradation: 1.0 %

Saved CO_2 Emission vs. Time



System Lifecycle Emissions Details

Item	LCE	Quantity	Subtotal
			[$kgCO_2$]
Modules	1686 kgCO2/kWp	15241 kWp	25689156
Supports	2.97 kgCO2/kg	1209600 kg	3590274
Inverters	294 kgCO2/	37.0	10880

GHARO NEWGEN (PRIVATE) LIMITED

114-CC2, Phase-6C, DHA, Lahore. Ph: 042 38020444

Ref. No: GNPL/GAL/24-01 August 19, 2024

The Registrar
NEPRA Tower,
Ataturk Avenue (East), Sector G-5/1,
Islamabad

Subject: Statement issued pursuant to Regulation 3 (4)(h) of the National Electric Power Regulatory Authority Licensing (Application, Modification, Extension and Cancellation) Procedure Regulations 2021

Dear Sir,

I, Rana Uzair Nasim, CEO, being the duly authorized representative of Gharo Newgen (Private) Limited, by virtue of Board Resolution dated June 17th 2024, hereby confirm that Gharo Newgen (Private) Limited has not been refused the grant of any license for the provision of any electric power services pursuant to the applicable provisions of the Regulation of Generation, Transmission and Distribution of Electric Power Act, 1997.

Sincerely,
For and on behalf of Gharo Newgen (Private) Limited

Rana Uzair Nasim
Chief Executive Officer

GHARO NEWGEN (PRIVATE) LIMITED

Regulation # 3(4)(c)(i)(a)

Certified Copies Of Certificate Of Incorporation

3(4)(c)(i)(c)

Certified Copies Of Annual Reports Of The Company

With reference to the requirement as per clause, " Schedule III (Regulation 3(4)(c)(i)(c)) Certified copies of annual reports of the company" is attached.

GHARO NEWGEN (PRIVATE) LIMITED
STATEMENT OF FINANCIAL POSITION
AS AT JUNE 30, 2024 (UN-AUDITED)

	Notes	30-Jun-24 Rupees	30-Jun-23 Rupees
ASSETS			
Current assets			
Other Receivables & Prepayments	1	52,500	52,500
Cash and bank balances	2	2,111,881	2,299,032
TOTAL ASSETS		2,164,381	2,351,532
EQUITY AND LIABILITIES			
SHARE CAPITAL AND RESERVES			
Authorised capital 10,000 (2023: 10,000) ordinary shares of Rs. 10 each		100,000	100,000
Issued, subscribed and paid up capital 1,000 (2023: 1,000) ordinary shares of Rs. 10 each fully paid in cash	3	10,000	10,000
Revenue reserve: Unappropriated loss		(865,207)	(687,236)
Share Deposit Money		2,618,088	2,618,088
TOTAL EQUITY		1,762,881	1,940,852
LIABILITIES			
Current liabilities			
Creditors and accrued expenses	4	401,500	410,680
		401,500	410,680
TOTAL EQUITY AND LIABILITIES		2,164,381	2,351,532

The annexed notes from 1 to 10 form an integral part of these financial statements.

CHIEF EXECUTIVE

DIRECTOR

GHARO NEWGEN (PRIVATE) LIMITED

Company Secretary

GHARO NEWGEN (PRIVATE) LIMITED
INCOME STATEMENT
FOR THE PERIOD ENDED JUNE 30, 2024

	Notes	30-Jun-24 Rupees	30-Jun-23 Rupees
Pre-Operating expenses	5	(177,971)	(636,011)
Operating loss		(177,971)	(636,011)
Financial charges	6	-	-
Loss before taxation		(177,971)	(636,011)
Taxation		-	-
Loss after taxation		(177,971)	(636,011)

The annexed notes from 1 to 10 form an integral part of these financial statements.

CHIEF EXECUTIVE

DIRECTOR

GHARO NEWGEN (PRIVATE) LIMITED

Company Secretary

GHARO NEWGEN (PRIVATE) LIMITED
STATEMENT OF CHANGES IN EQUITY
AS AT JUNE 30, 2024 (UN-AUDITED)

	Issued, subscribed and paid up capital	Capital Reserve	Revenue reserve	Total equity
		Share deposit money	Unappropriated loss	
	Rupees	Rupees	Rupees	Rupees
Balance as at June 30, 2022	10,000	-	(51,225)	(41,225)
Share Deposit money	-	2,618,088		2,618,088
Loss for the period	-	-	(636,011)	(636,011)
Previous year adjustment				
Balance as at June 30, 2023	10,000	2,618,088	(687,236)	1,940,852
Share Deposit money	-	-		-
Loss for the period	-	-	(177,971)	(177,971)
Previous year adjustment				
Balance as at June 30, 2024	10,000	2,618,088	(865,207)	1,762,881

The annexed notes from 1 to 10 form an integral part of these financial statements.

CHIEF EXECUTIVE

DIRECTOR

GHARO NEWGEN (PRIVATE) LIMITED

Company Secretary

GHARO NEWGEN (PRIVATE) LIMITED
STATEMENT OF CASH FLOWS
FOR THE PERIOD ENDED JUNE 30, 2024

	Note	30-Jun-24 Rupees	30-Jun-23 Rupees
CASH FLOWS FROM OPERATING ACTIVITIES			
Loss before taxation		(177,971)	(636,011)
Adjustment for non-cash charges and other items:			
Depreciation			-
Financial charges	6	-	-
Operating loss before working capital changes		(177,971)	(636,011)
Effect on cash flows due to working capital changes:			
Increase in current liabilities:			
Other Receivables		-	297,500
Creditors and accrued expenses		(9,180)	2,629,768
Cash generated from / (used in) operations		(187,151)	2,291,257
Taxes paid			-
Finance cost paid	6	-	-
Net cash generated from / (used in) operating activities		(187,151)	2,291,257
Net increase / (decrease) in cash and cash equivalents		(187,151)	2,291,257
Cash and cash equivalents at the beginning of the year		2,299,032	7,775
Cash and cash equivalents at the end of the year	2	2,111,881	2,299,032

The annexed notes from 1 to 10 form an integral part of these financial statements.

CHIEF EXECUTIVE

DIRECTOR

GHARO NEWGEN (PRIVATE) LIMITED

Company Secretary

		Note	30-Jun-24 Rupees	30-Jun-23 Rupees
1.	**Other Receivables & Prepayments**			
	Receivables from Related Party		52,500	52,500
			52,500	52,500
2.	**Cash and bank balances**			
	Cash in hand		799	6,498
	Cash at bank			
	Current accounts		2,111,082	2,292,534
			2,111,881	2,299,032

3. **Issued, subscribed and paid-up capital**

	30-Jun-24	30-Jun-23	30-Jun-24	30-Jun-23
	Number of shares		(Rupees)	(Rupees)
Ordinary shares of Rs. 10/- each fully paid in cash	1,000	1,000	10,000	10,000

Name of major shareholders	Share capital as at 30 June 2024	Share capital as at 30 June 2023
Mr. Rana Nasim Ahmed	900	900
Mr. Rana Uzair Nasim	99	99
Mr. Musaddiq Rahim	1	1
	1,000	1,000

		Note	30-Jun-24 Rupees	30-Jun-23 Rupees
4.	**Creditors and accrued expenses**			
	Due to related party		399,000	399,000
	Tax Payable		2,500	-
	Other Payable		-	11,680
			401,500	410,680

		Rupees	Rupees
5.	**Pre-Operating expenses**		
	Legal & Professional Charges	-	-
	Fee & Taxes	8,640	5,443
	Feasibility Study	-	350,000
	Traveling Expenses	153,539	171,501
	General Expenses	-	104,695
	Other Exp	15,792	4,372
		177,971	636,011
6.	**Financial charges**		
	Bank charges	-	-

7. **Remuneration of Chief Executive, Directors and Executives of the Company**

7.1 There were no any amount charged in these financial statements for remuneration, including certain benefits to the chief executive, directors And executives of the Company.

8. **Transaction with related parties**

The related parties comprise the associated companies, entities under common directorship and key management personnel. Amounts due from/to related parties are shown under respective notes of these financials statement.

8.1 Key management personnel are those persons having authority and responsibility for planning, directing and controlling the activities of the entity. The Company considers all members of its management team, including the Chief Executive Officer, the Directors as key management personnel.

	MW
9. **Capacity and production**	
Uninstalled capacity	-
Actual energy produced	-

9.1 The Company has not yet started its operations.

10. **Date of authorization**

These financial statements were authorized for issue on _____ by the Board of Directors of the Company.

CHIEF EXECUTIVE

DIRECTOR

GHARO NEWGEN (PRIVATE) LIMITED

Company Secretary

3(4)(d)(vi)

A Reasonably Detailed Profile Of The Applicant And The Applicant's Senior Management, Technical And Professional Staff

With reference to the requirement as per clause, " Schedule III (Regulation 3(4)(d)(vi)) * A reasonably detailed profile of the applicant and the applicant's senior management, technical and professional staff" is attached.

The project sponsors have a robust track record in the development, engineering, procurement, and construction (EPC), as well as operation and maintenance (O&M), of approximately 200 MW of installed projects. These projects encompass solar and biomass technologies within the country. The key sponsors' and CEO's profiles are as following:

Rana Nasim Ahmed

Mr. Rana Nasim Ahmed is the main sponsor of the Company and will retain a minimum of 51% shareholding in the Company. He is also the main sponsor of Harappa Solar (Private) Limited, an 18 MWp solar project commissioned in October 2017. Harappa Solar was the first private sector solar power producer in Pakistan and pioneered the use of a single-axis tracking system in the country. Additionally, Mr. Ahmed is also the main sponsor of Gharo Solar Limited, a 50 MWp solar project established in December 2019. Gharo Solar was the first solar power project in Pakistan with bifacial modules and the first within the K-Electric network to be financed by a foreign development finance institution (DFI).

Mr. Ahmed has vast industrial experience of more than two decades of managing four sugar mills to the highest international standards. He has spearheaded high-pressure cogeneration in the sugar industry by leading the development, construction, and operations of the first-ever 2 x 26.5 MW (53 MW total) bagasse-based project set up in 2014. These 53 MW biomass projects and two of the four sugar mills were set up as greenfield ventures on expedited timelines in self-EPC mode with multiple contractors, suppliers and consultants managed by Mr. Ahmed. Moreover, he has over fifteen years of experience managing equipment procurement and installation and leading commercial and operation and maintenance ("O&M") matters of 70 MW low-pressure, biomass power plants. Mr. Ahmed obtained his master's degree (with distinction) from the University of the Punjab and his MBA from Saint Louis University, USA.

Name	Designation
Rana Uzair Nasim	Chief Executive Officer
Husnain Arif	Chief Financial Officer
Muhammad Mohsin Iqbal	General Manager Technical

Rana Uzair Nasim

Mr. Rana Uzair Nasim is the CEO of the Company. Mr. Nasim has successfully led and managed solar, biomass and industrial projects with capex of over USD 150 million. He is also serving as the CEO of Gharo Solar Limited and Harappa Solar (Private) Limited since their inception and is the primary point of contact for various stakeholders including local and foreign shareholders / lenders, regulatory and public-sector agencies, power purchasers, suppliers, and contractors. Mr. Nasim has first-hand experience of greenfield project conceptualization and execution and has worked across different areas including design, policy and tariff development, tendering, financing, insurance, negotiation of project concession documents etc. He has also contributed to several important policy and regulatory developments in the broader renewable energy sector in Pakistan. Mr. Nasim previously worked as a management consultant in New York with Oliver Wyman and Dalberg Global Development Advisors. He holds a BA in Economics and an MS in Management Science & Engineering from Stanford University, California, USA.

Husnain Arif

Mr. Husnain Arif is the CFO of the Company. Mr. Arif is a qualified Chartered Financial Analyst (CFA), Chartered Accountant (CA) from England and Wales and fellow member of ACCA-UK. He has extensive experience in financial modelling; budgeting and transaction advisory for multiple industries including power, cement and banks. He is also well-acquainted with accounting and auditing standards i.e. IAS/IFRS and US GAAP. His Area of expertise also includes carrying out financial due diligence for project acquisitions and project financing for multiple industries. He has been a part of the development team for 18MWp Harappa Solar (Private) Limited and 50 MWp Gharo Solar Limited.

Muhammad Mohsin Iqbal

Muhammad Mohsin Iqbal is an accomplished General Manager Technical in the renewable energy sector with extensive experience in managing large-scale solar projects. With a solid background in Electrical Engineering and Project Management, he has successfully led the design, execution, and maintenance of numerous solar power systems across Pakistan, UAE and Saudi Arabia. His expertise spans over 17 years in the industry, where he has played a pivotal role in the growth and success of various high-profile renewable energy projects. Mohsin's leadership and technical skills are instrumental in driving innovation and efficiency within the solar energy landscape.

3(e)

Technical And Financial Proposals In Reasonable Detail For The Operation, Maintenance, Planning And Development Of The Facility Or System In Respect Of Which The License Is Being Sought

With reference to the requirement as per clause, " Schedule III (Regulation 3(e)) * Technical and financial proposals in reasonable detail for the operation, maintenance, planning and development of the facility or system in respect of which the license is being sought" is attached.

3. TECHNICAL OVERVIEW

3.1. Technology

It is proposed to install a 15 MWp solar power plant with 12 MWac on-grid central inverters. The Project shall be interconnected with the KE network through an 11kV transmission lines. The following sections give an overview of the technical scheme and key components of the Project. Solar PV modules shall be used to harness solar energy and convert it to electric power. The PV modules shall be connected in series to form a string and then multiple strings shall feed to String Combiner Box.

The PV modules shall be installed on a horizontal single axis tracking system which shall have a built-in algorithm to track the sun. The aim is an optimized positioning of the module surface to the sun during the day and ultimately, increase the total solar irradiation onto the module surface. The tracking system shall be ground mounted and pile-type foundations shall be used for the purpose.

The PV modules shall generate DC power, which shall be converted to AC power through inverters. Since the Project shall feed electricity to the grid and therefore, on-grid type inverters shall be installed at the plant. Apart from simple AC/DC conversion, the inverter shall also condition the power and make electricity compliant with the grid code requirement.

AC/DC cables are the means of transportation of electricity from one point to another, for example, from string combiner boxes to inverters and then to inverter transformers and finally to 11kV substation. During the transfer of electricity, the losses are unavoidable, however sufficient sizing and consideration shall reduce the losses. Further, the conversion of electricity to high voltage i.e., 11kV /low current by transformers shall also help in loss reduction.

This is the grid connection interface, where the electric power shall be collected and exported to the grid network. The substation shall primarily consist of 11kV switchgear, control / protection system and AC/DC aux power system etc.

Monitoring of grid-connected solar power plants shall be conducted locally as well as remotely through the internet. The monitoring shall be performed 24/7 and shall pinpoint faults in individual components causing production loss.

Major components of utility-scale systems are:

- Solar Modules / Panels
- Module Mounting Structures (fixed or tracking)
- Solar Inverters
- Balance of Systems (BoS) comprising of
    - DC Cables
    - String Combiner Boxes
    - AC Cables
    - Transformers

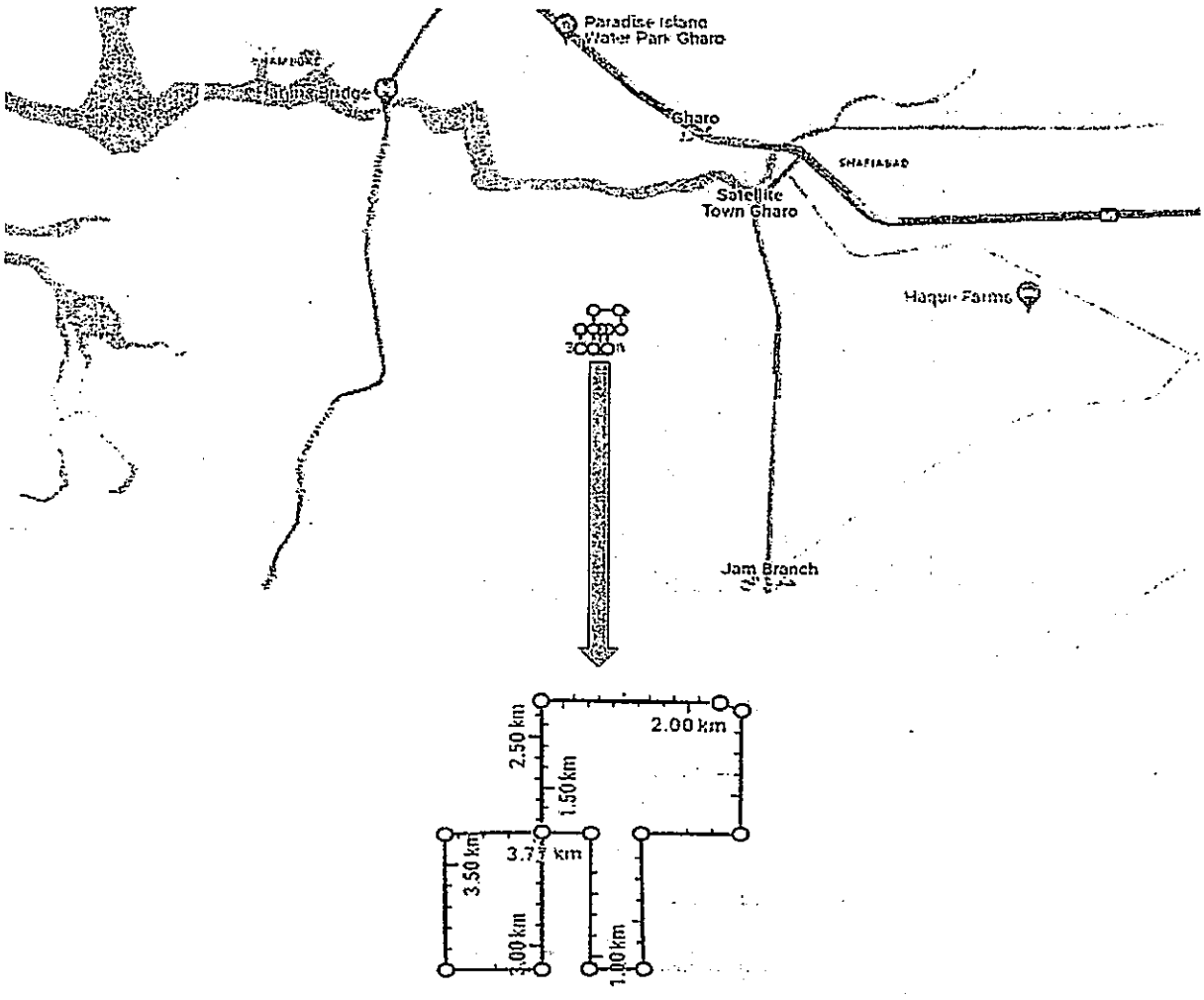
- HT Panels / RMU units
- SCADA & Monitoring System
- Earthing system
- Illumination system
- Module cleaning system
- AC / Ventilation System for inverter rooms

- Civil works including foundations, inverter rooms, leveling, grading, fencing, etc.
- Power evacuation systems include step-up transformers, switchyard, tariff metering arrangement, etc.

The scheme proposed for evacuation of power from the Gharo Newgen to KE grid comprises 11 kV circuits. In the Photovoltaic category, PV panels without concentrators are widely used. These panels are either with fixed tilt or manual seasonal tilt or single axis / dual axis tracking arrangements. Fixed tilt arrangements are in the majority; however, single axis trackers are also gaining in popularity due to the gain in generation over fixed tilt systems.

3.2. Site

The Project Site is located near the town of Gharo at Deh Ghairabad, Mirpur Sakro, District Thatta, Sindh approximately 6 km along the Sindh Coastal Highway and then approximately 1.25 km via connecting road from the Highway. The Site is about 55 km away from Jinnah International Airport, Karachi.



3.3. Interconnection

The electric power generated from the Generation Facility/Solar Power Plant of the Company shall be dispersed to the load center of K-Electric.

The proposed Interconnection Arrangement/Transmission Facility for dispersal of electric power comprises the direct 11 kV lines of approximately 7-8 km length to be laid from the 11 kV bus bar of the Generation Facility/Solar Power Plant to the Gharo Grid Station.

3.4. Commissioning & Expected Life

As per the standard energy purchase agreement ("EPA") the Project life and EPA term has been assumed as 25 years from COD and all equipment is being procured corresponding to the same.

3.5. Operation & Maintenance

Operation & Maintenance for a Solar PV Plant is relatively straightforward and less intensive compared to other power generation technologies. The operations shall be managed by either a third-party O&M consultant or an in-house technical and operational expert team, well-equipped with required capabilities. Most O&M functions shall be performed by permanent staff and the operation of the facility will be automated, supervised and controlled by SCADA.
The operation team shall operate and monitor the facility in accordance with Prudent Utility Practices, applicable standards and the manufacturers' recommendations.

Operations and Maintenance tasks shall include:

- Periodic cleaning of PV Panels (few times per month).
- Periodic operational checks and tests of equipment in accordance with OEM recommendations.
- Regular plant inspections.
- Routine maintenance services.
- Implement and regulate the facility's preventive and corrective maintenance program.
- Critical / non-critical reactive repairs.
- Plant security covering entire fenced area.
- General shift operations for coordinating plant operation, maintenance & liaison with power purchaser; and
- Maintain critical spares for plant & equipment.

3.6. Monitoring and facilities

Monitoring of system operation parameters shall be arranged locally and also from remote locations through internet. Weather monitoring station, for irradiance, DHI measurement, wind velocity & ambient temperature, String currents, Inverter Parameters, Transformer protections and temperature, HT Panel

parameters, Export & import (auxiliary) energy and Perimeter Security through CCTVs & alert systems are hooked-up to SCADA system. Also, there will be a separate PLC based SCADA system for monitoring/controlling tracker system.

3.7. Site Description

1.	Name of Licensee	Gharo Newgen (Private) Limited
2.	Plant Location	Deh Ghairabad, Mirpur Sakro, District Thatta, Sindh
3.	Type of Generation	Solar
4.	Type of Technology	Single Axis Tracker with Bifacial Solar Modules
5.	System Type	Grid Tied
6.	Plant Capacity	15MWp

Site Coordinates:

The site coordinates are as follow:

Latitude (North)	Longitude (East)
24°42'58.0"N	67°34'09.5"E

4. Financial Overview

Project cost has been calculated after detailed analysis, evaluation and understanding of parameters that affect the development and operation of solar projects. The following table provides a breakdown of Project costs:

EPC Cost including Degradation	8,449,680
Non-EPC Cost	1,002,934
Insurance During Construction	32,700
Development Cost	318,522
Finance Fees & Charges	206,950
IDC	444,857
Total Project Cost (USD)	9,452,614

3(f)

Feasibility Study

With reference to the requirement as per clause, " Schedule III (Regulation 3(f)) *Feasibility Report" is attached.

Feasibility Study

15 MWp Gharo Newgen Solar Project
Deh Ghairabad, Mirpur Sakro, District Thatta, Sindh

August 2024

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1 Project Background

Gharo Newgen (Private) Limited (the "Company") is a special purpose company for the development of a 15MWp solar power plant. This plant will be strategically located in the licensed service territory of K-Electric Limited (the "K-Electric") which is a privately-owned power utility in Pakistan. K-Electric is solely responsible for provision of electricity to Karachi and its adjoining areas. The Company's initiative aligns with K-Electric's objective to diversify their generation mix and ensure the provision of cost-effective electricity to their end-consumers. The proposed solar project will be connected to the Gharo Grid Station in Gharo, District Thatta and will operate at an 11kV voltage. Their efforts will further support K-Electric's ongoing endeavors to provide sustainable and affordable power supply to their valued customers.

The project sponsors have a robust track record in the development, engineering, procurement, and construction (EPC), as well as operation and maintenance (O&M), of approximately 200 MW of installed projects. These projects encompass solar and biomass technologies within the country. The key sponsors' and CEO's profiles are as following: The key sponsors' and CEO's profiles are as following:

Rana Nasim Ahmed

Mr. Rana Nasim Ahmed is the main sponsor of the Company and will retain a minimum of 51% shareholding in the Company. He is also the main sponsor of Harappa Solar (Private) Limited, an 18 MWp solar project commissioned in October 2017. Harappa Solar was the first private sector solar power producer in Pakistan and pioneered the use of a single-axis tracking system in the country. Additionally, Mr. Ahmed is the main sponsor of Gharo Solar Limited, a 50 MWp solar project established in December 2019. Gharo Solar was the first power project in Pakistan with bifacial modules and the first within the K-Electric network to to be financed with a foreign development finance institution (DFI).

He also has minority shareholding in a listed sugar sector conglomerate in Pakistan. Mr. Ahmed has vast industrial experience of more than two decades of managing four sugar mills to the highest international standards. He has spearheaded high-pressure cogeneration in the sugar industry by leading the development, construction, and operations of the first-ever 2 x 26.5 MW (53 MW total) bagasse-based IPPs set up in 2014. These 53 MW biomass projects and two of the four sugar mills were set up as Greenfield ventures on expedited timelines in self-EPC mode with multiple contractors, suppliers and consultants managed by Mr. Ahmed.

Moreover, he has over fifteen years of experience managing equipment procurement and installation and leading commercial and operation and maintenance ("O&M") matters of 70 MW low-pressure, biomass and solar power plants. Mr. Ahmed obtained his master's degree (with distinction) from the University of the Punjab and his MBA from Saint Louis University, USA.

Rana Uzair Nasim

Mr. Nasim is the CEO of Gharo Newgen (Private) Limited. He has successfully led and managed solar, biomass and small hydro projects with capex of over USD 150 million. He is also serving as the CEO of Gharo Solar Limited and Harappa Solar (Pvt) Limited since their inception and is the primary point of contact for various stakeholders including local and foreign shareholders / lenders, regulatory and public-sector agencies, power purchasers, suppliers, and contractors.

He has first-hand experience of Greenfield project conceptualization and execution and has worked across different areas including design, policy and tariff development, tendering, financing, insurance, negotiation of project concession documents etc. He has also contributed to several important policy and regulatory developments in the broader renewable energy sector in Pakistan.

Mr. Nasim previously worked as a management consultant in New York with Oliver Wyman and Dalberg Global Development Advisors. He holds a BA in Economics and an MS in Management Science & Engineering from Stanford University, California, USA.

2 Power Market

2.1 Structure of Power Sector in Pakistan

Historically, the power sector in Pakistan has been owned and operated by government entities, primarily the Water and Power Development Authority ("WAPDA") until the drive to unbundle started in the early 1990s. Since then, the sector has evolved much with private sector involvement primarily in generation and more recently on the model of a fully vertically integrated utility company. The generation, transmission, distribution and retail supply of electricity in Pakistan is presently undertaken by a number of public and private sector entities comprising of one (1) national transmission company; ten (10) regional public sector-owned distribution companies; four (4) public sector thermal generation companies; one (1) public sector hydropower generation company and many Independent Power Producers. These entities enable the supply of power to the entire country except for Karachi. The metropolitan city of Karachi and some of its surrounding areas are supplied power by K-Electric, which is the only vertically integrated utility owned by the private sector responsible for the generation, transmission and distribution of electricity in its region.

Moreover, CPPA, previously residing within NTDC, has been converted into a legal, independent body acting as a central counterparty to power purchase transactions. The present form of the power structure in Pakistan is presented below:

2.2 Electricity Generation

In July 2023, power generation in Pakistan reached 14,839 GWh (19,945MW), showing a 4.9% increase from the previous year. This was a significant improvement from July 2022, when power generation was at 14,151 GWh (19,020MW). The rise in power generation was mainly due to a higher contribution from Re-gasified Liquid Natural Gas (RLNG) of 37.7%, followed by coal with 21%, and hydel with 11%.

Pakistan Power Generation Capacity

As on 30th June	2018	2019	2020	2021	2022	2023
Thermal	24,021	25,670	25,244	25,098	24,010	26,983
Hydropower	8,713	9,761	9,861	9,915	10,452	10,593
Nuclear	1,467	1,467	1,467	2,612	3,345	3,575
Renewables	1,779	2,247	2,147	2,147	2,725	2,598
Total	**35,980**	**39,145**	**38,719**	**39,772**	**40,532**	**43,749**

All figures in MW; Source: NEPRA State of Industry Report, 2023

The primary source of electricity generation in July 2023 was hydel, making up 37.2% of the power mix and surpassing all other sources. RLNG followed closely with 19.7% of the overall generation, while coal accounted for 14.7% of the power share. Nuclear energy contributed 14.2% of the total energy mix, while wind, solar, and bagasse generation made up 3.7%, 0.5%, and 0.3% respectively. Electrical energy generated in recent years by fuel type is presented in the table below:

Pakistan Energy Generation by Source

As on 30th June	2017-18	2018-19	2019-20	2020-21	2021-22	2022-23
Thermal	92,012	89,402	80,826	88,678	93,270	71,900
% Share	68.87%	65.24%	60.21%	61.76%	0.00%	52.09%
Hydel	28,069	33,096	38,699	38,800	35,546	35,274
% Share	21.01%	24.15%	28.83%	27.02%	23.07%	25.56%
Nuclear	9,050	9,136	9,898	11,090	18,294	24,055
% Share	6.77%	6.67%	7.37%	7.72%	11.87%	17.43%
Import	555	487	514	498	514	479
% Share	0.42%	0.36%	0.38%	0.35%	0.33%	0.35%
Renewables	3,907	4,918	4,305	4,522	6,432	6,321
% Share	2.92%	3.59%	3.21%	3.15%	4.18%	4.58%
Total	**133,593**	**137,039**	**134,242**	**143,588**	**154,056**	**138,029**

All figures in GWh; Source: NEPRA State of Industry Report, 2023

Pakistan is actively transitioning to cleaner energy, emphasizing nuclear power, renewables, and solar energy. With over 50 years of nuclear power experience and six plants producing 3,500 MW (12% of total power), the country seeks to reduce reliance on thermal fossil fuels

(61% of power generation). Global support for nuclear energy, termed a "Nuclear Resurgence," aligns with Pakistan's capacity.

Policies like the National Power Policy 2013, Power Generation Policy 2015, Alternative and Renewable Energy Policy 2019, and National Electricity Policy 2021 outline a roadmap for clean energy investments, including solar. These policies aim to cut dependence on imported fuels, fostering public-private partnerships. Pakistan's commitment to clean energy signifies a strategic move towards a more sustainable and environmentally friendly power sector. Thermal generation breakdown in the country in recent years is given in the table below:

Pakistan Energy Generation by Source (Thermal Fuel Mix)

	2017-18	2018-19	2019-20	2020-21	2021-22	2022-23
Gas + RLNG	50,842	58,824	46,950	49,678	47,488	41,834
% share of thermal generation	55.25%	65.80%	58.09%	56.02%	50.91%	58.18%
FO + HSD	28,947	13,854	7,909	10,998	18,722	8,094
% share of thermal generation	31.46%	15.50%	9.79%	12.40%	20.07%	11.26%
Coal	12,225	16,725	25,966	28,001	27,060	21,972
% share of thermal generation	13.29%	18.71%	32.13%	31.58%	29.01%	30.56%
Total	**92,014**	**89,403**	**80,825**	**88,677**	**93,270**	**71,900**

All figures in GWh; Source: PSS/NTDC/KE

Due to this skewed energy mix, it has now become imperative upon the power sector in Pakistan to move towards generation technologies that are sustainable and rely on indigenous resources.

2.3 Demand and Supply of Electricity

In Pakistan, since 2020, there has been a positive trend in the overall supply of electricity. The country has been able to achieve a surplus supply which peaked in 2023 at a surplus of 6,097 MWh.

However, if we dig deep and specifically review the performance of electricity suppliers within KE's network, there is still a shortfall that is appearing. Moreover, it is expected to remain at the same level in the next year as well. The following tables highlights KE's historic demand and supply gap and projected figures for the near future:

Historical Power Supply and Demand in NTDC system

Year	Generation Capability	Peak Demand	Surplus/(Deficit)
2019	24,565	25,627	(1,062)
2020	27,780	26,252	1,528
2021	27,819	28,253	(434)

2022	27,748	24,564	3,184
2023	30,574	23,679	6,895

All figures in MW; Source: NEPRA State of Industry Report, 2023

Projected Power Supply and Demand in NTDC System

Year	Planned Generation Capability	Projected Peak Demand	Surplus/(Deficit)
2024	33,953	27,302	6,651
2025	38,854	29,675	9,179
2026	40,595	31,227	9,368
2027	41,865	32,753	9,112
2028	43,180	34,438	8,742

All figures in MW; Source: NEPRA State of Industry Report, 2023

Historical Power Supply and Demand of K-Electric System

Year	Generation Capability	Peak Demand	Surplus/(Deficit)
2019	3,196	3,530	(334)
2020	3,202	3,604	(402)
2021	3,424	3,604	(180)
2022	3,383	3,670	(287)
2023	3,409	3,654	(245)

All figures in MW; Source: NEPRA State of Industry Report, 2023

Projected Power Supply and Demand in K-Electric System

Year	Planned Generation Capability	Projected Peak Demand	Surplus/(Deficit)
2024	3,678	3,879	(201)
2025	4,377	4,070	307
2026	4,426	4,252	174
2027	4,857	4,367	490

2.4 Key Organizations

2.4.1 National Electric Power Regulatory Authority ("NEPRA")

NEPRA Act, Rules & Regulations

NEPRA, the National Electric Power Regulatory Authority, plays a vital role in regulating the power sector. It is responsible for granting licenses, determining tariffs, monitoring compliance with quality standards, and resolving consumer complaints. NEPRA exercises its powers under the NEPRA Act, Rules, and Regulations, and reviews its own decisions to

ensure fair and informed decision-making. Through meticulous scrutiny and engagement with stakeholders, including consumers, NEPRA gathers valuable data and insights for well-informed decision-making in the public interest.

2.4.2 K-Electric ("KE")

KE is a privately-owned power utility which is solely responsible for provision of electricity to Karachi and its adjoining areas. Since privatization, KE has made continued investments in generation capacity, improving its fleet efficiency, and launching transmission and distribution enhancement programs.KE produces electricity from its own generation units with an installed capacity of 2,817 MW, and in addition, has arrangements with external power producers for around 1,668 MW which includes 1,100 MW from the National Grid.As of June 2023, KE has an installed capacity of 4,485 MW which is primarily dependent on imported RLNG, RFO and coal. Approximately, 98% of KE's energy requirements are met by thermal plants whereas its renewable energy share only stands at 2%. As a result, KE and its customers are facing the challenge of rising fuel prices due to the global increase in fuel prices and significant rupee devaluation. Due to the significant growth in Karachi's population and setting up of special economic zones and industrial parks, it is anticipated that KE's power demand has reached around 4,168 MW. To meet the increasing demand and rationalize its generation cost, KE plans to induct approximately 673 MW renewable plants by FY 2026 as per KE PAP. The planned projects will help KE to diversify its fuel mix benefiting consumers and the economy at large.

3 Applicable Framework & Policy

The Company intends to sell power to KE pursuant to Regulation 30 of the NEPRA (Electric Power Procurement) Regulations, 2022. Subsequently, the Company has successfully negotiated with K-Electric. As a result, KE had included the Project in its Power Acquisition Programme for FY 2024 – 2030 ("PAP") which have been approved by the Authority vide its order having reference no. NEPRA/R/Advisor(CTBCM)/LAS-22/PAP(K.E)/7271-75 dated May 17, 2024.

4 Solar Power

4.1 Solar PV Power Generation

As of 2024, Pakistan is making significant developments in its energy sector by prioritizing solar power. The country is advancing its solar energy initiatives with an ambitious plan aimed at deploying 9 GW of solar power by 2030. This plan includes 6 GW from large-scale projects, 2 GW from medium-scale projects, and 1 GW from rooftop solar installations. Currently, Pakistan's total installed electricity capacity stands at 42,131 MW, with renewable sources contributing 6.8% of this capacity. This shift reflects a strategic emphasis on developing indigenous and renewable energy resources.

As of 2024, global solar photovoltaic (PV) capacity has continued to expand significantly. The total cumulative capacity has now exceeded 1,300 gigawatts (1.3 terawatts), up from 1,177 gigawatts in 2022. This growth reflects a consistent annual addition of around 250 gigawatts of new capacity, with 2023 and 2024 both seeing substantial contributions to this increase.

China remains the dominant player in the solar PV market, leading with a cumulative capacity of over 350 gigawatts, while the United States follows with approximately 140 gigawatts. Regions like Chile and Honduras continue to stand out for their high percentage of electricity consumption covered by solar power, driven by ongoing investments and supportive policies. The sector has also benefited from technological advancements, including improved efficiency of photovoltaic cells, the introduction of bifacial panels, and better energy storage solutions, all contributing to the growth and effectiveness of solar power worldwide.

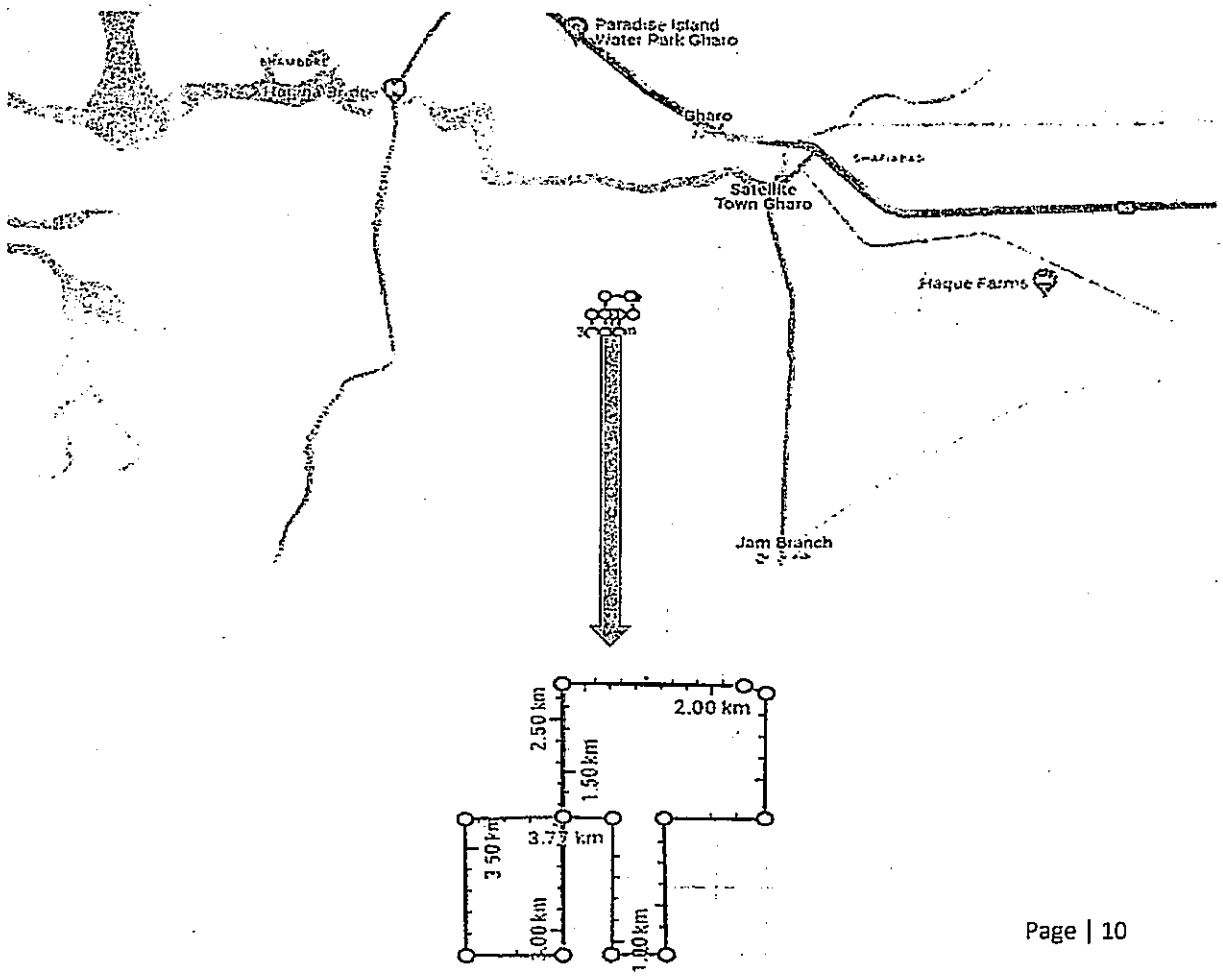
4.2 Project Site and Location

The Project Site is located near the town of Gharo at Deh Ghairabad, Mirpur Sakro, District Thatta, Sindh approximately 6 km along the Sindh Coastal Highway and then approximately 1.25 km via connecting road from the Highway. The Site is about 55 km away from Jinnah International Airport, Karachi.

Site Coordinates:

The site coordinates are as follow:

Latitude (North)	Longitude (East)
24°42'58.0"N	67°34'09.5"E



5 Plant Type and Technology

5.1 Technology Overview

It is proposed to install a 15 MWp solar power plant with 12 MWac on-grid inverters. The Project shall be interconnected with the KE network through an 11kV transmission line. A conceptual diagram is provided below:

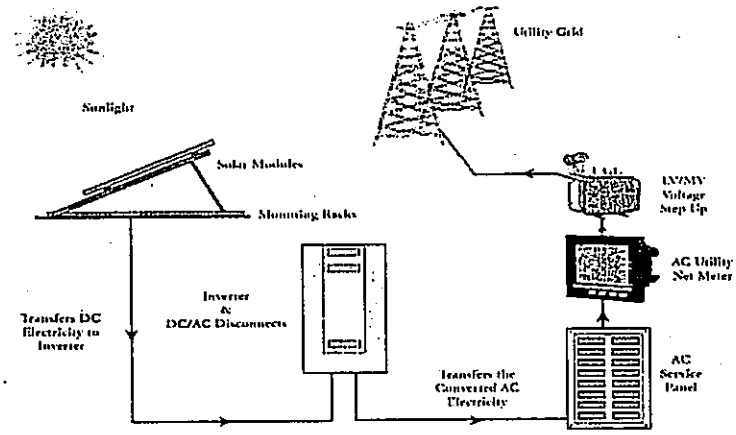


Figure 1 - Conceptual diagram of Technology used.

The final selection of the equipment shall be based on detailed technical and financial feasibility. The following sections give an overview of the technical scheme and key components of the Project.

5.2 Solar PV Modules

Solar PV modules shall be used to harness solar energy and convert it to electric power. The PV modules shall be connected in series to form a string and then multiple strings shall feed to String Combiner Box.

At present, Mono Crystalline Bifacial Technology is prevalent market technology, however the Company shall evaluate all bankable technological options available in the market. The final selection shall be based on the best yield and the lowest cost of electricity.

5.3 Mounting Structure

The PV modules shall be installed on a horizontal single axis tracking system which shall have a built-in algorithm to track the sun. The aim is an optimized positioning of the module surface to the sun during the day and ultimately, increase the total solar irradiation onto the module surface. The tracking system shall be ground mounted and pile-type foundations shall be used for the purpose.

5.4 Inverters

The PV modules shall generate DC power, which shall be converted to AC power through inverters. Since the Project shall feed electricity to the grid and therefore, on-grid type inverters shall be installed at the plant. Apart from simple AC/DC conversion, the inverter shall also condition the power and make electricity compliant with the grid code requirement.

5.5 Inverter Transformers

A simple yet highly efficient and integral component not only on solar farms but in general, all transmission and distribution networks are transformers. The transformer shall take the output from the inverters and step-up the power to 11kV voltage. The higher voltage enables electricity to be transmitted economically over large distances with minimum loss of energy.

5.6 Cables

AC/DC cables are the means of transportation of electricity from one point to another, for example, from string combiner boxes to inverters and then to inverter transformers and finally to 11kV substation. During the transfer of electricity, the losses are unavoidable, however sufficient sizing and consideration shall reduce the losses. Further, the conversion of electricity to high voltage i.e., 11kV /low current by transformers shall also help in loss reduction

5.7 11kV Substation

This is the grid connection interface, where the electric power shall be collected and exported to the grid network. The substation shall primarily consist of 11kV switchgear, control / protection system and AC/DC aux power system etc.

5.8 Monitoring

Monitoring of grid-connected solar power plants shall be conducted locally as well as remotely through the internet. An expert control room shall be established at the plant which shall enable the operator to real-time monitoring of the solar plant. The monitoring shall be performed 24/7 and shall pinpoint faults in individual components causing production loss.

5.9 General Design

Solar PV plants can be designed for any capacity right from a fraction of kW rating for roof top installation to hundreds of MW capacity for ground mounted plants by repeating modular blocks. The schematic below depicts the typical configuration of a utility-scale solar plant.

Major components of utility-scale systems are:

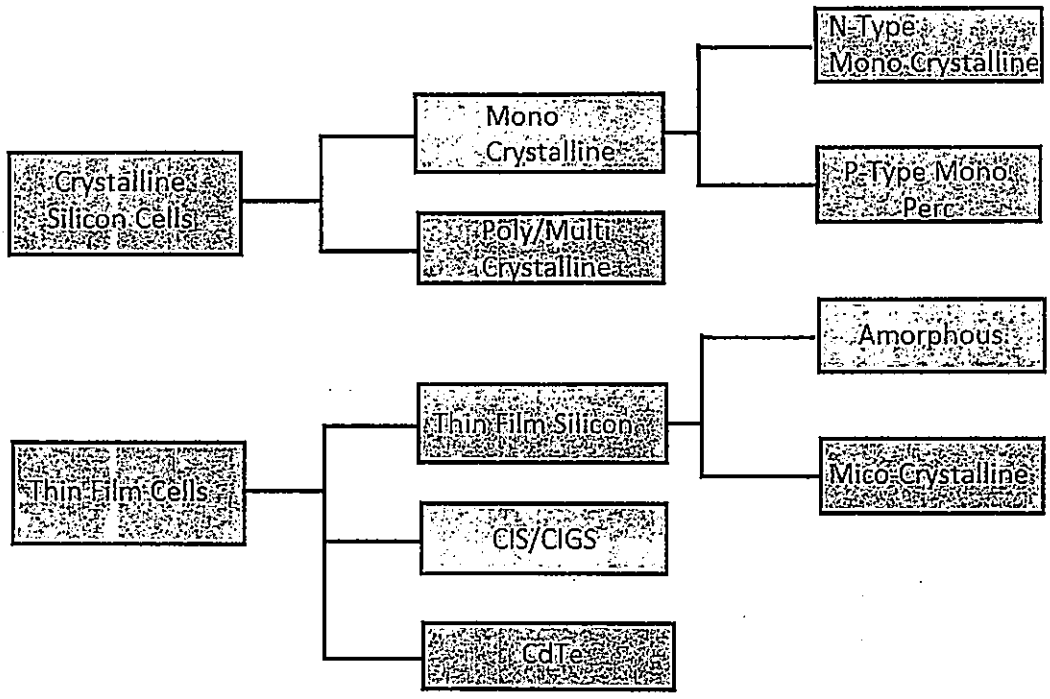
- Solar Modules / Panels
- Module Mounting Structures (fixed or tracking)
- Solar Inverters
- Balance of Systems (BoS) comprising of
    - DC Cables
    - String Combiner Boxes
    - AC Cables
    - Transformers
    - HT Panels / RMU units
    - SCADA & Monitoring System
    - Earthing system
    - Illumination system
    - Module cleaning system
    - AC / Ventilation System for inverter rooms
- Civil works including foundations, inverter rooms, leveling, grading, fencing, etc.
- Power evacuation systems include step-up transformers, switchyard, tariff metering arrangement, etc.

The scheme proposed for evacuation of power from the Gharo Newgen to KE grid comprises 11 kV circuits.

In the Photovoltaic category, PV panels without concentrators are widely used. These panels are either with fixed tilt or manual seasonal tilt or single axis / dual axis tracking arrangements. Fixed tilt arrangements are in the majority; however, single axis trackers are also gaining in popularity due to the gain in generation over fixed tilt systems.

In PV plants, two broad types of panels are used:

- (Mono crystalline) bifacial panels, which will have cells in series/parallel assembled in each module / panel.
- Thin film panels, made by depositing extremely thin layers of photosensitive materials in nano-micrometer range on a substrate (mostly glass). Amorphous Silicon (a-Ci) / micromorph silicon (A-Si/μC-Si), Cadmium Telluride (CdTe), Cadmium Indium Selenide (CIS) / Cadmium Indium Gallium Selenide (CIGS) are different types in thin film technology.



- Bifacial modules represent a promising technology for increasing PV system's lifetime generated electricity. Their core innovation is the ability to capture and utilize light from both sides of the modules.

6 Design and Specifications of the Plant

It is proposed to install 15MWp capacity Solar PV plant with Bifacial solar PV modules with single axis trackers and central inverters. The tracker will be with tilt angle +/- 55 Deg. Generated power shall be stepped-up to 11kV through inverter transformers and then connecting the output to KE Grid, as shown in the attached Single Line Diagram.

6.1 PV Modules

It is proposed to consider an average of 630Wp Mono Crystalline bifacial modules, from Tier-1 PV module manufacturers (Longi Solar or JA Solar or equivalent). The modules shall be protected by high transmission tempered glass covered on both sides with anodized aluminum alloy frames. Serially connected cells shall be terminated to IP65 junction boxes at bottom with 4 and 6 sq.mm multi-strand copper cables. Positive & Negative terminals shall be terminated with MC4 connectors, for making module interconnections.

Design Parameters:

Typical parameters of the modules (Based on JA Solar technical data sheet):

Electrical Parameters	JAM72D42-630/LB
Maximum Power (Pmax)	630 Watt
Module Type	Mono Crystalline, Bifacial
Module Efficiency	22.5%
Maximum Power Current (Imp)	14.35A
Maximum Power Voltage (Vmp)	43.9V
Short Circuit Current (Isc)	15.21A
Open Circuit Voltage (Voc)	52.47V
Operating Temperature	-40 °C to + 85 °C

6.2 Solar Inverters and Auxiliaries

6.2.1 Solar Inverters

Solar inverters represent critical equipment in the Solar PV plant, as the reliability and performance of the inverters greatly influences the overall plant generation. It is proposed to use 3 Central Inverters, out of three (3) central Inverter two (2) Inverters have a nominal rated capacity of 4.4MW and One (1) Inverter have a rated capacity of 3.3MW. Negative earthing in inverters & Anti-PID kits shall be planned to counter PID effect for the modules. Inverters are expected to be from Sungrow or equivalent and shall meet the performance requirements stipulated in the national Grid Code for Solar Power Plants and requirements of K-Electric.

Parameters (typical) of the proposed inverter:

Input (DC)

Description	Data
Max. DC power	3.3MW, 4.4MW
Max. input voltage	1500 V
MPP voltage range for nominal power	895V - 1500V

Output (AC)

Description	Data
Rated normal power	3399 kVA @ 40 °C, 4532kVA @ 40°C
Nominal AC voltage	3 / PE, 630 V
AC frequency / range	45-55 Hz
Max. output current	219.2A, 292.2A

6.2.2 PV DC Cabling

The modules will be connected with DC cables, in series & parallel combinations and hooked-up to Inverters. A total of 882 strings (27modules per string) shall be connected with the inverters of capacity 12MW.

6.2.3 Inverter Transformers

It is proposed to use twin secondary oil filled transformers for stepping up the power generated from PV system, by connecting one LT panel per Primary. The transformers intended for connecting to the Solar Inverters shall confirm to IEC:60076. The transformers will be as per the following specification:

Parameter	Data
Number of transformers and rating	2 Nos. of 4.4 MVA & 1 Nos. of 3.3MVA
Cooling	ONAN
Ratio	11/0.63-0.63 kV
Transformer Vector	Dy11
Impedance	7% , 8%

6.2.4 HT Panels

It is proposed to provide 11 kV Main Switchgear at Plant Main Control building and One (1) RMU near the inverter station which will connect two (2) inverter transformers while the 2nd RMU panel will be coupled with MV Switch Gear Total, three (3) no's of outdoor inverter stations are planned with outdoor 11kV two RMU panels which will be connected to the main 11kV switchboard in control room. Brief parameters of 11 kV switchboards shall be as given below:

Parameter	Data
Rated Voltage	11 kV, 3 Phase, 50 Hz
Maximum Voltage	12 kV
Power frequency Voltage	28 kV rms
Impulse withstand Voltage	75 kV peak
Short time rating	26.2 kA for 3 Sec
Maximum bus bar temperature	85 Deg. C

6.2.5 Power Evacuation System

Power evacuation to the National grid through plant metering yard shall be planned, by providing outgoing feeders from the main 11 kV bus bar.

6.3 Monitoring System and SCADA

Monitoring of system operation parameters shall be arranged locally and also from remote locations through internet. Weather monitoring station, for irradiance, DHI measurement, wind velocity & ambient temperature, String currents, Inverter Parameters, Transformer protections and temperature, HT Panel parameters, Export & import (auxiliary) energy and Perimeter Security through CCTVs & alert systems are hooked-up to SCADA system. Also, there will be a separate PLC based SCADA system for monitoring/controlling tracker system.

6.4 Module Cleaning System

Module cleaning system shall be envisaged for spraying the soft water over the modules manually by providing storage tanks, water pumps, high pressure piping network & valves. This cleaning process is to be carried out periodically depending upon the intensity of dust deposition over the PV modules. As an alternative, automated cleaning system shall also be evaluated and considered depending on techno commercial viability.

6.5 A/C and Ventilation System

Suitable Air Conditioning or Ventilation (Wet or Dry pressurized) system shall be envisaged for the Inverter & control rooms.

6.6 Water Source

The raw water for the plant is required for meeting the module cleaning requirements (after treatment, if required) will be drawn from Bore wells.

6.7 Civil and Structural Works

The proposed single axis tracker will have 1 module stacked vertically in portrait orientation, one string comprising 27 modules connected in series (individual tracker dimension will be 93.14m x2.4 m) and distance between trackers will be 5.5 Mtrs (Ground Coverage Ratio, GCR of 44.8 %). The Tracker will be with tilt angle of +/- 55 Deg.

Main columns of these tracker steel panel tables will be with galvanized MS hot rolled sections / GI cold formed sections / Magnelis or equivalent, while the rafters cross bracing & purlins will be with GI cold formed sections / galvanized / Magnelis steel tubes or equivalent. Structural materials foundation bolts, fastening bolts, screws, nuts, washers shall conform to the relevant International Standards. All mild steel members (inner & outer surface area) will be electro galvanizing/hot dip galvanizing and will be further painted to meet the corrosion category of C5.

6.8 Firefighting System

The function of fire-fighting system is to supply water to the main risk areas of the solar power plant.

The fire protection system is required for early detection, containment and suppression of fires. A comprehensive fire protection system shall be provided to meet the above objective and all statutory and insurance requirements of the National Fire Protection Association (NFPA).

The fire-fighting system shall consist of the following:

6.8.1 Portable Fire Extinguishers

Dry Chemical Powder, CO_2 and foam-type extinguisher system shall be provided. The equipment shall be designed as per NFPA 10.

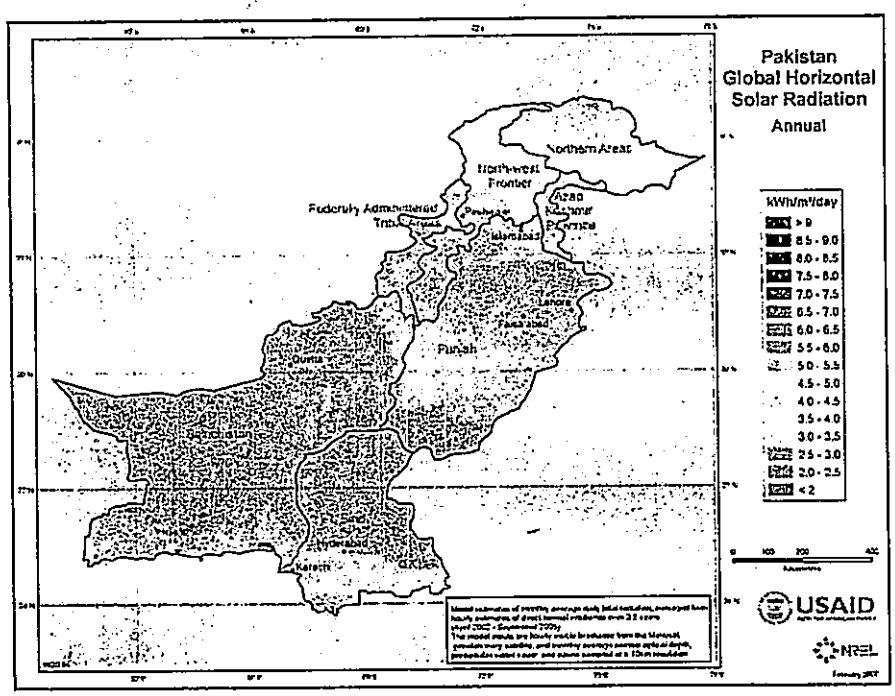
6.8.2 Fire Alarm & Detection System

Fire detection system for the solar power plant will provide early detection of fire and raise alarm. A comprehensive fire protection system shall be planned to meet the above objective and meet all statutory and insurance requirements of the National Fire Protection Association (NFPA). A multitude of systems will be provided to combat various types of fires in different areas of the plant and all such systems for various areas shall form a part of a centralized protection system for the entire plant. Fire alarm system detection system shall be provided in following areas:

- Firm alarm and signaling in all electrical/instrumentation panel rooms.
- Manual call points and Electric Horns in outdoor areas.

7 Meteorological & Climate Data, Yield & Variability Analysis

Pakistan lies in an area of one of the highest solar insolation suitable for solar technology. The immense solar resource remains largely untapped. The solar irradiation map of the region showing the average insolation (Global Horizontal Irradiance in kWh/m2/day) values is given here below:



The Company has used weather data inputs from Solargis and Metenorm due to its better precision and high time resolution. Under World Bank program, the Solargis data has been validated at 9 different locations in Pakistan, resulting low uncertainty and more dependability on the data. The average irradiance data (GHI) based on long term analysis is given below for quick reference:

Month	Global Horizontal Irradiance Data (KWh/m2)	
	Meteonorm 8.1	Solargis
Jan	124.9	137.2
Feb	136.9	150.3
Mar	180.0	196.9
April	195.2	212.7
May	204.8	218.4
June	181.8	186.7
July	142.0	148.1
Aug	138.5	143.6
Sept	156.4	166.3
Oct	154.3	172.6
Nov	130.7	139.5
Dec	117.7	129.6
Total	1863.2	2001.9

Figure 2 - Average Irradiance Data

7.1 Projected Yield for Solar

As part of the project feasibility, the Company intends on performing a bankable energy yield assessment for the Project. The results of the initial yield assessment are provided in Annex C. The Project is expected to produce 30.024 million units during the first year of production.

7.2 Solar Irradiation

Pakistan lies in an area of one of the highest solar insolation suitable for solar technology. The immense solar resource remains largely untapped. The solar radiation maps of the region (Source: NREL) show the average insolation (Global Horizontal Irradiance in KWh/Sq.M/day) values, as below:

Description	Data
Northern parts of Baluchistan	5.5-6.5 KWh/Sq.M
Central & East Baluchistan, Southern parts of Punjab & North & North- East parts of Sindh	5.0-5.5 KWh/Sq.M
Major parts of Punjab (other than north-west zone), Central parts of Baluchistan & Sindh	4.5-5.0 KWh/Sq.M

Site selection and planning of PV power plants requires reliable solar resource data. The solar resource of location is usually characterized by the values of the global horizontal irradiation, direct normal irradiation and diffuse horizontal irradiation as defined below:

7.2.1 Global Horizontal Irradiation (GHI)

GHI is the total solar energy received on a unit area of horizontal surface. It includes energy from the sun that is received in a direct beam and from all directions of the sky when radiation is scattered off the atmosphere (diffuse irradiation). The yearly sum of the GHI is of particular relevance for PV power plants, which are able to make use of both the diffuse and beam components of solar irradiance.

7.2.2 Direct Normal Irradiation (DNI)

DNI is the total solar energy received on a unit area of surface directly facing the sun at all times. The DNI is of particular interest for solar installations that track the sun and for concentrating solar technologies as concentrating technologies can only make use of the direct component of irradiation.

7.2.3 Diffuse Horizontal Irradiation (DHI)

DHI is the energy received on a unit area of horizontal surface from all directions when radiation is scattered off the atmosphere or surrounding area.
Variability and characteristics of solar radiation are influenced by a number of factors. Many reasons, such as day-night cycle, seasonal cycle, and shading by cloud formations or surrounding terrain, are quite obvious. Others are not so easy to track e.g. content of water vapor and aerosols in the atmosphere, thickness of ozone layer, etc. In the past only, simple observations were possible.

7.2.4 Solar Irradiation Data through Solargis:

The Solargis database is a high-resolution database recognized as the most reliable and accurate source of solar resource information. The data is calculated using in-house developed algorithms that process satellite imagery and atmospheric and geographical inputs.

Solar GIS Satellite based data is on hourly basis and most appropriate data to represent the irradiation profile. Hence, the values from Solar GIS are considered as higher accuracy than other owing to the following points:

- Hourly data series, as other GHI data from Meteonorm and other sources under are of monthly series.
- Solar GIS methodology enhances accuracy of predicted irradiance data to better match terrestrial irradiance measured by the ground-based station.
- Particularly, the higher spatial resolution leads to the ability of distinguish irradiance level within small geographical boundary while half hourly temporal resolution and daily average atmospheric optical depth inputs can estimate irradiance in line with the dynamic variation in diurnal atmospheric condition.
- Solargis recently validated its resource data for Pakistan with on-ground measurements. The project was supported by the World Bank.

Solar irradiation data for the proposed site made available in Solargis is given below:

Months	Global Horizontal Irradiation kWh/m2	Ambient Temperature °C	Global Inclined Irradiation kWh/m2
January	137.2	19.1	173.6
February	150.3	22	188.5
March	196.9	26.1	247.1
April	212.7	29.2	261.5
May	218.4	30.9	262.8

June	186.7	31.5	215.2
July	148.1	30.2	164.7
August	143.6	29.1	160.1
September	166.3	29.2	201.4
October	172.6	29	216
November	139.5	25.2	175.9
December	129.6	20.39	162.1
Total	**2001.9**	**26.84**	**2428.9**

Solargis data file for project location is attached with this report as Annexure-4 for reference.

For computation of yield analysis, solar irradiance and other values from Solargis have been considered in this report.

7.3 Solar Yield Analysis using PVsyst:

The PVsyst software, widely being used by most of the developers, has been used to ascertain yield and performance of the systems / options considered in this report.

Yield from the Solar system varies depending on the following factors:

- Direct Irradiance
- Tilt and Facing of the module with respect to Sun.
- Selection of Solar PV Technology and Make of the module.
- Inverter Type and Make
- Cable sizing and cable losses
- Grid availability.

7.3.1 Losses considered for Yield Calculation:

PVSYST calculates the direct current (DC) electricity generated from the modules in hourly time steps throughout the year. This direct current is converted to alternating current (AC) in an inverter. A number of losses occur during the process of converting irradiated solar energy into AC electricity. Some of these losses are calculated within the PVSYST software, whilst others are assumed figures based on the performance of similar PV plants. The losses are described in the following subsections.

(a) Incident Angle Losses

The incidence angle loss or "Incidence Angle Modifier" (IAM) accounts for losses in radiation penetrating the front glass of the PV modules due to angles of incidence other than perpendicular. This loss is derived from the ratio of direct and diffuse radiation, sun angles and the tilt of the modules.

(b) Low Irradiance Loss

The conversion efficiency of a PV module reduces at low light intensities. This causes a loss in the output of a module compared with the standard conditions at which the modules are tested (1000 W/Sq.M). This "low irradiance loss" depends on the characteristics of the module and the intensity of the incident radiation.

(c) Module Temperature

The characteristics of a PV module are determined at standard temperature conditions of 25°C. For every 1°C temperature rise above 25°C there is reduction in performance of modules. This temperature dependent performance differs for different PV technologies.

(d) Module Quality

Most PV modules do not match exactly the manufacturer's nominal specifications. Modules are sold with a nominal peak power and a given tolerance within which the actual power is guaranteed to lie. In practice PV modules usually lie below the nominal power but within the tolerance.

(e) Module Mismatch

Due to the inherent inaccuracy of the silicon photovoltaic cell manufacturing process, PV modules, expected to have the same electrical features, will not be identical. This (relatively small) heterogeneity among modules is at the basis of the mismatch loss. The mismatch loss depends both on the specific PV modules used for the project and on the procedure followed to assemble the modules on site.

(f) DC Cable Resistance

Electrical resistance in the wires between the power available at the modules and at the terminals of the array gives rise to ohmic losses (I^2R).

(g) Inverter Performance

The inverters used at any PV plant convert from DC power into AC power with a maximum efficiency of 99%. The same is reflected in the Inverter datasheet. However, depending on the inverter load, they will not always operate at maximum efficiency.

(h) Soiling

In order to produce maximum energy on any given day, it is best to keep the panels clean at all times. The cleaning of modules will depend on the rainfall and cleaning strategy defined in the O&M contract; thus, it may not be possible to keep the panels clean all the time. Unless a particularly robust cleaning strategy is employed, the soiling loss for horizontally mounted modules may be expected to be higher than modules that are inclined, as inclined modules will benefit more from the cleaning effect of rainwater run-off.

(i) Degradation

The performance of a PV module can decrease over time. The degradation rate is typically higher in the first year upon initial exposure to light and then stabilizes. The extent of degradation and the process by which it occurs varies between module technologies.

The initial degradation occurs due to depreciation in the cell, which are activated on exposure to light. The subsequent degradation occurs at the module level and may be caused by:

- Effect of the environment on the surface of the module e.g. pollution
- Mechanical stress and dampness on the contacts
- Cell contact breakdown
- Wiring degradation
- Factors affecting the degree of degradation include the quality of materials used in manufacture, the manufacturing process, and also the O&M regime employed at the site.

7.3.2 PVsyst Inputs

The following table indicated the inputs considered for the PVsyst analysis:

Description	Values
Site Co-Ordinate	24°42'58.0"N+67°34'09.5"E
Plane Tilt	+/- 55Deg
Pitch	5.5Mtrs
Collector Band Width	2.47 Mtrs
Meteo Data	Solargis - 2001.9kWh/m2

7.3.3 Loss Distribution in PVSYST simulation

The following table gives the extract of loss distribution in yield simulation –

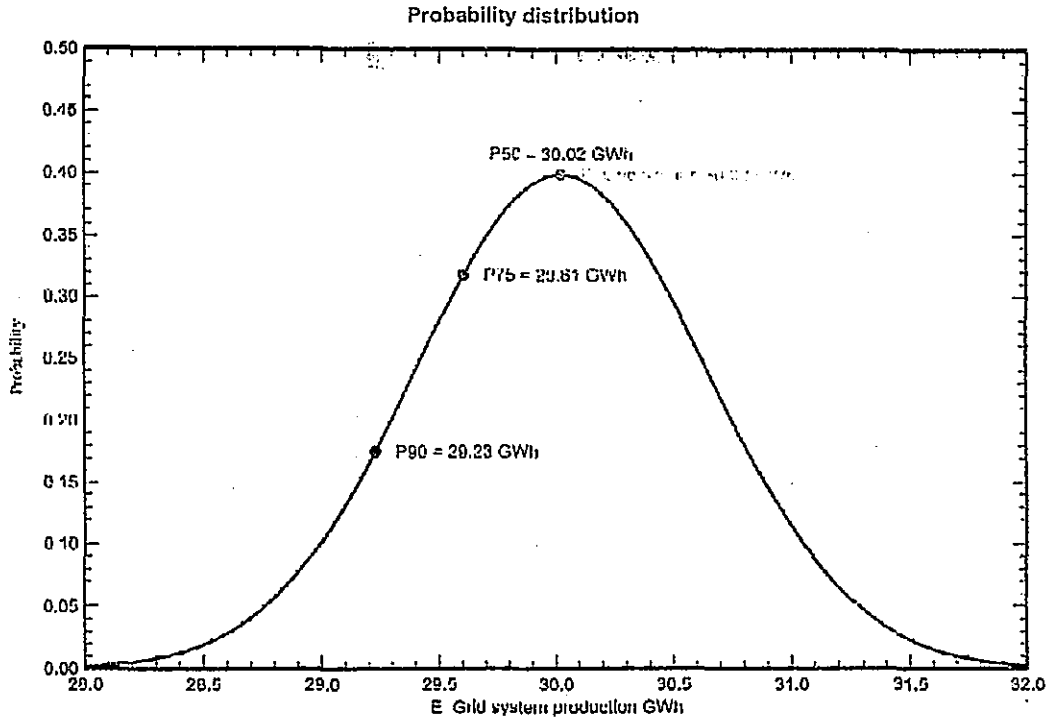
Consideration - JA 630 Wp Mono Bifacial Module / GCR: 44.8% / Tracker elevation: 0.6 m. 1P arrangement / Sungrow 4.4MVA & 3.3MVA inverter

Description	Loss – Using Solar GIS
Horizontal Global Irradiation	2002 kWh/m2
Global incident in coll. Plane	(+)21.3%
Near Shading	(-)2.11%
IAM Factor	(-)2.00%
Soiling Loss Factor	(-) 3.0%
Ground Reflection from Front Side	(+)0.29%
PV Loss due to Irradiance Level	(+)0.4%
PV Loss due to Temperature	(-)6.51%
Light Induced Degradation	(-) 1.0%
Module Quality Loss	(+) 0.7%
Mismatch	(-)1.1%
Mismatch for Back Irradiance	(-)0.71%
Ohmic Wiring Loss	(-)1.15%
Inverter Loss during Operation	(-)1.4%
Inverter Loss over nominal inverter power	(-)0.01%
AC Ohmic Loss	(-)0.25%
External Transformer Loss	(-)1.53%
Auxiliaries (fans, others)	(-)0.58%
System Unavailability	(-)1.09%
Energy Injected into Grid, for 15002.82 kWp modules	30024191 kWh
Performance Ratio (After the Losses)	82.39%

7.3.4 Probabilistic evaluation of forecast production using Solargis:

The forecast generation by solar power plants is mainly dependent on the Meteo data used for the simulation, which has natural variation due to change in weather patterns from year to year. Additional uncertainty results from variation in system parameters (module degradation, soiling etc.). Simulations for solar generation can be expressed in terms of different probabilities of exceedance e.g. P50, P75, P90. Typically, either P75 or P90 is used for risk / financial analysis or the P50 value is used with conservative assumptions for system losses.

Description	Data (Solargis)
Year-Year variability variance	-1.0%
Deviation of System Parameters Uncertainties	
PV module modelling/parameters	1.0%
Inverter efficiency uncertainty	0.5%
Soiling and Mismatch uncertainties	1.0%
Degradation uncertainty	1.0%
Global Variability (Meteo+System) Variance	2.1% (Quadratic Sum)
Annual Production Probability	P50 – 30.024 GWh P75 – 29.610 GWh P90 – 29.230 GWh



Probability Graph – Solargis

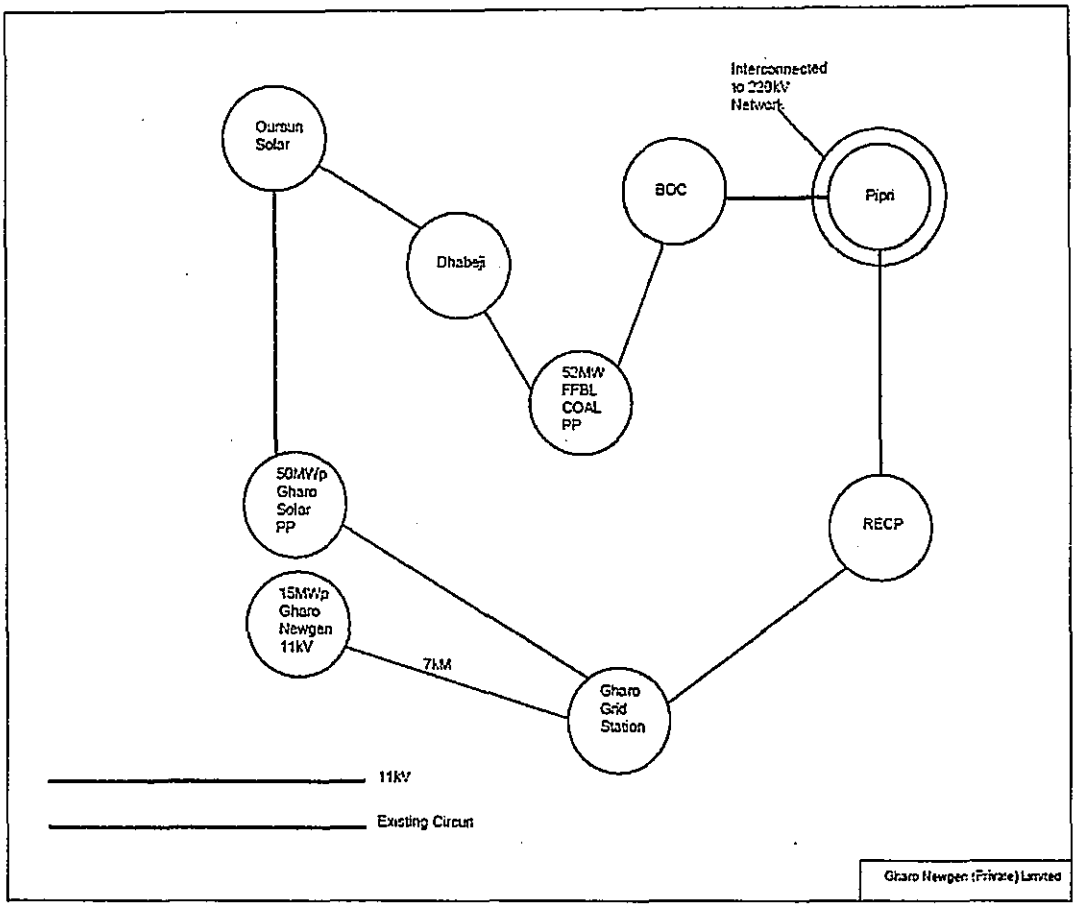
Note: PVsyst analysis report for the above arrangement and yield is attached with this report as Annexure-

8 Grid Interconnection

8.1 Interconnection Arrangement

The electric power generated from the Generation Facility/Solar Power Plant of the Company shall be dispersed to the load center of K-Electric.

The proposed Interconnection Arrangement/Transmission Facility for dispersal of electric power comprises the direct 11 kV lines of approximately 7-8 km length to be laid from the 11 kV bus bar of the Generation Facility/Solar Power Plant to the Gharo Grid Station.



9 Operations and Maintenance (O&M)

Operation & Maintenance for a Solar PV Plant is relatively straightforward and less intensive compared to other power generation technologies. The operations shall be managed by either a third-party O&M consultant or an in-house technical and operational expert team, well-equipped with required capabilities. Most O&M functions shall be performed by permanent staff and the operation of the facility will be automated, supervised and controlled by SCADA.

The operation team shall operate and monitor the facility in accordance with Prudent Utility Practices, applicable standards and the manufacturers' recommendations.

Operations and Maintenance tasks shall include:

- Periodic cleaning of PV Panels (few times per month).
- Periodic operational checks and tests of equipment in accordance with OEM recommendations.
- Regular plant inspections.
- Routine maintenance services.

- Implement and regulate the facility's preventive and corrective maintenance program.
- Critical / non-critical reactive repairs.
- Plant security covering entire fenced area.
    - General shift operations for coordinating plant operation, maintenance & liaison with power purchaser; and
    - Maintain critical spares for plant & equipment.

10 Key Operating Assumptions

The following sections provide a summary of the general, project cost, operating and financing assumptions related to the Project. The feasibility has been prepared following a detailed discussion of these assumptions with Project sponsors. The proceeding sections discuss the following assumptions:

- Plant Generation
- General & Timeline
- Project Cost
- Financing Assumptions
- Project Tariff & Revenue
- Financial / Economic Analysis

11 Plant Generation Parameters

Key generation parameters as per PVsyst simulations are summarized below. The value for plant factor of 22.85% has been assumed for financial projections.

Expected Generation at Different Probabilities

Probability Level	Generation (MWh)	Plant Factor
P50	30,024	22.85%
P75	29,610	22.53%
P90	29,230	22.24%

11.1 Project Timeline

A construction period of 8 months following financial close has been assumed for the Project. Financial Close is targeted in January 2025 with a target Project commercial operations date ("COD") of September 2025. A schedule of activities and key milestones is provided in table below.

Project Timeline

Period	Tasks
July 2022 to June 2023	✓ Incorporation of Project Company
	✓ Identification of Project land and initial yield study
	✓ Land acquisition
July 2023 to June 2024	✓ Inclusion in KE Power Acquisition Program (PAP)
	✓ Approval of Project in PAP by the Authority (NEPRA)
July 2024 to November 2024	... Contractor/supplier negotiation and selection
	... Tariff submission and approval
	... Concurrence application and approval
	... EPA finalization with KE and NEPRA approval
	☐ Lenders' due diligence
December 2024	☐ Financial Close
January 2025	☐ Commencement of works and supply
August 2025	☐ Project Commissioning

✓ Completed ... In Progress ☐ To be initiated

11.2 Project Life

As per the standard energy purchase agreement ("EPA") the Project life and EPA term has been assumed as 25 years from COD and all equipment is being procured corresponding to the same.

11.3 Project Cost

The break-down of the estimated Project Cost is provided below in table. The project cost is based on an estimated PKR/USD exchange rate of PKR 300/USD.

Estimated Project Cost

Estimated Project Cost	USD million	PKR million
EPC Cost	8.1	2,430
Other Costs	1.074	322.2
Duties & Taxes	1.026	307.829
Project Cost	**10.2**	**3,060**
EPC Cost per MW	0.540	
Project Cost per MW	0.677	

11.4 Project Financing

The Project financing will be based on a debt-to-equity ratio of 80:20. Under the base case financial projections, debt is assumed to be 100% foreign financed. The lenders have been selected and financial terms have been negotiated. Foreign debt shall be

repaid in 14 years after COD amortized over the period through fixed annuity-based installments.

Key parameters of the Project funding are provided in table below:

Project Funding

Project Cost	PKR 3,060 million
Debt	PKR 2,448 million
Equity	PKR 612 million
Lending Rate (Foreign)	SOFR (4.5%) plus Margin (4.5%) (Total 9.0% fixed)
Repayment Period	14 years

11.5 Project Tariff

Key Assumptions for Tariff

Description	Basis
EPC cost per MW	USD 540,000
Project Cost per MW	USD 676,771
Construction Period	8 months
Exchange rate (PKR/USD)	300.0
Plant Factor	22.85%
Expected Annual Generation	30,024,900 MWh
Assumed Degradation per annum	0.40%
O&M Cost per annum	USD 12,500 per MW
Debt to equity ratio	80:20
Return on Equity (IRR based)	13.0%
Loan Repayment Period	14 years
Repayment Frequency	Quarterly
Foreign Debt Cost	SOFR (4.5%) plus 4.5% (Total 9.0% fixed)

Based on the above assumptions the respective tariff components along with relevant indexations are provided in table below:

Tariff Details

Description	Tariff Components PKR per kWh Year 1-14	Year 15-25	Indexation
O&M	1.9004	1.9004	US CPI, Local CPI, PKR/USD Parity

Description	Tariff Components PKR per kWh Year 1-14	Year 15-25	Indexation
Return on Equity	2.6667	2.6667	PKR/USD Parity
Insurance	0.4105	0.4105	N/A
Debt Servicing Component	9.9157		KIBOR, SOFR, PKR/USD Parity
Total Tariff	14.8933	4.9776	
Levelized Tariff	12.9489		

11.6 Project Revenue

The Project shall be exclusively selling all energy generated to K-Electric Limited under a 25-year Energy Purchase Agreement ("EPA"). The EPA shall be based on the tariff determined by NEPRA, which shall be adjusted on a quarterly basis as per the above-mentioned indexation mechanism. The financial projections summarized below show that the Project is expected to generate positive earnings before interest, taxes and depreciation (EBITDA) and net profits throughout its life and have favorable financial ratios.

Projected Financial Statements

	Year 1	Year 5	Year 10	Year 15	Year 20
Balance Sheet (PKR in Million)					
Fixed Assets	2,771	2,196	1,621	1,045	470
Receivables	191	66	107	59	97
Total Assets	**2,962**	**2,262**	**1,728**	**1,104**	**567**
Long Term Debt	2,705	3,268	2,343	-	-
Working Capital	54	100	165	-	-
Paid Up Capital	620	620	620	620	620

Retained Earnings	(417)	(1,727)	(1,400)	483	(54)
Total Liabilities & Equity	**2,962**	**2,262**	**1,728**	**1,104**	**567**
Cashflow Statement					
Cashflow from Operating Activities	214	387	895	510	886
Cashflow from Financing Activities	(110)	(283)	(727)	-	-
Cashflow during the year	**104**	**103**	**168**	**510**	**886**
Key Ratios					
Interest Coverage Ratio (Times)	1.76	2.35	4.99	-	-
Debt Service Coverage Ratio (Times)	1.21	1.20	1.20	-	-
Loan Life Coverage Ratio (Times)	1.25	1.42	1.91	-	-
Project Life Coverage Ratio (Times)	1.80	2.05	2.75	-	-

12 Annexure-1: Plant Layout

Attached in PDF format as separate file.

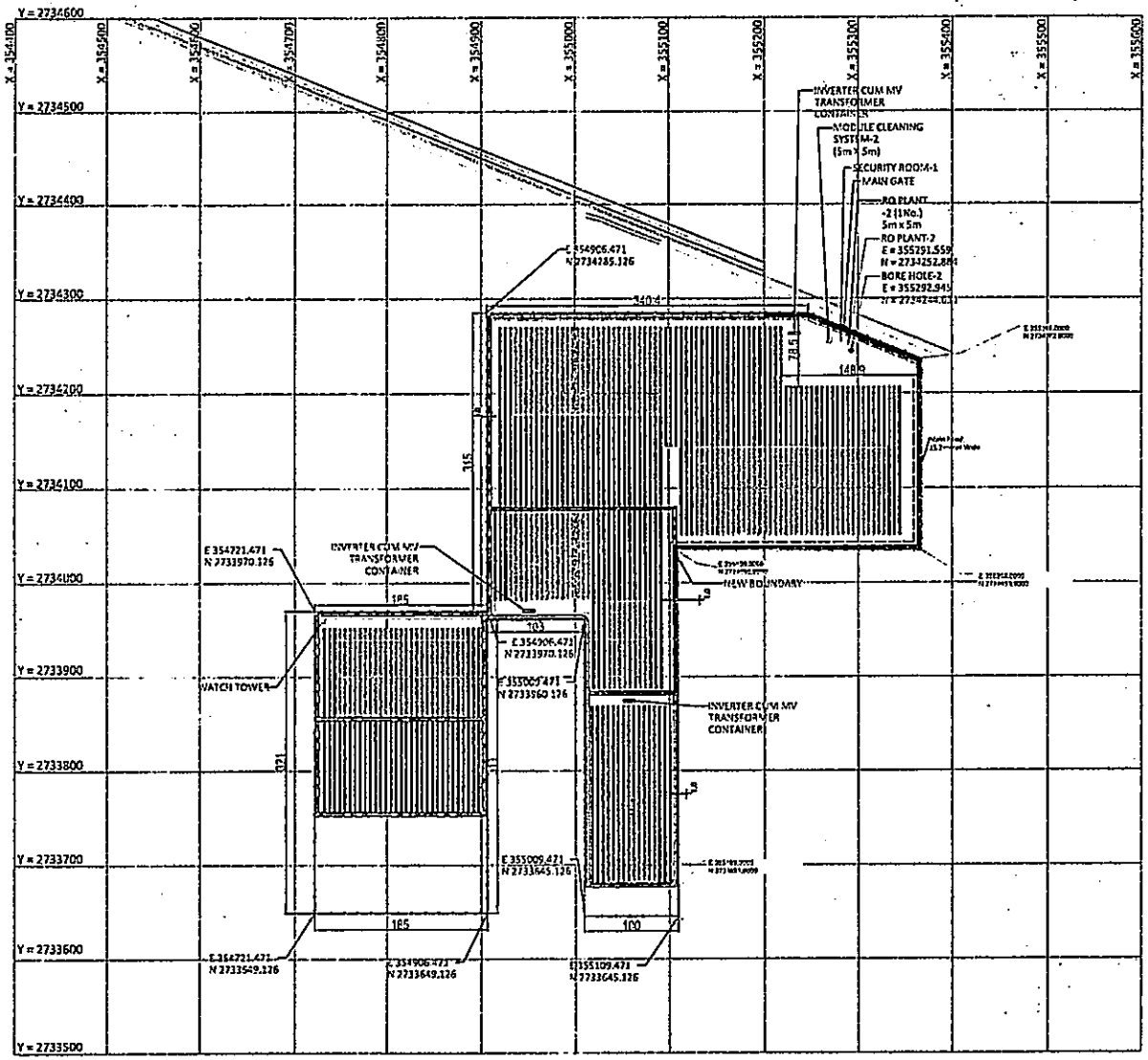
13 Annexure-2: Single Line Diagram

Attached in PDF format as separate file.

14 Annexure-3: PV Syst Simulation

Attached in PDF format as separate file.

Annexure-1: Plant Layout



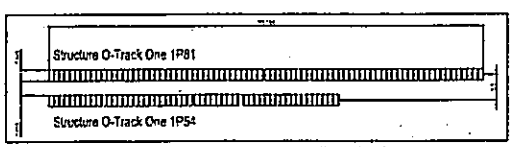
GHARO 50MW SOLAR POWER PLANT					
STRUCTURE	TYPE: TRACKER			TILT: 60°	
PV MODULES	TYPE: JA SOLAR 630 Wp BIFACIAL N-TYPE			POWER: 630 Wp	NUMBER: 23814
STRINGS	PV MODULES PER STRING: 27				NUMBER: 882
INVERTERS	TYPE: SUNGROW CENTRAL INVERTER WITH INVERTER TRANSFORMER			POWER: 3.3 MW 4.4 MW	NUMBER: 1 2
GEOMETRIC DATA	AZIMUTH: 0	PITCH: 55	PV PLANT PERIMETER: 3898		PV PLANT AREA: 62 ACRES
TOTAL PEAK POWER INSTALLED:				15	kWp
TOTAL NOMINAL POWER INSTALLED:				12	MVA

LEGEND	DESCRIPTION	
	GH-2 BOUNDARY	
	GNL BOUNDARY	
	TRACKER 1P×81 TRACKER 1P×54	
	BITUMEN ROAD (6-mtrs wide)	
	WBM ROAD (4mtrs wide)	
e	RO PLANT (5m X 5m)	
	MODULE CLEANING SYSTEM (10m X 10m)	
	WATCH TOWER	
	ERECTION METRIAL STORAGE AREA	
	51 Nos. OF EXTERIOR TRACKER	(1P X 81)
	135 Nos. OF EDGE TRACKER	(1P X 81)
	52 Nos. OF INTERIOR TRACKER	(1P X 81)
	06 Nos. OF EXTERIOR TRACKER	(1P X 54)
	63 Nos. OF EDGE TRACKER	(1P X 54)

S.No	DESCRIPTION	DETAILS
1.	TRACKING TYPE	HORIZONTAL SINGLE-AXIS TRACKER, WITH INDEPENDENT TRACKER ROW
2.	TRACKING RANGE	UP TO 120° (± 60°)
3.	MAXIMUM SLOPES	NORTH-SOUTH DIRECTION 15% - EAST-WEST DIRECTION 30%
4.	MODULE CONFIGURATIONS	CONFIGURABLE, 1 STRING 1P27/2 STRINGS 1P54/1STRINGS 1P81 WITH 3,500V

S.No	DESCRIPTION	UNIT
1.	RATED MAXIMUM POWER (PMAX) [W]	630
2.	OPEN CIRCUIT VOLTAGE(VOC) [V]	52.47
3.	MAXIMUM POWER VOLTAGE(VMP) [V]	43.90
4.	SHORT CIRCUIT CURRENT(ISC) [A]	15.21
5.	MAXIMUM POWER CURRENT(IMP) [A]	14.35
6.	MODULE EFFICIENCY [%]	22.5

S.No	DESCRIPTION	UNIT
1.	RATED MAX POWER(PMAX) [W]	680
2.	OPEN CIRCUIT VOLTAGE(VOC) [V]	52.47
3.	MAX POWER VOLTAGE(VMP) [V]	43.90
4.	SHORT CIRCUIT CURRENT(ISC) [A]	16.43
5.	MAX POWER CURRENT(IMP) [A]	15.50



TYPICAL TRACKER ARRANGEMENT DRAWING

SIZE: A2 THIS IS A CAD FILE - DO NOT MAKE ANY CORRECTIONS MANUALLY

REV	DATE	DESCRIPTION	BY	CHD	APPD.
2	06.08.2024	THE PANEL WP CHANGED TO 630Wp INSTEAD OF 620Wp	TM	FAK	BM
1	04.07.2024	UPDATED AS PER INVERTER CONFIGURATION	FAK	FAK	BM
0	19.07.2024	INITIAL SUBMISSION	BM	FAK	BM

REVISIONS

CONTROLLED COPY UNCONTROLLED COPY

GHARO SOLAR-2 (PRIVATE) LIMITED

15MWp SOLAR POWER PLANT

AVANT-GARDE ENGINEERS & CONSULTANTS (FZC.)
Sharjah, UAE.

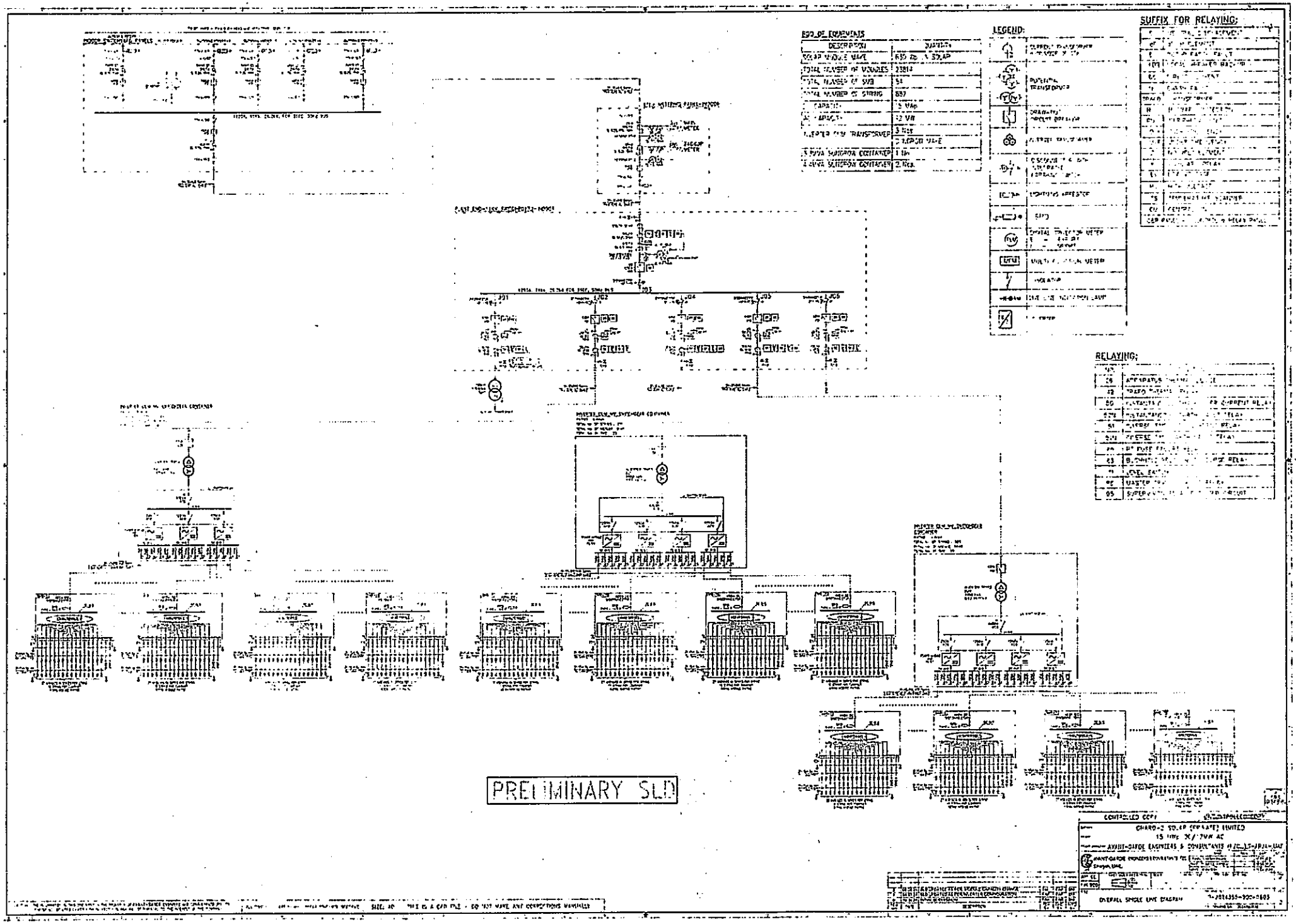
DRN BY: EL
CHKD BY: 900
SCALE: 1:4500
PROJECTION:

SOLAR PV ARRAY LAYOUT

DRAWING NO: 2-2024355-900-0602

SIZE: A3
ISSUE DATE: 05.08.2024

Annexure-2: Single Line Diagram


BOQ OF EQUIPMENTS
LEGEND:
SUFFIX FOR RELAYING:
RELAYING:
PRELIMINARY SLD

Annexure-3: PV Syst Simulation

PVSYST
PHOTOVOLTAIC SOFTWARE

Version 7.3.1

PVsyst - Simulation report

Grid-Connected System

Project: 15MW GNL Project Central Inverter

Variant: New simulation variant

Tracking system with backtracking

System power: 15.00 MWp

Gharo - Pakistan

Gharo Solar Limited

PVsyst V7.3.1
VC0, Simulation date:
07/26/24 16:26
with v7.3.1

Project summary

Geographical Site
Gharo
Pakistan

Situation

Latitude	24.72 °N
Longitude	67.57 °E
Altitude	7 m
Time zone	UTC+5

Project settings
Albedo 0.20

Meteo data
Gharo
SolarGIS Monthly aver. . period not spec. - Synthetic

System summary

Grid-Connected System
Simulation for year no 1

Tracking system with backtracking

PV Field Orientation

Orientation	
Tracking plane, horizontal N-S axis	
Axis azimuth	0 °

Tracking algorithm
Astronomic calculation
Backtracking activated

Near Shadings
Linear shadings

System information

PV Array		Inverters	
Nb. of modules	23814 units	Nb. of units	3 units
Pnom total	15.00 MWp	Pnom total	12.10 MWac
		Pnom ratio	1.240

User's needs
Unlimited load (grid)

Results summary

Produced Energy	30024191 kWh/year	Specific production	2001 kWh/kWp/year	Perf. Ratio PR	82.39 %
Apparent energy	31731086 kVAh				

Table of contents

Project and results summary 2
General parameters, PV Array Characteristics, System losses 3
Near shading definition - Iso-shadings diagram 6
Main results 7
Loss diagram 8
Predef. graphs 9
P50 - P90 evaluation 10
Single-line diagram 11
CO_2 Emission Balance 12

General parameters

Grid-Connected System — **Tracking system with backtracking**

PV Field Orientation

Orientation		Tracking algorithm		Backtracking array	
Tracking plane, horizontal N-S axis		Astronomic calculation		Nb. of trackers	322 units
Axis azimuth	0 °	Backtracking activated		**Sizes**	
				Tracker Spacing	5.50 m
				Collector width	2.46 m
				Ground Cov. Ratio (GCR)	44.8 %
				Phi min / max.	-/+ 55.0 °
				Backtracking strategy	
				Phi limits for BT	-/+ 63.2 °
				Backtracking pitch	5.50 m
				Backtracking width	2.47 m

Models used

Transposition	Perez
Diffuse	Perez, Meteonorm
Circumsolar	separate

Horizon	Near Shadings	User's needs
Free Horizon	Linear shadings	Unlimited load (grid)

Bifacial system

Model: 2D Calculation unlimited trackers

Bifacial model geometry		Bifacial model definitions	
Tracker Spacing	5.50 m	Ground albedo	0.20
Tracker width	2.46 m	Bifaciality factor	45 %
GCR	44.8 %	Rear shading factor	5.0 %
Axis height above ground	2.10 m	Rear mismatch loss	10.0 %
		Shed transparent fraction	0.0 %

Grid injection point

Power factor
Cos(phi) (lagging) 0.950

PV Array Characteristics

Array #1 - PV Array

PV module		Inverter	
Manufacturer	JA Solar	Manufacturer	Sungrow
Model	JAM72D42-630/LB	Model	SG3300UD
(Custom parameters definition)		(Custom parameters definition)	
Unit Nom. Power	630 Wp	Unit Nom. Power	3300 kWac
Number of PV modules	5940 units	Number of inverters	1 unit
Nominal (STC)	3742 kWp	Total power	3300 kWac
Modules	220 Strings x 27 In series	Operating voltage	895-1500 V
At operating cond. (50°C)		Max. power (=>22°C)	3795 kWac
Pmpp	3479 kWp	Pnom ratio (DC:AC)	1.13
U mpp	1087 V	Power sharing within this inverter	
I mpp	3201 A		

PV Array Characteristics

Array #2 - Sub-array #2

PV module

Manufacturer	JA Solar
Model	JAM72D42-630/LB
(Custom parameters definition)	
Unit Nom. Power	630 Wp
Number of PV modules	17874 units
Nominal (STC)	11.26 MWp
Modules	662 Strings x 27 In series
At operating cond. (50°C)	
Pmpp	10.47 MWp
U mpp	1087 V
I mpp	9632 A

Inverter

Manufacturer	Sungrow
Model	SG4400UD
(Custom parameters definition)	
Unit Nom. Power	4400 kWac
Number of inverters	2 units
Total power	8800 kWac
Operating voltage	895-1500 V
Max. power (=>22°C)	5060 kWac
Pnom ratio (DC:AC)	1.28
Power sharing within this inverter	

Total PV power

Nominal (STC)	15003 kWp
Total	23814 modules
Module area	66568 m²

Total inverter power

Total power	12100 kWac
Number of inverters	3 units
Pnom ratio	1.24

Array losses

Array Soiling Losses
Loss Fraction 3.0 %

Thermal Loss factor
Module temperature according to irradiance
Uc (const) 29.0 W/m²K
Uv (wind) 0.0 W/m²K/m/s

LID - Light Induced Degradation
Loss Fraction 1.0 %

Module Quality Loss
Loss Fraction -0.7 %

Module mismatch losses
Loss Fraction 0.7 % at MPP

Strings Mismatch loss
Loss Fraction 0.4 %

Module average degradation
Year no 1
Loss factor 2 %/year
Mismatch due to degradation
Imp RMS dispersion 0.4 %/year
Vmp RMS dispersion 0.4 %/year

IAM loss factor
ASHRAE Param.: IAM = 1 - bo (1/cosi -1)
bo Param. 0.07

DC wiring losses

Global wiring resistance 1.4 mΩ
Loss Fraction 1.5 % at STC

Array #1 - PV Array		Array #2 - Sub-array #2	
Global array res.	5.6 mΩ	Global array res.	1.9 mΩ
Loss Fraction	1.5 % at STC	Loss Fraction	1.5 % at STC

System losses

Unavailability of the system
Time fraction 0.8 %
2.9 days,
5 periods

Auxiliaries loss
constant (fans) 42.0 kW
0.0 kW from Power thresh.

AC wiring losses

Inv. output line up to MV transfo

Inverter voltage	630 Vac tri
Loss Fraction	0.40 % at STC
Inverters: SG3300UD, SG4400UD	
Wire section (3 Inv.)	Copper 3 x 3 x 2500 mm²
Average wires length	68 m

MV line up to Injection

MV Voltage	11 kV
Average each inverter	
Wires	Alu 3 x 300 mm²
Length	1300 m
Loss Fraction	0.61 % at STC

AC losses in transformers

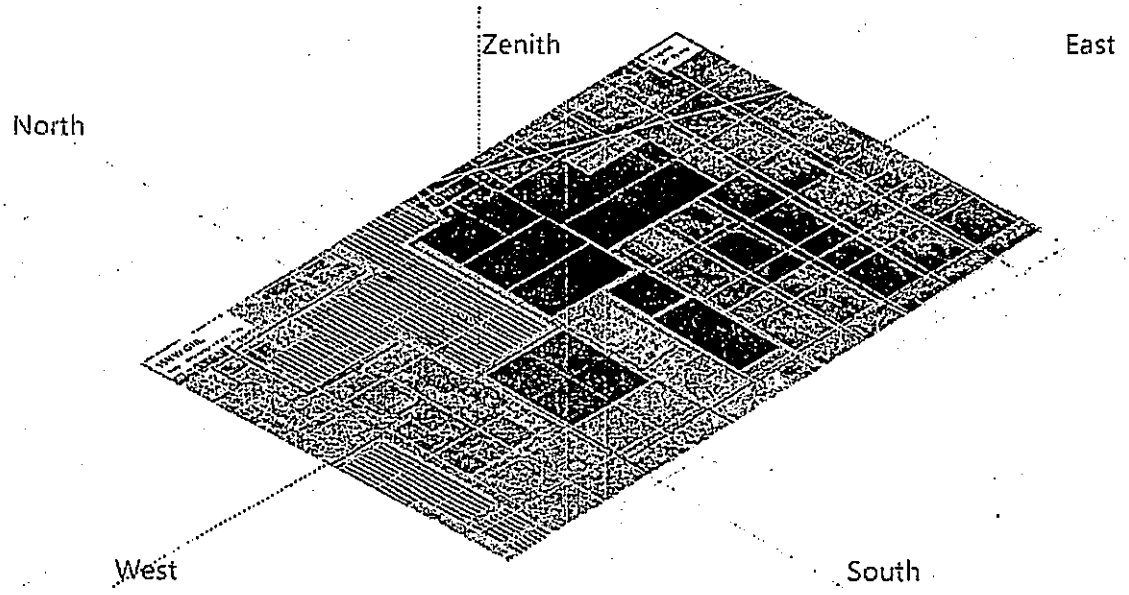
MV transfo

Medium voltage	11 kV
One transfo parameters	
Nominal power at STC	4.91 MVA
Iron Loss (24/24 Connexion)	8.54 kVA
Iron loss fraction	0.17 % at STC
Copper loss	57.01 kVA
Copper loss fraction	1.16 % at STC
Coils equivalent resistance	3 x 0.94 mΩ

Operating losses at STC (full system)	
Nb. identical MV transfos	3
Nominal power at STC	14.73 MVA
Iron loss (24/24 Connexion)	25.63 kVA
Copper loss	171.04 kVA

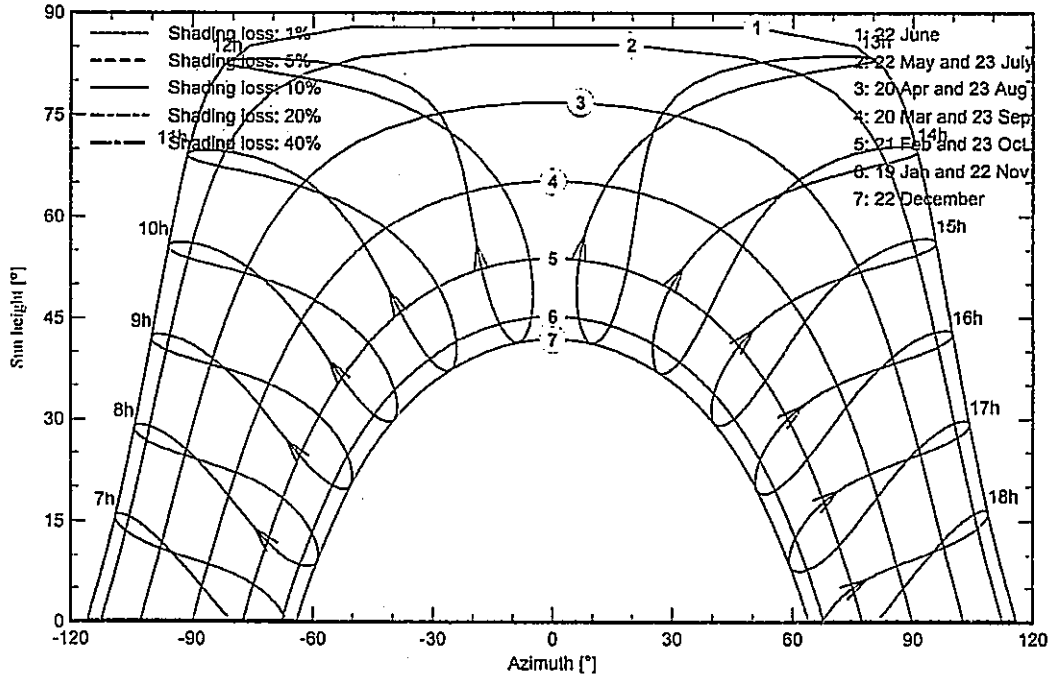
Near shadings parameter

Perspective of the PV-field and surrounding shading scene



Iso-shadings diagram

Orientation #1



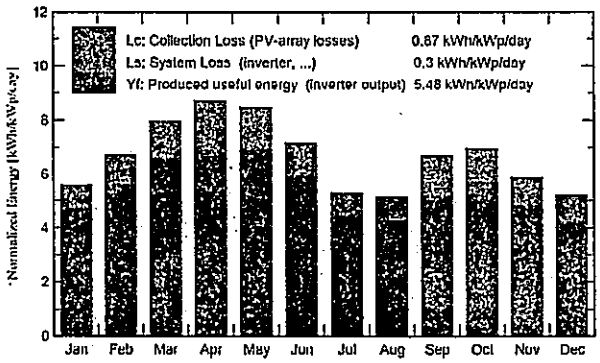
PVsyst V7.3.1
VC0, Simulation date:
07/26/24 16:26
with v7.3.1

Main results

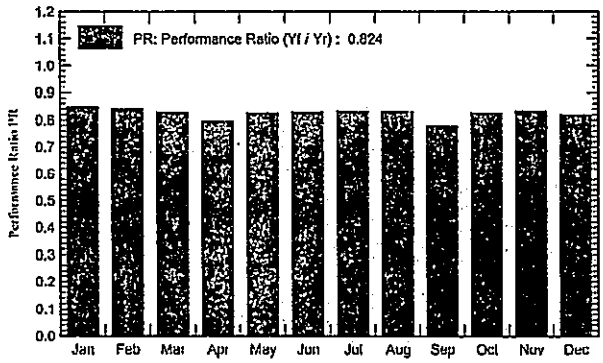
System Production

Produced Energy	30024191 kVAh/year	Specific production	2001 kWh/kWp/year
Apparent energy	31731086 kVAh/year	Performance Ratio PR	82.39 %

Normalized productions (per installed kWp)



Performance Ratio PR



Balances and main results

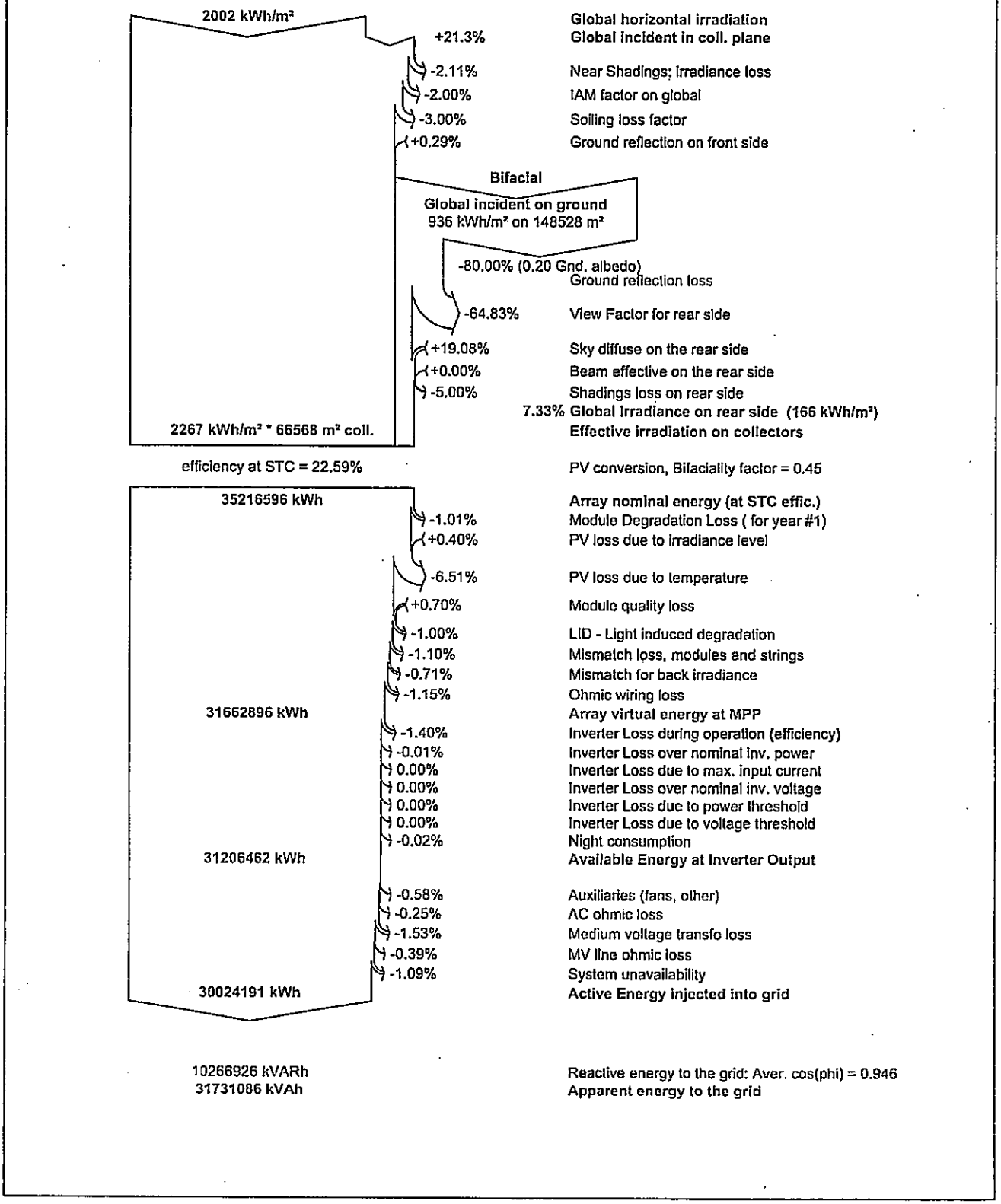
	GlobHor kWh/m²	DiffHor kWh/m²	T_Amb °C	GlobInc kWh/m²	GlobEff kWh/m²	EArray kWh	E_Grid kWh	PR ratio
January	137.2	52.0	19.10	173.6	160.3	2306758	2210800	0.849
February	150.3	54.3	22.00	188.5	175.8	2483945	2381232	0.842
March	196.9	72.8	26.10	247.1	232.1	3213291	3079572	0.831
April	212.7	83.3	29.20	261.5	246.8	3366047	3126050	0.797
May	218.4	100.7	30.90	262.8	247.5	3395278	3257077	0.826
June	186.7	102.6	31.50	215.2	201.5	2792791	2680656	0.830
July	148.1	101.2	30.20	164.7	152.4	2150412	2060213	0.834
August	143.6	94.8	29.10	160.1	148.4	2094962	2003727	0.834
September	166.3	83.9	29.20	201.4	188.2	2626230	2354973	0.779
October	172.6	65.8	29.00	216.0	201.8	2790303	2677152	0.826
November	139.5	54.3	25.20	175.9	162.7	2295177	2202406	0.835
December	129.6	49.0	20.39	162.1	149.1	2143484	1990333	0.819
Year	2001.9	914.7	26.84	2428.9	2266.6	31658679	30024191	0.824

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		

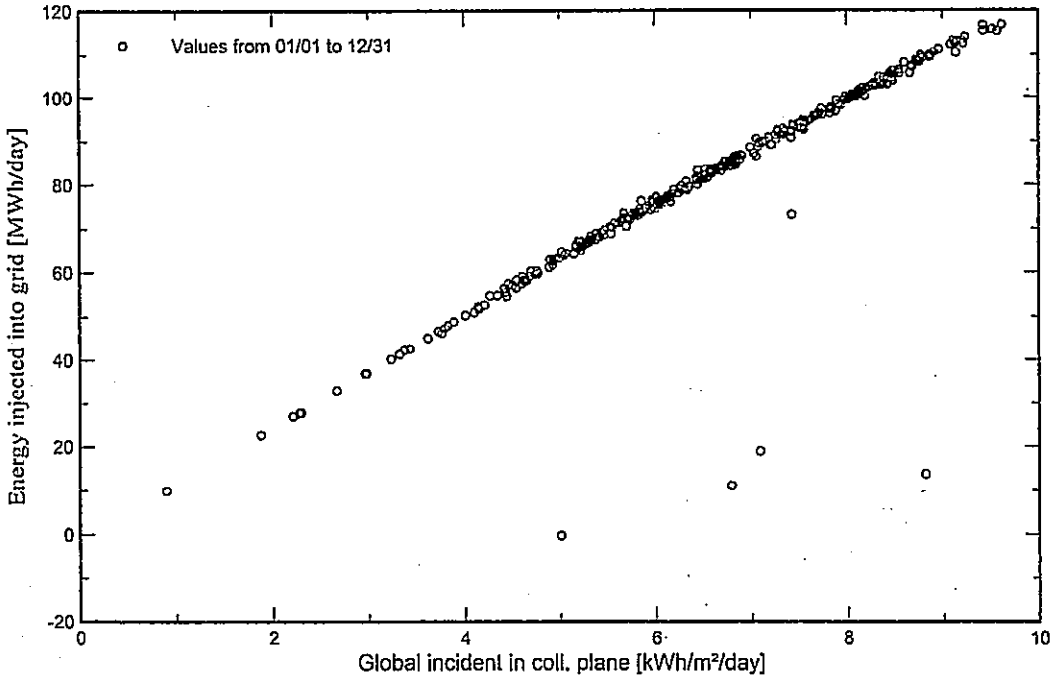
PVsyst V7.3.1
VC0, Simulation date:
07/26/24 16:26
with v7.3.1

Loss diagram

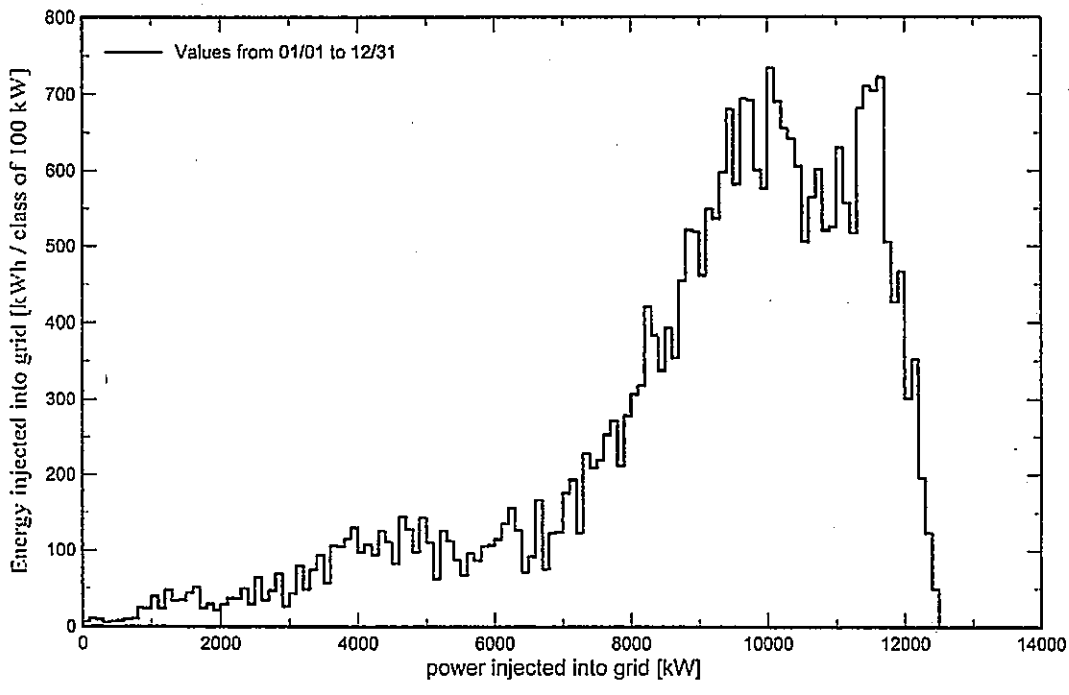


Predef. graphs

Daily Input/Output diagram



System Output Power Distribution



P50 - P90 evaluation

Meteo data

Source	SolarGIS Monthly aver. , period not spec.
Kind	Not defined
Year-to-year variability(Variance)	-1.0 %
Specified Deviation	

Global variability (meteo + system)

Variability (Quadratic sum)	2.1 %

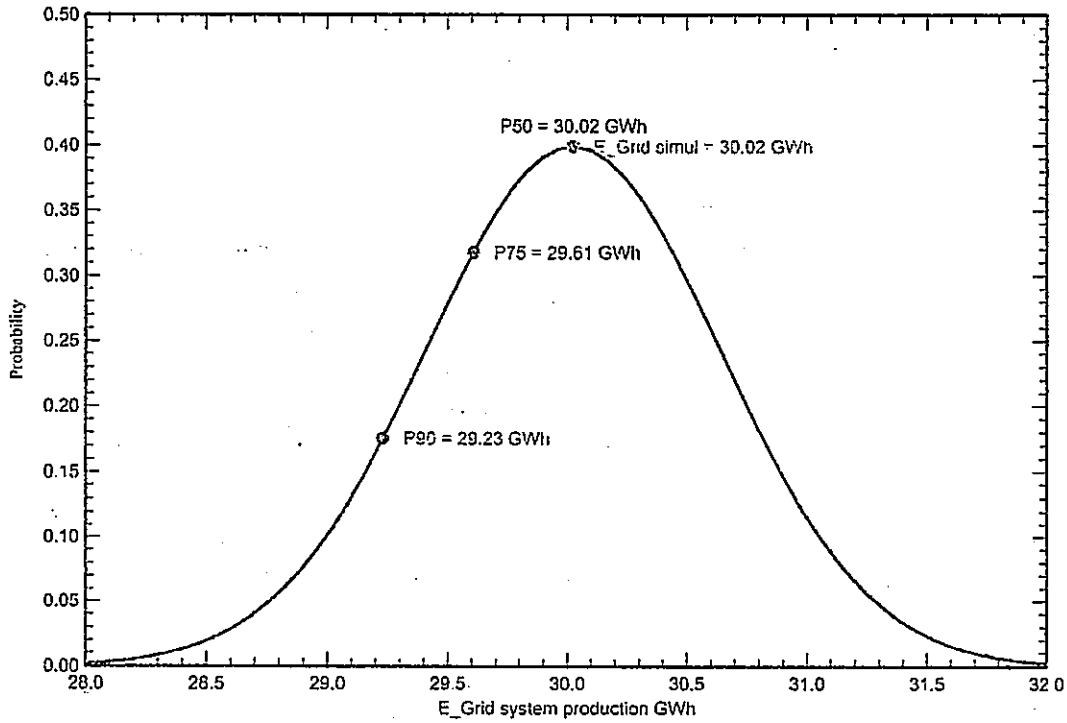
Simulation and parameters uncertainties

PV module modelling/parameters	1.0 %
Inverter efficiency uncertainty	0.5 %
Soiling and mismatch uncertainties	1.0 %
Degradation uncertainty	1.0 %

Annual production probability

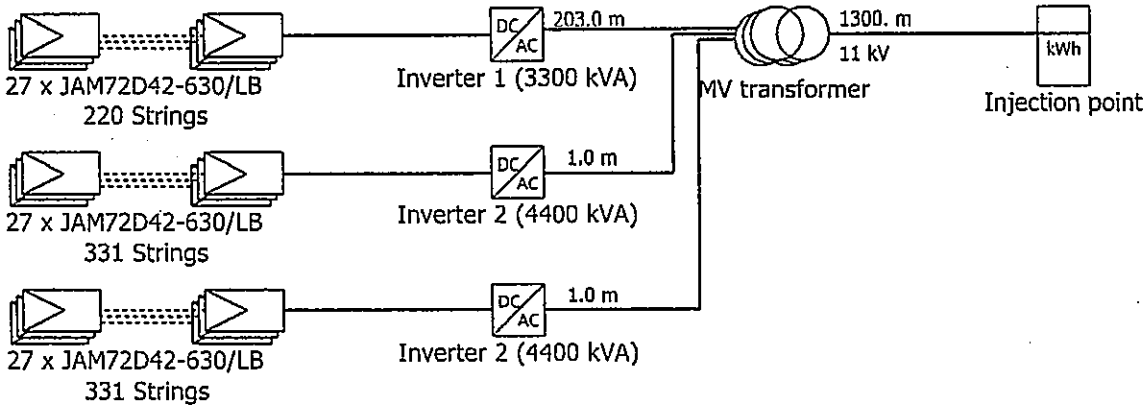
Variability	0.62 GWh
P50	30.02 GWh
P90	29.23 GWh
P75	29.61 GWh

Probability distribution



Single-line diagram

PVsyst V7.3.1
VC0, Simulation date:
07/26/24 16:26
with v7.3.1



PV module	JAM72D42-630/LB
Inverter 1	SG3300UD
Inverter 2	SG4400UD
String	27 x JAM72D42-630/LB

	15MW GNL Project Central Inver ter	
	VC0 : New simulation variant	07/26/24

CO_2 Emission Balance

Total: 318489.9 tCO_2

Generated emissions

Total: 29290.31 tCO_2

Source: Detailed calculation from table below:

Replaced Emissions

Total: 400823.0 tCO_2

System production: 30024.19 MWh/yr

Grid Lifecycle Emissions: 445 gCO_2/kWh

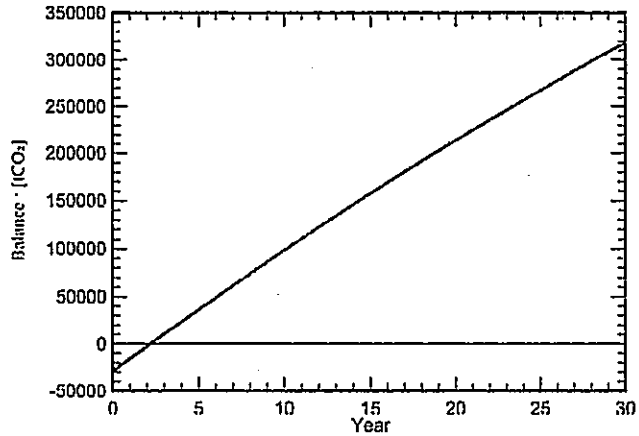
Source: IEA List

Country: Pakistan

Lifetime: 30 years

Annual degradation: 1.0 %

Saved CO_2 Emission vs. Time



System Lifecycle Emissions Details

Item	LCE	Quantity	Subtotal
			[$kgCO_2$]
Modules	1686 kgCO2/kWp	15241 kWp	25689156
Supports	2.97 kgCO2/kg	1209600 kg	3590274
Inverters	294 kgCO2/	37.0	10880

3(g) & 3(7)

An Affidavit Stating Whether The Applicant Has Been Granted Any Other License Under The Act

&

An Affidavit As To The Correctness, Authenticity And Accuracy Of The Application

With reference to the requirement as per clause, "Schedule III (Regulation 3(g)) *an affidavit stating whether the applicant has been granted any other license under the Act;" is attached.

And

With reference to the requirement as per clause, "Schedule III (Regulation 3(7)) *An affidavit as to the correctness, authenticity and accuracy of the application " is attached.

E-STAMP

1161

ID : PB-LHR-A1AE0ED3E892DDFC
Type : Low Denomination
Amount : Rs 300/-

Scan for online verification

Description : AFFIDAVIT - 4
Applicant : GHARO NEWGEN PRIVATE LIMITED [00000-0000000-0]
Representative From : GHARO NEWGEN PRIVATE LIMITED
Agent : ADIL [00000-0000000-0]
Address : LAHORE
Issue Date : 19-Aug-2024 10:39:21 AM
Delisted On/Validity : 26-Aug-2024
Amount In Words : Three Hundred Rupees Only
Reason : AFFIDAVIT IN FAV OF NEPRA
Vendor Information : Muhammad Abubakar Waheed | PB-LHR-833 | Tufail Road

Zaheer Ahmad Advocate + OATH COMMISSIONER + Lahore

نوٹ یہ ورائیفکیشن تاریخ اجرا سے سات دنوں تک کے لیے قابل استعمال ہے ای اسٹامپ کی تصدیق بذریعہ ویب سائٹ، کیو آر کوڈ یا ایس ایم ایس کی جا سکتی ہے۔
Type "eStamp <16 digit eStamp Number>" send to 8100

BEFORE THE NATIONAL ELECTRIC POWER REGULATORY AUTHORITY

AFFIDAVIT

I, Rana Uzair Nasim, son of Rana Nasim Ahmed, resident of 76-b, St # 4, DHA Phase 5, Lahore, bearing CNIC no. 35201-8925121-7, as Chief Executive Officer of Gharo Newgen (Private) Limited, with its registered office located at number 114 CC-2 DHA, Phase 6, Lahore, being the duly authorized representative of Gharo Newgen (Private) Limited, hereby solemnly affirm and declare that the contents of the accompanying application for the grant of electric power generation/concurrence and the supporting documents, including all annexes thereto, are true, accurate and correct to the best of my knowledge and belief, and that nothing has been concealed.

I also affirm that all further documentation and information to be provided by me in connection with the accompanying application shall be true, accurate and correct to the best of my knowledge and belief.

I also further affirm that Gharo Newgen (Private) Limited has not been granted any other license pursuant to the applicable provisions of the Regulation of Generation, Transmission and Distribution of Electric Power Act, 1997.

Deponent
Rana Uzair Nasim
Chief Executive Officer
Gharo Newgen (Private) Limited
19-08-2024

Verification:

Verified on oath at Lahore on this 19th day of August 2024 that the contents of the above affidavit are correct and true to the best of my knowledge and belief.

DEPONENT

Rana Uzair Nasim
Chief Executive Officer
19-08-2024

ATTESTED
Zaheer Ahmad Advocate
Oath Commissioner Lahore

3(6)

Authorization From Board Resolution/ Power Of Attorney

With reference to the requirement as per clause, " Schedule III (Regulation 3(6)) *Authorization from Board Resolution/ Power of Attorney " is attached.

GHARO NEWGEN (PRIVATE) LIMITED

114-CC2, Phase-6C, DHA, Lahore. Ph: 042 38020444

EXTRACT OF RESOLUTIONS PASSED BY THE BOARD OF DIRECTORS OF M/S GHARO NEWGEN (PRIVATE) LIMITED (THE "COMPANY") IN A MEETING HELD ON JUNE 17, 2024 AT ITS REGISTERED OFFICE LOCATED AT 114-CC2, PHASE-6C, DHA, LAHORE

RESOLVED THAT the Company be and is hereby authorised to file application(s) before the National Electric Power Regulatory Authority ("**NEPRA**") in relation to the grant of concurrence by NEPRA (the "**Application(s)**"), so that the Company is authorized to set up a 15MWp solar PV generating facility located within the service territory of K-Electric) for the purpose of supplying electric power to K-Electric through the distribution system of the Gharo Grid Station located in Gharo, District Thatta.

FURTHER RESOLVED THAT Mr. Rana Nasim Ahmed, Director and Mr. Rana Uzair Nasim, Chief Executive Officer, (the "**Authorised Person**") are duly authorized singly and severally to file, submit and present the Application(s) (along with all annexes), affidavits, and any documents in support thereof before NEPRA, sign the necessary documentation, pay the necessary filing fees, appear, or appoint a duly authorized representative to appear, and/or make any oral / written representations on behalf of the Company before NEPRA, and undertake or do any matter(s) / act(s) necessary for the filing, submission, processing, completion and finalization of the Application(s), or incidental thereto.

FURTHER RESOLVED THAT in addition to the Authorised Person, the associates and partners of RIAA Barker Gillette (formerly RIAALAW), including Mr. Adil Khalid Tirmizey and Mr. Minam Karim shall also have the aforementioned powers.

Certified that the above resolutions: (i) were duly passed on June 17, 2024 at a meeting of the board of directors of Gharo Newgen (Private) Limited held with the necessary quorum of directors; and (ii) has not been rescinded and remains in operation and that this is a true copy of the extract of the said resolutions.

GHARO NEWGEN (PRIVATE) LIMITED

Rana Uzair Nasim
Chief Executive Officer
Gharo Newgen (Private) Limited

3(i)

Location (Location Maps, Site Map, Land)

With reference to the requirement as per clause, " Schedule III (Regulation 3(4)(a)(A)9(e) 3(i)) *Location (location maps, site map, land " is attached.

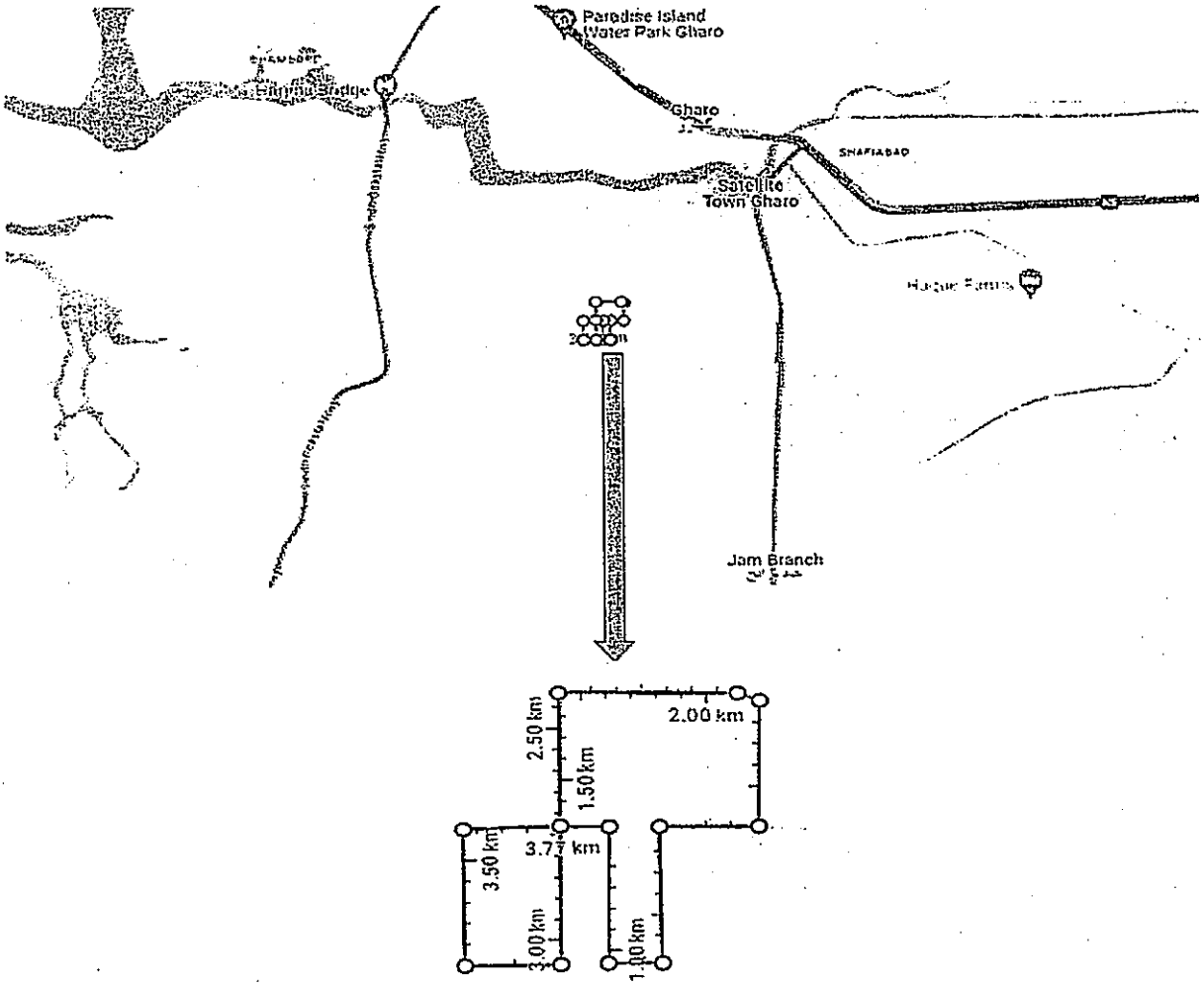
4.2 Project Site and Location

The Project Site is located near the town of Gharo at Deh Ghairabad, Mirpur Sakro, District Thatta, Sindh approximately 6 km along the Sindh Coastal Highway and then approximately 1.25 km via connecting road from the Highway. The Site is about 55 km away from Jinnah International Airport, Karachi.

Site Coordinates:

The site coordinates are as follow:

Latitude (North)	Longitude (East)
24°42'58.0"N	67°34'09.5"E



3(iii)

Water Source At Site For Maintenance

With reference to the requirement as per clause, " Schedule III (Regulation 3(4)(a)(A)9(e) 3(iii)) *Water source at site for maintenance " is attached.

6.1 Water Source

The raw water for the plant Maintenance, essential for meeting the module cleaning needs, will be drawn from bore wells and processed through an RO plant to achieve appropriate TDS and pH values. The water will be distributed throughout the plant via underground water pipelines equipped with distributed valves.

3(iv)

Infrastructure: Roads, Rail, Staff Colony, Amenities

With reference to the requirement as per clause, " Schedule III (Regulation 3(4)(a)(A)9(e) 3(iv)) *Infrastructure: roads, rails, staff colony, amenities " is attached.

3(4)(a)(A)(e)3(iv): Infrastructure: Roads, rail, staff colony, amenities:

The infrastructure for the solar power plant will encompass well-constructed access roads to facilitate the smooth transportation of equipment and materials, ensuring efficient movement within the plant premises. A dedicated staff colony will be established on-site to house operational and maintenance personnel, guaranteeing their round-the-clock availability. The colony will be equipped with essential amenities such as water supply, electricity and communication facilities, along with the comfortable living environment for the staff. Additional infrastructure will include necessary utilities and support facilities, such as a security office and storage areas.

3(vii)

Plant Characteristics (Generation Voltage, Frequency etc.)

With reference to the requirement as per clause, " Schedule III (Regulation 3(4)(a)(A)9(e) 3(iv)) *Infrastructure: roads, rails, staff colony, amenities " is attached.

1. Plant Characteristics

1.1 Technical Details

Parameters	Details
Plant DC Capacity	15MWp
Plant AC Output Capacity	12MWp
Output Voltage	11kV
Frequency	50Hz
Annual Generation (1st Year)	30024191 kWh
Capacity Factor	22.85%

1.2 PV Module:

Electrical Parameters	JAM72D42-630/LB
Maximum Power (Pmax)	630 Watt
Module Type	Mono Crystalline, Bifacial
Module Efficiency	22.5%
Maximum Power Current (Imp)	14.35A
Maximum Power Voltage (Vmp)	43.9V
Short Circuit Current (Isc)	15.21A
Open Circuit Voltage (Voc)	52.47V
Operating Temperature	-40 °C to + 85 °C

1.3 Inverter:

Description	Data
Inverters Rated power	2 Nos. of 4.4 MVA & 1 No. of 3.3MVA
Max. input voltage	1500 V
MPP voltage range for nominal power	895V - 1500V

Output (AC)

Description	Data
Rated normal power	3399 kVA @ 40 °C, 4532kVA @ 40°C
Nominal AC voltage	3 / PE, 630 V
AC frequency / range	45-55 Hz
Max. output current	219.2A, 292.2A

1.4 Inverter Transformer:

Parameter	Data
Number of transformers and rating	2 Nos. of 4.4 MVA & 1 No. of 3.3MVA
Cooling	ONAN
Ratio	11/0.63-0.63 kV
Transformer Vector	Dy11
Impedance	7% , 8%

1.5 HT Panels:

Parameter	Data
Rated Voltage	11 kV, 3 Phase, 50 Hz
Maximum Voltage	12 kV
Power frequency Voltage	28 kV rms
Impulse withstand Voltage	75 kV peak
Short time rating	26.2 kA for 3 Sec
Maximum bus bar temperature	85 Deg. C

2.1 Interconnection Arrangement

The electric power generated from the Generation Facility/Solar Power Plant of the Company shall be dispersed to the load center of K-Electric.

The proposed Interconnection Arrangement/Transmission Facility for dispersal of electric power comprises the direct 11 kV lines of approximately 7-8 km length to be laid from the 11 kV, 50Hz bus bar of the Generation Facility/Solar Power Plant to the Gharo Grid Station.