Table of Contents

1. Executive Summary

The 250kW$_{AC}$ /363kW$_{DC}$ rooftop Solar Power Plant at Bharat Seats Limited, Kharkhoda, Haryana, hereby mentioned as BSL, Kharkhoda is planned to be developed by Sunbeam Real Ventures Private Limited. The PPA was executed based on an initial assessment of 363kW$_{DC}$. A brief overview of the project simulation summary is also projected below:

PVsyst V7.4.8
VC1, Simulation date:
12/03/25 15:37
with V7.4.8

Project: BSL KHARKHODA with Solargis

Variant: New simulation variant

Solo Power (India)

Project summary

Geographical Site		**Situation**		**Project settings**	
BSL Kharkhoda		Latitude	28.83 °N	Albedo	0.20
India		Longitude	76.92 °E		
		Altitude	218 m		
		Time zone	UTC+5.5		

Weather data
BSL Kharkhoda
SolarGIS Monthly aver. , period not spec. - Synthetic

System summary

Grid-Connected System — **No 3D scene defined, no shadings**

PV Field Orientation		**Near Shadings**	**User's needs**
Fixed planes	2 orientations	No Shadings	Unlimited load (grid)
Tilts/azimuths	3 / 42 °		
	3 / -138 °		

System information

PV Array		**Inverters**	
Nb. of modules	620 units	Nb. of units	2 units
Pnom total	363 kWp	Pnom total	250 kWac
		Pnom ratio	1.451

Results summary

Produced Energy	533044 kWh/year	Specific production	1470 kWh/kWp/year	Perf. Ratio PR	83.98 %

- **Solar Plant Developer and Ownership (Shareholders):**
  i. Sunil Gadhoke
  ii. Viraj Gadhoke
- **Location and Approach Roads**
  BSL is located at Kharkhoda in the state of Haryana. The geo-location of upcoming solar plant of 250kW$_{AC}$ /363kW$_{DC}$ at Kharkhoda is 28.83°N, 76.92°E. The site proposed for the solar plant is approximately at a distance of
  - 32 km from New Delhi,

- **Total Solar Power Capacity to be Developed (MW$_{AC}$)**
  250kW$_{AC}$
- **Solar Power Evacuation Plan (Refer ANNEXURE 2)**
  Solar Power transmission and evacuation of each roof is done at the 800A spare feeder of the client Distribution Panel at 415V. The transmission of solar power generated will be through 2Rx3.5Cx240sqmm Al cable.

2. Scope of Report

- **Introduce the concept of the solar plant**
  A Rooftop Solar Plant is a small to medium-scale photovoltaic system (PV system) designed under C&I segment, basically for captive power consumption. They operate in grid parallel mode with the ability to export surplus power to the local electricity distribution network. It provides security of power supply and resilience through self-generation with great cost benefits, particularly when the current and the future escalated grid tariff are accounted. It also assists in reducing carbon footprints and contributes to improved environmental impacts.
- **A brief description of the solar plant being planned**
  250kW$_{AC}$ solar plant is planned at the rooftop of BSL facility in Kharkhoda of Haryana, India. The power generated will be consumed by the facility. The PV technology installed here is mono-crystalline N-type TOPCON modules and 2 Sungrow inverters of 125kW are used to convert the DC power generated from the PV modules to the grid.
- **Purpose of the DPR**
  Detailed project report is a complete document for investment decision-making, approval, planning. Detailed project report is based document for planning the solar plant and implementing the solar plant. In this DPR all details, starting from Renewable energy scenario in India, Solar irradiation available at site, Type of Roof and planning of Rooftop Solar Plant installed are included.

3. Solar Sector Overview

- **PV Technologies**
  Photovoltaics (PV) is the conversion of light into electricity using semiconducting materials that exhibit the photovoltaic effect, a phenomenon studied in physics, photochemistry, and electrochemistry. A typical photovoltaic system employs solar panels, each comprising a number of solar cells, which generate electrical power. PV installations may be ground-mounted, rooftop mounted or wall mounted. The mount may be fixed, or use a solar tracker to follow the sun across the sky. Solar PV has specific advantages as an energy source: once installed, its operation generates no pollution and no greenhouse gas emissions, it shows simple scalability in respect of power needs and silicon has large availability in the Earth's crust. Photovoltaic systems have long been used in specialized applications, and standalone and grid-connected PV systems have been in use since the 1990s. They were first mass-produced in 2000, when German environmentalists and the Eurosolar organization got government funding for a ten thousand roof program. Advances in technology and increased manufacturing scale have in any case reduced the cost, increased the reliability, and increased the efficiency of photovoltaic installations Net metering and financial incentives, such as preferential feed-in tariffs for solar-generated electricity, have supported solar PV installations in many countries. More than 100 countries now use solar PV. The term "photovoltaic" comes from the Greek word (phōs) meaning "light", and from "volt", the unit

of electro-motive force, the volt, which in turn comes from the last name of the Italian physicist Alessandro Volta, inventor of the battery (electrochemical cell). The term "photo-voltaic" has been in use in English since 1849. Photovoltaics are best known as a method for generating electric power by using solar cells to convert energy from the sun into a flow of electrons by the photovoltaic effect. Solar cells produce direct current electricity from sunlight which can be used to power equipment or to recharge a battery. The first practical application of photovoltaics was to power orbiting satellites and other spacecraft, but today the majority of photovoltaic modules are used for grid connected power generation. In this case, an inverter is required to convert the DC to AC. Photovoltaic power generation employs solar panels composed of a number of solar cells containing a photovoltaic material. Copper solar cables connect modules (module cable), arrays (array cable), and sub-fields. Because of the growing demand for renewable energy sources, the manufacturing of solar cells and photovoltaic arrays has advanced considerably in recent years.

Solar photovoltaic power generation has long been seen as a clean energy technology which draws upon the planet's most plentiful and widely distributed renewable energy source – the sun. Cells require protection from the environment and is usually packaged tightly in solar panels. Photovoltaic power capacity is measured as maximum power output under standardized test conditions (STC) in "W_P" (watts peak). The actual power output at a particular point in time may be less than or greater than this standardized, or "rated", value, depending on geographical location, time of day, weather conditions, and other factors. Solar photovoltaic array capacity factors are typically under 25%, which is lower than many other industrial sources of electricity.

- **Overview of Available Technology**

  Solar energy can be converted into electricity using the following two broad technology options:

  Photovoltaics (PV) is a method of generating electrical power by converting solar radiation into direct current electricity using semiconductors that exhibit the photovoltaic effect. Photovoltaic power generation employs solar panels composed of several cells containing a photovoltaic material. Materials presently used for photovoltaic include mono-crystalline silicon, multi-crystalline silicon, amorphous silicon, cadmium telluride, and copper indium selenide/sulphide. PV uses both direct and diffuse radiation for generation of electricity. Concentrated solar power (CSP) is the system that uses lenses or mirrors to concentrate a large area of sunlight, or solar thermal energy, onto a small area. Electrical power is produced when the concentrated light is converted to heat which drives a heat engine (usually a steam turbine) connected to an electrical power generator. CSP uses only direct radiation for generating electricity. As the Solar Plants has been allocated a 20MW Solar PV, this DPR will confine itself to the description of solar photovoltaic (PV) options.

- **Solar PV Technology**

  Photovoltaic conversion is the direct conversion of sunlight into electricity with no intervening heat engine. A PV cell consists of two or more thin layers of semiconducting material, most commonly silicon. When the silicon is exposed to light, electrical charges are generated; and this can be conducted away by metal contacts as direct current. The electrical output from a single cell is small; so multiple cells are connected and encapsulated (usually glass covered) to form a module (also called a panel). PV generation technology is commercially proven and large multi-megawatt generation plants have been operating since the 1990s. Costs associated with the technology are high, but the technology is well known and reliable. The major categories of solar photovoltaic technologies available are:

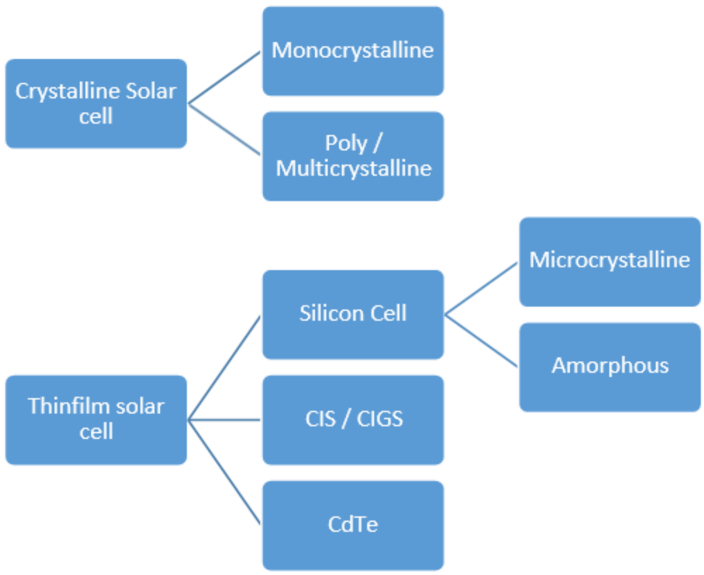
Mono-crystalline silicon cells: In these cells, the silicon has a single continuous crystal lattice structure with almost no defects or impurities. Their main advantage is high efficiency; though a complicated manufacturing process is required to produce mono-crystalline silicon, which results in higher costs than those of other technologies.

Multi-crystalline silicon cells: These cells are produced using numerous grains of mono-crystalline silicon. The manufacturing process involves casting of silicon into ingots, which are subsequently cut into very thin wafers and assembled into complete cells. These are cheaper to produce because of a simpler manufacturing process.

Thin film: Extremely thin layers of photosensitive materials are deposited on a low-cost backing like glass, stainless steel or plastic. The selected materials are all strong light absorbers and only need to be about 1-micron thick, so materials costs are significantly reduced. The most common materials are amorphous silicon (a-Si), or the polycrystalline materials such as cadmium telluride (CdTe) and copper indium (gallium) (CIS or CIGS). Thin film cells trade-off lower efficiencies against a significantly lower cost of materials.

Concentrating PV: Concentrating the sunlight by optical devices like lenses or mirrors reduces the area of expensive cells or modules, and increases their efficiency. The most important benefit of this technology is the possibility to reach system efficiencies beyond 30%, which cannot be achieved by single junction 1-sun[1] photovoltaic technology.

1. 1-sun means testing conditions using irradiance of 1000 W/m^2



4. Solar Plant Details

- **Roof Size**
  The area of shadow free roof available for developing the solar power plant is approximately 3,936 m^2.
- **Total power capacity (in AC) to be located within the solar plant**
  250kW$_{AC}$

- **External Transmission infrastructure requirements, capacity already available, augmentation required up to target destinations: (Refer ANNEXURE-2)**
  Solar Power transmission and evacuation at the 800A spare feeder of the client Distribution Panel at 415V. The transmission of solar power generated will be through 2Rx3.5Cx240sqmm Al cable.
- **Solar Radiation Resource Assessment station:** The following data sensors shall be provided in the plant (in the module area) to monitor the following parameters:
  - Global Horizontal Irradiance – Pyranometer
  - Collector plane Irradiance – Pyranometer
  - Ambient temperature
  - Module temperature
- **Drainage System:**
  Water based cleaning is done on the subject rooftop solar plant through a network of PVC plumbing pipes from the water tapping point to the PV module area.
- **Telecommunication infrastructures:** Communication System is planned to be installed to fetch the plant and its equipment performance data through Datalogger to monitor the plant remotely.

4.1 Solar Irradiation and Weather Data

- **Average monthly GHI from the nearest met station or other reliable sources**
  The average monthly GHI of Sohna was taken from SolarGIS meteorological database and the following monthly values of irradiance, ambient temperature and wind speed. It experiences an annual average rainfall of 636mm. The figure below shows the monthly solar irradiation and weather data at Manesar along with the monthly generation table P50 figures as simulated in PVSyst. The simulation table also specifies the estimated PR on monthly basis.

New simulation variant
Weather data and incident energy

	GlobHor kWh/m²	DiffHor kWh/m²	T_Amb °C	WindVel m/s	GlobInc kWh/m²	DifSInc kWh/m²	Alb_Inc kWh/m²	DifS_GI ratio
January	92.0	52.8	13.10	2.3	92.2	38.81	0.011	0.000
February	122.4	56.9	16.50	2.7	122.9	35.07	0.018	0.000
March	175.8	75.4	22.20	2.1	176.2	41.50	0.023	0.000
April	193.3	88.6	28.70	2.4	193.6	46.90	0.026	0.000
May	194.5	105.3	32.50	2.6	194.6	58.52	0.025	0.000
June	163.6	100.3	33.00	2.6	163.5	60.36	0.021	0.000
July	142.9	96.5	30.10	2.3	142.8	64.88	0.018	0.000
August	152.3	92.8	28.90	2.8	152.3	58.25	0.021	0.000
September	154.6	77.9	28.10	2.3	154.8	47.64	0.021	0.000
October	147.9	73.9	25.30	2.3	148.2	44.87	0.021	0.000
November	111.1	59.6	20.20	1.8	111.5	39.56	0.016	0.000
December	97.0	52.4	15.09	2.0	97.4	36.01	0.014	0.000
Year	1747.4	932.4	24.51	2.3	1749.9	572.36	0.236	0.000

- **Wind**
  Wind speed influences air temperature. In other words, at higher wind speeds, the air temperature could decrease and so does the solar cell operating temperature. That means that wind can help a solar PV system perform more efficiently to harvest the positive influence of wind on solar cell operation temperature, one will install systems at heights elevated above the surface of the roof. This allows wind to flow between the surface of the solar panels and

the roof, reducing the operating temperature of the solar cells. This helps us ensure maximum module and solar PV system efficiency for the system.
Wind speed, including wind gusts, can have physical impacts on solar PV systems. For example, if a solar PV system was not installed with the correct mounting equipment (e.g. rails, attachments, fasteners, etc.) and there are high wind gusts, then the system could be damaged. If the damage is significant, the electrical operation of the system could be affected. In a worst-case scenario, the solar panels could be dislodged from the mounting equipment or the roof due to high winds. The system would lose electrical contact and be inoperable.

- **Temperature**
  Local air temperature means the temperature of the air directly around the panels of the system. That can change how the solar PV system's voltage will function. Since solar cells – the physical material within a solar panel that converts sunlight into electricity – are under glass, they are well insulated. Thus, they have higher temperatures than the environment immediately around the panel. Temperature and voltage have an inverse relationship meaning the higher the temperature, the lower the operating voltage. Lower operating voltages cause lower module (and overall) system efficiency.
- **Rain and Humidity**
  Humidity can slow efficiency in two ways. Tiny water droplets, or water vapour, can collect on solar panels (like beads of sweat) and reflect or refract sunlight away from solar cells. This reduces the amount of sunlight hitting them and producing electricity. Consistent hot, humid weather can degrade the solar panels themselves over their lifetime. This is true for both crystalline silicon cells and thin film modules. Rain can also affect in many ways like If rainy period in year is more than generation is also reduced after rain water droplets cause same effect as above.

4.2 Annual Energy Yield Assessment

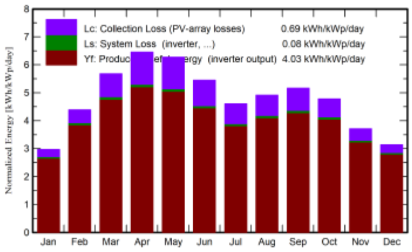
- **Simulation using reputed PV software**
  With the SolarGIS data, PVSyst simulation at 3° tilt and azimuth of 42° & -138°S was performed to assess the annual energy yield. A degradation of 1% was considered for a duration of one year from the time of installation. The simulation was performed on the basis of 363kW$_{DC}$ and 250kW$_{AC}$. The simulation result obtained is as shown in the Table given below. Annual Specific yield is 1359kWh/kWp/yr.

Main results

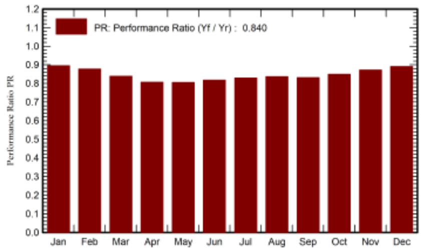
System Production

Produced Energy (P50)	533044 kWh/year	Specific production (P50)	1470 kWh/kWp/year	Perf. Ratio PR	83.98 %
Produced Energy (P75)	511903 kWh/year	Specific production (P75)	1411 kWh/kWp/year		
Produced Energy (P90)	492833 kWh/year	Specific production (P90)	1359 kWh/kWp/year		

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	92.0	52.8	13.10	92.2	88.9	30562	29937	0.896
February	122.4	56.9	16.50	122.9	118.7	39904	39115	0.878
March	175.8	75.4	22.20	176.2	170.3	54658	53607	0.839
April	193.3	88.6	28.70	193.6	187.3	57778	56696	0.807
May	194.5	105.3	32.50	194.6	188.1	57937	56880	0.806
June	163.6	100.3	33.00	163.5	158.0	49421	48512	0.818
July	142.9	96.5	30.10	142.8	137.8	43785	42956	0.830
August	152.3	92.8	28.90	152.3	147.1	47116	46221	0.837
September	154.6	77.9	28.10	154.8	149.6	47589	46693	0.831
October	147.9	73.9	25.30	148.2	143.3	46543	45668	0.849
November	111.1	59.6	20.20	111.5	107.6	35976	35274	0.872
December	97.0	52.4	15.09	97.4	94.0	32132	31484	0.891
Year	1747.4	932.4	24.51	1749.9	1690.6	543400	533044	0.840

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		

- **Orientation and tilt angle of solar PV modules:** 3° tilt and azimuth of 42° & -138°S
- **Capacity Utilization Factor (CUF): 16%**
- **Annual Degradation:** 1.6% for the 1st year and 0.4% thereafter

4.3 Electrical Infrastructure

- **Electrical Interface Point**

  A grid-tied solar power system produces solar electricity that is fed directly into the utility grid, hence the term grid-tied, as the system is tied, literally, to the grid. Grid-connected or utility-interactive PV systems are designed to operate in parallel with and interconnected with the electric utility grid. The primary component in grid-connected PV systems is the inverter, or power conditioning unit (PCU).

  The PCU converts the DC power produced by the PV array into AC power consistent with the voltage and power quality requirements of the utility grid, and automatically stops supplying power to the grid when the utility grid is not energized. A bi-directional interface is made between the PV system AC output circuits and the electric utility network, typically at an on-site distribution panel or service entrance. This allows the AC power produced by the PV system to either supply on-site electrical loads, or to back feed the grid when the PV system output is greater than the on-site load demand.

  At night and during other periods when the electrical loads are greater than the PV system output, the balance of power required by the loads is received from the electric utility.

4.4 Module Mounting Infrastructure

Since the roof profile is that of Standing Seam type; clamp type structure is proposed for mounting of modules on the roof.

5. Operation & Maintenance

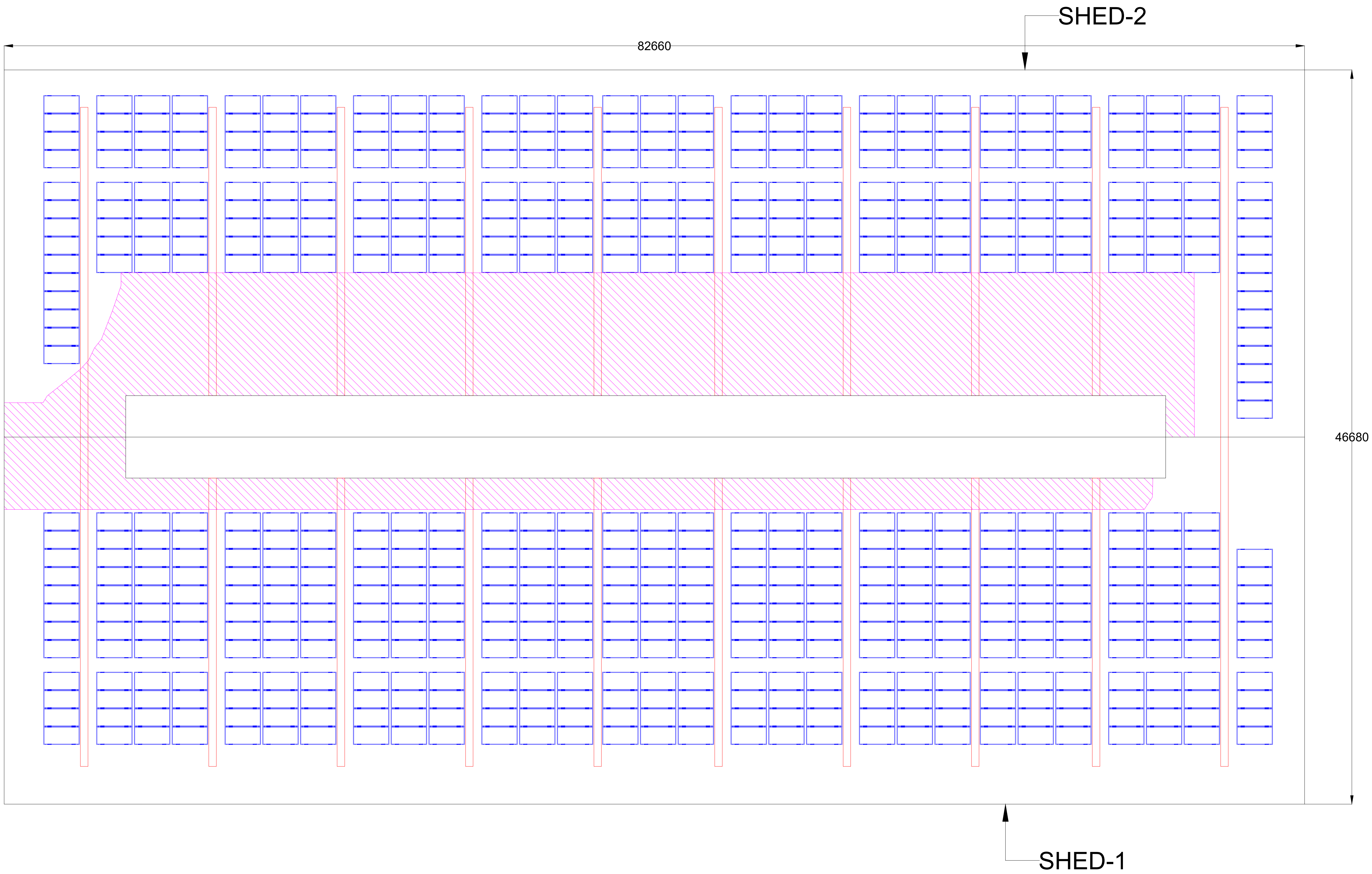
The operation and maintenance of the plant will be taken care by the Asset Management Team of the project developer. Water based module cleaning and preventive maintenance as per the suggested OEM is scheduled and performed to maintain the generation guarantee and plant performance mentioned in the PPA. An annual cleaning cycles of 32-36 is undertaken with 12 monthly, 4 quarterly & 1 annual schedules of preventive maintenance. In case of any breakdowns in between these cycles, it will be attended on immediate basis.

6. Conclusion

A generation guarantee of 4,43,534kWh/yr has been mutually agreed according to the PPA.

List of Annexures

- Annexure 1: General Lay Out Plan of Solar Power Plant
- Annexure 2: Power Evacuation System Diagram
- Annexure 3: Equipment Layout
- Annexure 4: PVSyst Report
- Annexure 5: Bill of Materials



BHARAT SEATS LIMITED, KHARKHODA

362.7 kWp SOLAR POWER MAIN PLANT INFO

NAME OF ROOF	MODULE TILT	NO. OF MODULES	DC CAPACITY (kWp)
SHED-1 SOUTH -WEST	3°	346	202.41
SHED-2 NORTH-EAST	3°	274	160.29
TOTAL		620	362.70
MODULE USED- JINKO 585 Wp			

LEGENDS

(blue rectangle)	JINKO 585 Wp
(pink rectangle)	SKYLIGHT
(black line)	BOUNDARY
(pink hatch)	SHADOW

A - ISSUED FOR INFORMATION	☐
B - ISSUED FOR APPROVAL	☑
C - ISSUED FOR CONSTRUCTION	☐
D - AS BUILT	☐

DEVELOPER/CLIENT:
BHARAT SEATS LIMITED, KHARKHODA

POWER PURCHASER:
BHARAT SEATS LIMITED, KHARKHODA

PROJECT:
362.7 kWp ROOF SOLAR PV PROJECT

LOCATION:
28.825468N,76.919323E

SHEET TITLE:
MODULE LAYOUT

DRAWING NO:
VE-PP-65_MODULE LAYOUT

STAMP: ORIGINAL : "420X297"

A4 A3 A2 A1 A0

THIS INFORMATION IS CONFIDENTIAL AND IS NO PART IS TO BE DISCLOSED TO OTHERS WITHOUT WRITTEN PERMISSION FROM CONCERN PERSON

(All dimensions are in mm)

DATE : 27-02-2025

PREPARED BY : AYUSH KUMAR

CHECKED BY : ANKIT D.

APPROVED BY : S. SHAHNAZ

APPROVED BY :

APPROVED BY :

NO.	REVISION	DATE

A - ISSUED FOR INFORMATION	☐
B - ISSUED FOR APPROVAL	☐
C - ISSUED FOR CONSTRUCTION	☑
D - AS BUILT	☐

SCALE

SHEET NO
1

VIBGYOR ENERGY

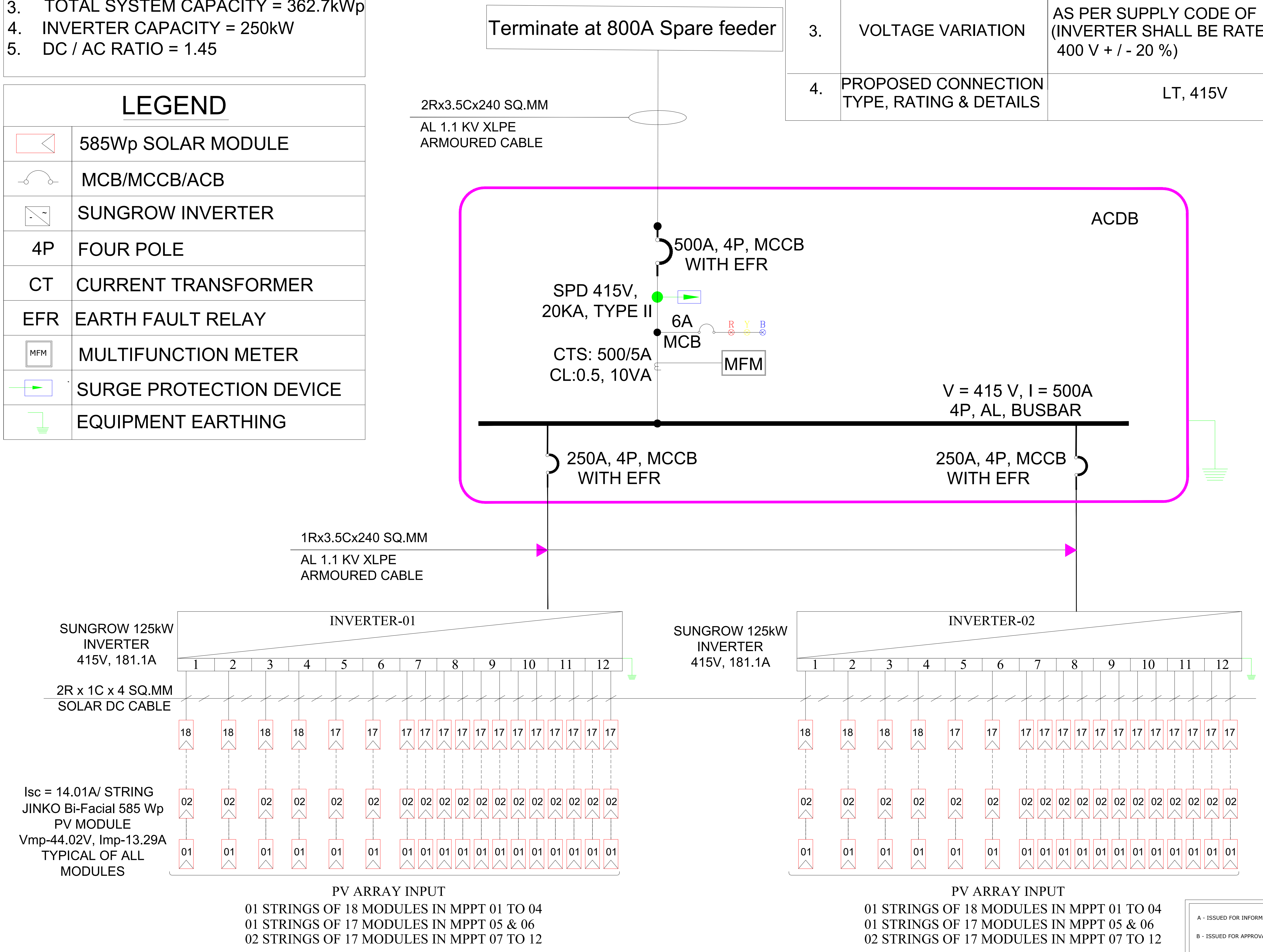
SYSTEM INFO :

1. MODULE RATING, EACH = 585Wp
2. TOTAL NOS. OF MODULES = 620 NOs.
3. TOTAL SYSTEM CAPACITY = 362.7kWp
4. INVERTER CAPACITY = 250kW
5. DC / AC RATIO = 1.45

LEGEND

(symbol)	585Wp SOLAR MODULE
(symbol)	MCB/MCCB/ACB
(symbol)	SUNGROW INVERTER
4P	FOUR POLE
CT	CURRENT TRANSFORMER
EFR	EARTH FAULT RELAY
MFM	MULTIFUNCTION METER
(symbol)	SURGE PROTECTION DEVICE
(symbol)	EQUIPMENT EARTHING

S. NO.	PARAMETER	DETAILS
1.	SUPPLY VOLTAGE	415 V
2.	SUPPLY FREQUENCY	50 HZ
3.	VOLTAGE VARIATION	AS PER SUPPLY CODE OF DISCOM (INVERTER SHALL BE RATED FOR 400 V + / - 20 %)
4.	PROPOSED CONNECTION TYPE, RATING & DETAILS	LT, 415V



A - ISSUED FOR INFORMATION	
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DEVELOPER/CLIENT:
BHARAT SEATS LIMITED,KHARKHODA

POWER PURCHASER:
BHARAT SEATS LIMITED,KHARKHODA

PROJECT:
362.7KWp ROOF SOLAR PV PROJECT

LOCATION:
28.825468N,76.919323E

SHEET TITLE:
SINGLE LINE DIAGRAM

DRAWING NO:
VE-PP-65_SINGLE LINE DIAGRAM

STAMP: ORIGINAL : "420X297"

A4 A3 A2 A1 A0

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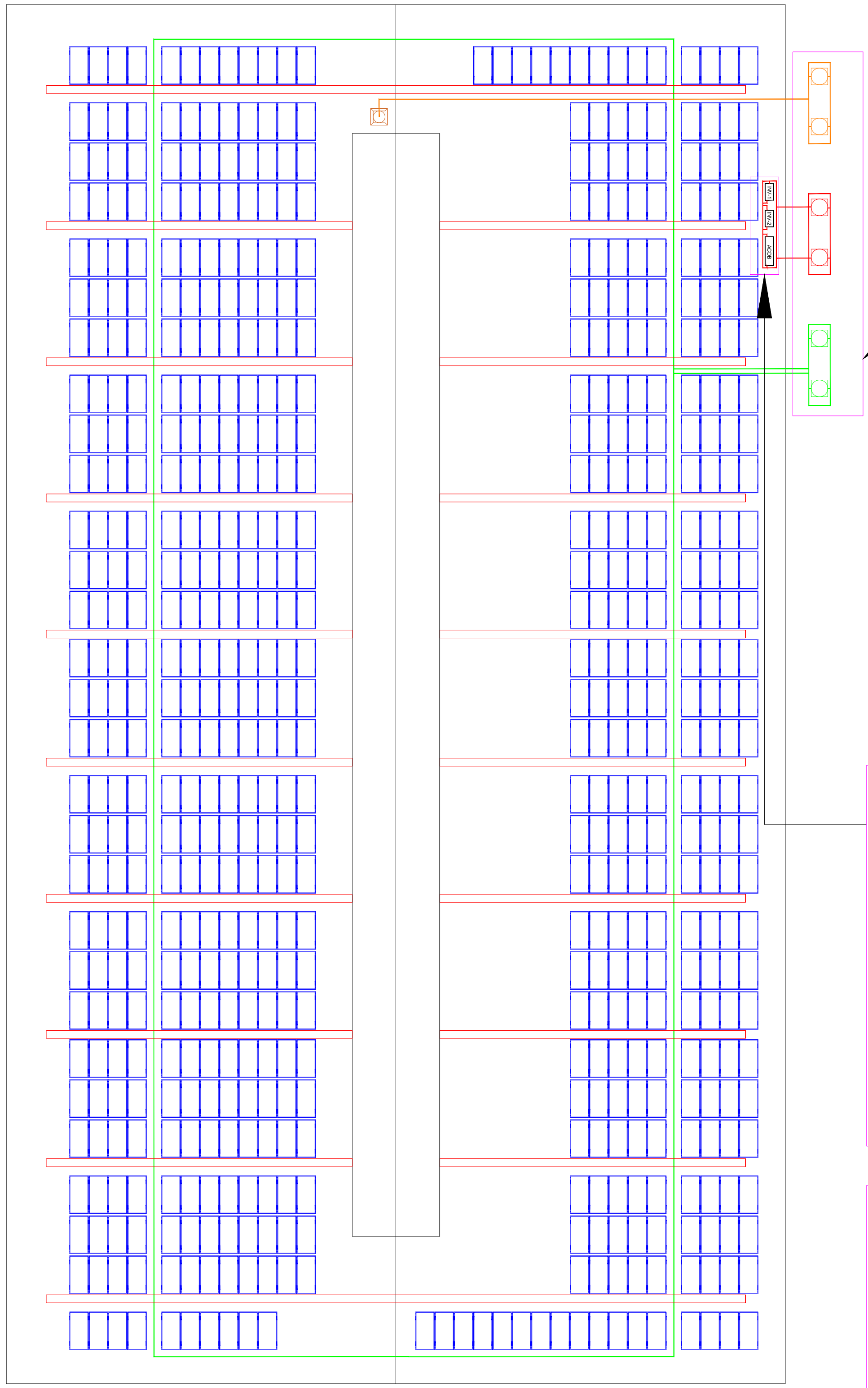
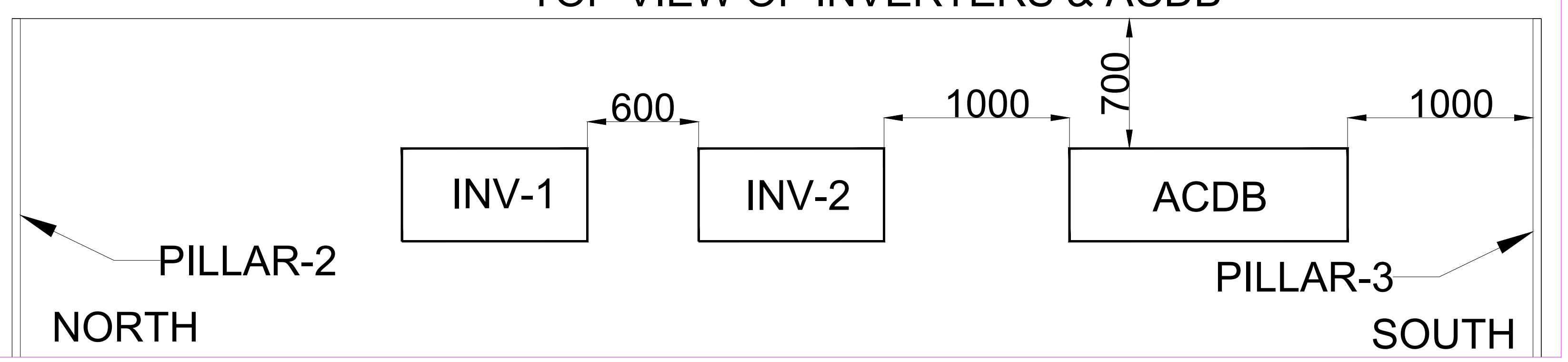


EARTHING PITS LOCATION, DETAILS SHOWN IN EARTHING & L.A. LAYOUT

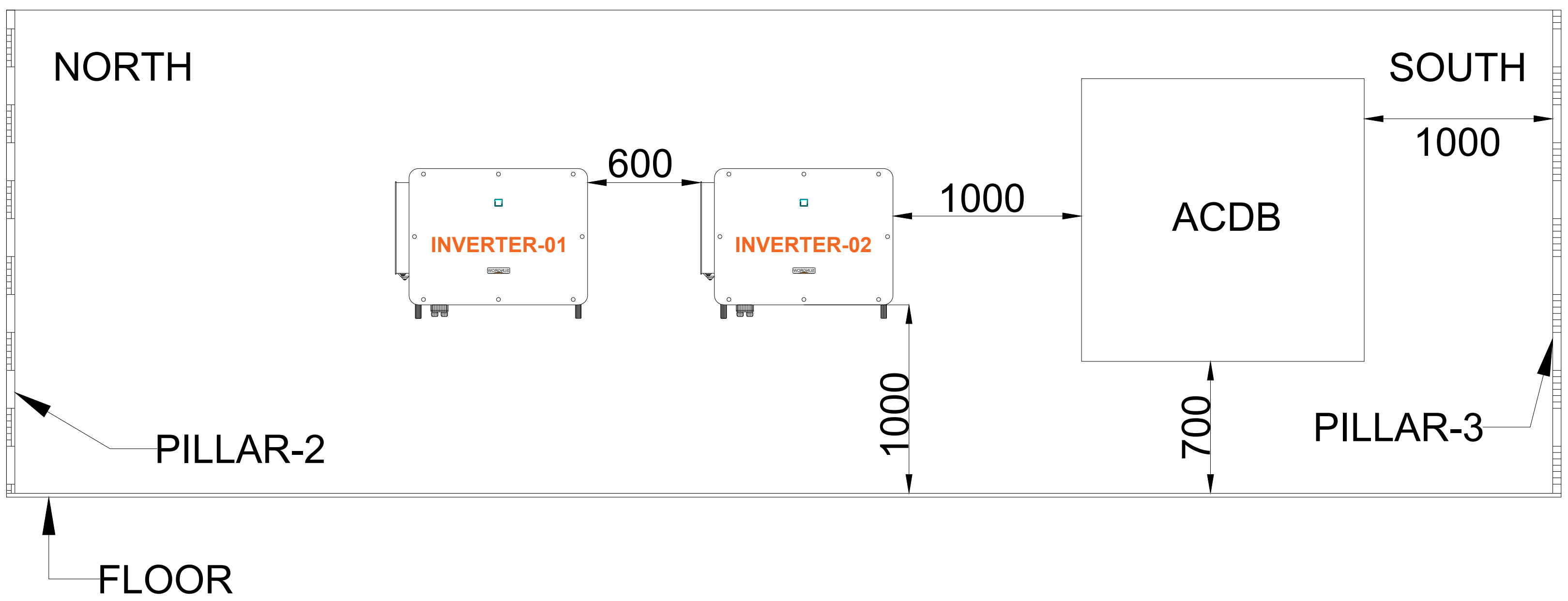
LEGENDS

	L.A EARTHING PITS (17.2 Ø, 300MM LONG CU BONDED WITH TREATED EARTH PIT FOR LA EARTHING)
	L.A EARTHING CABLE (50 SQ MM DOWN CONDUCTOR)
	17.2Ø, 3000MM LONG CU BONDED WITH TREATED EARTH PIT FOR DC EARTHING
	25X3 G.I. STRIP & 4 SQ MM CU CABLE
	25X3 G.I. STRIP & 50 SQ MM CU CABLE
	17.2Ø, 3000MM LONG CU BONDED WITH TREATED EARTH PIT FOR AC EARTHING
	MODULES
	LIGHTNING ARRESTER
	SKYLIGHT
	COVERED AREA BY L.A

TOP VIEW OF INVERTERS & ACDB



FRONT VIEW OF INVERTERS & ACDB



NOTES:

1) INVERTERS & ACDB ARE PLACED ON NORTH-EAST SIDE OF THE BUILDING AT FIRST FLOOR .
2) L.A IS PLACED ON NORTH-EAST SIDE OF THE SHED.
3) A.C, D.C, & L.A EARTHING PITS WILL BE DONE ON THE NORTH-EAST SIDE OF THE SHED.
4) SOLAR POWER WILL BE TERMINATED FROM SOLAR ACDB TO CLIENT SPARE FEEDER (800A).

DEVELOPER/CLIENT: BHARAT SEATS LIMITED, KHARKHODA

POWER PURCHASER: BHARAT SEATS LIMITED, KHARKHODA

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SCALE

SHEET NO 1

VIBGYOR ENERGY

Version 7.4.8

PVsyst - Simulation report

Grid-Connected System

Project: BSL KHARKHODA with Solargis

Variant: New simulation variant

No 3D scene defined, no shadings

System power: 363 kWp

BSL Kharkhoda - India

Author

Solo Power (India)

Project: BSL KHARKHODA with Solargis

Variant: New simulation variant

Solo Power (India)

Project summary

Geographical Site		Situation		Project settings	
BSL Kharkhoda		Latitude	28.83 °N	Albedo	0.20
India		Longitude	76.92 °E		
		Altitude	218 m		
		Time zone	UTC+5.5		

Weather data
BSL Kharkhoda
SolarGIS Monthly aver. , period not spec. - Synthetic

System summary

Grid-Connected System — **No 3D scene defined, no shadings**

PV Field Orientation		Near Shadings	User's needs
Fixed planes	2 orientations	No Shadings	Unlimited load (grid)
Tilts/azimuths	3 / 42 °		
	3 / -138 °		

System information

PV Array		Inverters	
Nb. of modules	620 units	Nb. of units	2 units
Pnom total	363 kWp	Pnom total	250 kWac
		Pnom ratio	1.451

Results summary

Produced Energy	533044 kWh/year	Specific production	1470 kWh/kWp/year	Perf. Ratio PR	83.98 %

Table of contents

General parameters

Grid-Connected System

No 3D scene defined, no shadings

PV Field Orientation

Orientation		**Sheds configuration**	**Models used**	
Fixed planes	2 orientations	No 3D scene defined	Transposition	Perez
Tilts/azimuths	3 / 42 °		Diffuse	Perez, Meteonorm
	3 / -138 °		Circumsolar	separate

Horizon	**Near Shadings**	**User's needs**
Free Horizon	No Shadings	Unlimited load (grid)

PV Array Characteristics

PV module		**Inverter**	
Manufacturer	Jinkosolar	Manufacturer	Sungrow
Model	JKM585N-72HL4-V	Model	SG125CX-P2
(Custom parameters definition)		(Custom parameters definition)	
Unit Nom. Power	585 Wp	Unit Nom. Power	125 kWac
Number of PV modules	620 units	Number of inverters	2 units
Nominal (STC)	363 kWp	Total power	250 kWac

Array #1 - PV Array

Orientation	#2		
Tilt/Azimuth	3/-138 °		
Number of PV modules	238 units	Number of inverters	8 * MPPT 10% 0.8 unit
Nominal (STC)	139 kWp	Total power	96.6 kWac
Modules	14 string x 17 In series		
At operating cond. (50°C)		Operating voltage	180-1000 V
Pmpp	129 kWp	Pnom ratio (DC:AC)	1.44
U mpp	661 V		
I mpp	195 A		

Array #2 - Sub-array #2

Orientation	#2		
Tilt/Azimuth	3/-138 °		
Number of PV modules	36 units	Number of inverters	2 * MPPT 6% 0.1 unit
Nominal (STC)	21.06 kWp	Total power	14.6 kWac
Modules	2 string x 18 In series		
At operating cond. (50°C)		Operating voltage	180-1000 V
Pmpp	19.49 kWp	Pnom ratio (DC:AC)	1.44
U mpp	700 V		
I mpp	28 A		

Array #3 - Sub-array #3

Orientation	#1		
Tilt/Azimuth	3/42 °		
Number of PV modules	34 units	Number of inverters	2 * MPPT 6% 0.1 unit
Nominal (STC)	19.89 kWp	Total power	13.8 kWac
Modules	2 string x 17 In series		
At operating cond. (50°C)		Operating voltage	180-1000 V
Pmpp	18.40 kWp	Pnom ratio (DC:AC)	1.44
U mpp	661 V		
I mpp	28 A		

PV Array Characteristics

Array #4 - Sub-array #4

Orientation	#1		
Tilt/Azimuth	3/42 °		
Number of PV modules	204 units	Number of inverters	6 * MPPT 11% 0.7 unit
Nominal (STC)	119 kWp	Total power	81.7 kWac
Modules	12 string x 17 In series		
At operating cond. (50°C)		Operating voltage	180-1000 V
Pmpp	110 kWp	Pnom ratio (DC:AC)	1.46
U mpp	661 V		
I mpp	167 A		

Array #5 - Sub-array #5

Orientation	#1		
Tilt/Azimuth	3/42 °		
Number of PV modules	108 units	Number of inverters	6 * MPPT 6% 0.3 unit
Nominal (STC)	63.2 kWp	Total power	43.3 kWac
Modules	6 string x 18 In series		
At operating cond. (50°C)		Operating voltage	180-1000 V
Pmpp	58.5 kWp	Pnom ratio (DC:AC)	1.46
U mpp	700 V		
I mpp	84 A		

Total PV power		**Total inverter power**	
Nominal (STC)	363 kWp	Total power	250 kWac
Total	620 modules	Number of inverters	2 units
Module area	1602 m²	Pnom ratio	1.45
Cell area	1474 m²	Power sharing defined	

Array losses

Array Soiling Losses
Loss Fraction 3.0 %

Thermal Loss factor
Module temperature according to irradiance
Uc (const) 20.0 W/m²K
Uv (wind) 0.0 W/m²K/m/s

LID - Light Induced Degradation
Loss Fraction 1.0 %

Module Quality Loss
Loss Fraction -0.3 %

Module mismatch losses

Array #1 - PV Array
Loss Fraction 2.0 % at MPP

Array #2 - Sub-array #2
Loss Fraction 2.0 % at MPP

Array #3 - Sub-array #3
Loss Fraction 2.0 % at MPP

Array #4 - Sub-array #4
Loss Fraction 2.0 % at MPP

Array #5 - Sub-array #5
Loss Fraction 2.0 % at MPP

IAM loss factor
Incidence effect (IAM): User defined profile

0°	30°	50°	60°	70°	75°	80°	85°	90°
1.000	1.000	1.000	1.000	0.989	0.971	0.931	0.737	0.000

DC wiring losses

Global wiring resistance	10 mΩ
Loss Fraction	1.5 % at STC

Array #1 - PV Array

Global array res.	55 mΩ
Loss Fraction	1.5 % at STC

Array #2 - Sub-array #2

Global array res.	410 mΩ
Loss Fraction	1.5 % at STC

Array #3 - Sub-array #3

Global array res.	387 mΩ
Loss Fraction	1.5 % at STC

Array #4 - Sub-array #4

Global array res.	64 mΩ
Loss Fraction	1.5 % at STC

Array #5 - Sub-array #5

Global array res.	137 mΩ
Loss Fraction	1.5 % at STC

System losses

Auxiliaries loss

AC wiring losses

Inv. output line up to injection point

Inverter voltage	400 Vac tri
Loss Fraction	0.58 % at STC

Inverter: SG125CX-P2

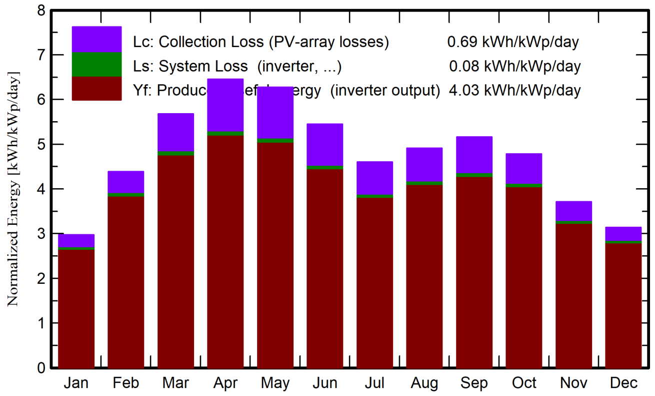
Wire section (2 Inv.)	Copper 2 x 3 x 120 mm²
Average wires length	33 m

Main results

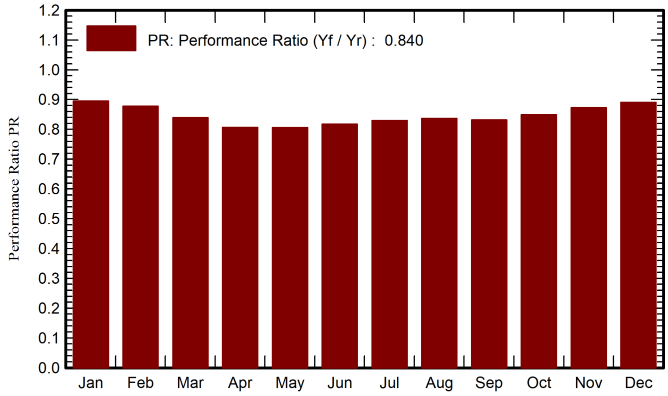
System Production

Produced Energy (P50)	533044 kWh/year	Specific production (P50)	1470 kWh/kWp/year	Perf. Ratio PR	83.98 %
Produced Energy (P75)	511903 kWh/year	Specific production (P75)	1411 kWh/kWp/year		
Produced Energy (P90)	492833 kWh/year	Specific production (P90)	1359 kWh/kWp/year		

Normalized productions (per installed kWp)



Performance Ratio PR



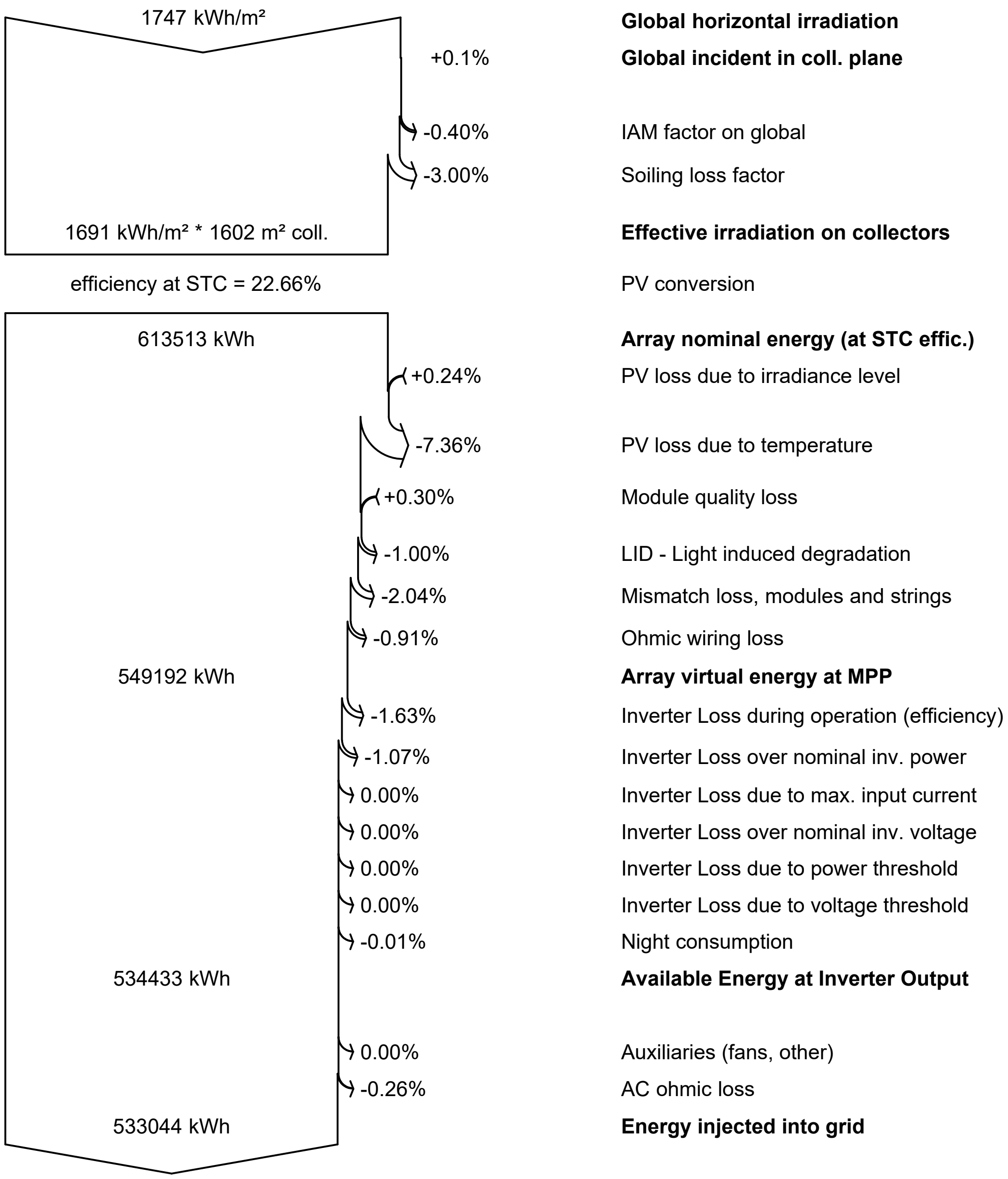
Balances and main results

	GlobHor kWh/m²	DiffHor kWh/m²	T_Amb °C	GlobInc kWh/m²	GlobEff kWh/m²	EArray kWh	E_Grid kWh	PR ratio
January	92.0	52.8	13.10	92.2	88.9	30562	29937	0.896
February	122.4	56.9	16.50	122.9	118.7	39904	39115	0.878
March	175.8	75.4	22.20	176.2	170.3	54658	53607	0.839
April	193.3	88.6	28.70	193.6	187.3	57778	56696	0.807
May	194.5	105.3	32.50	194.6	188.1	57937	56880	0.806
June	163.6	100.3	33.00	163.5	158.0	49421	48512	0.818
July	142.9	96.5	30.10	142.8	137.8	43785	42956	0.830
August	152.3	92.8	28.90	152.3	147.1	47116	46221	0.837
September	154.6	77.9	28.10	154.8	149.6	47589	46693	0.831
October	147.9	73.9	25.30	148.2	143.3	46543	45668	0.849
November	111.1	59.6	20.20	111.5	107.6	35976	35274	0.872
December	97.0	52.4	15.09	97.4	94.0	32132	31484	0.891
Year	1747.4	932.4	24.51	1749.9	1690.6	543400	533044	0.840

Legends

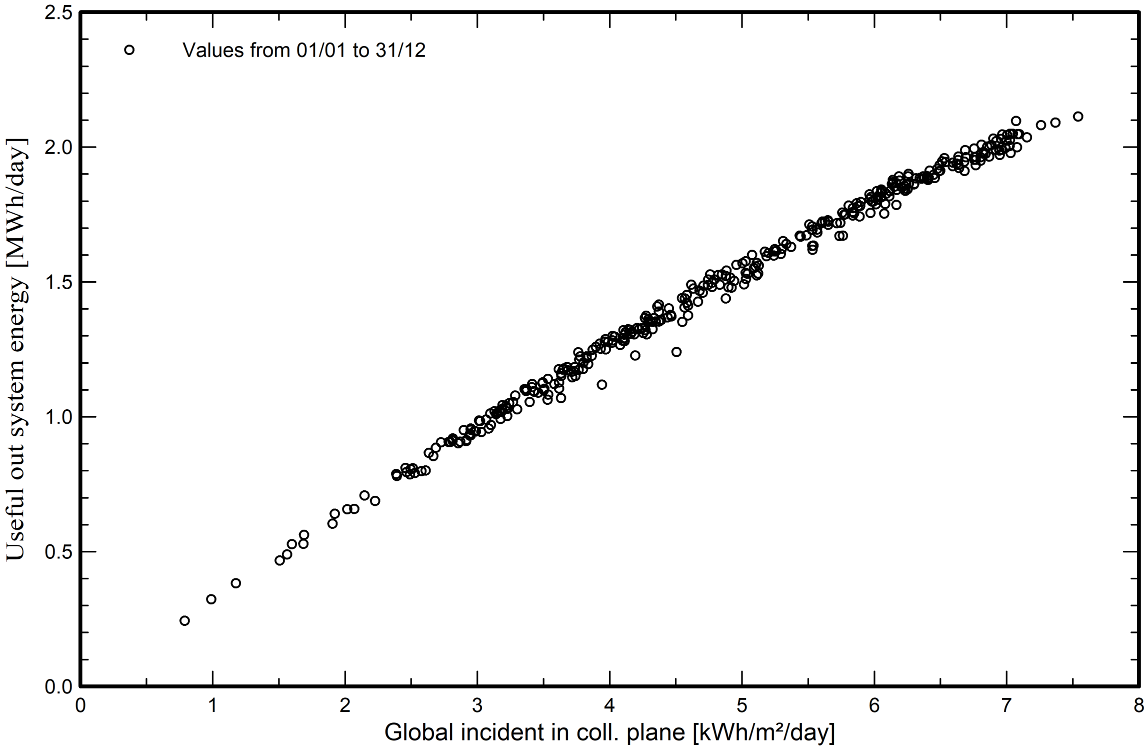
GlobHor	Global horizontal irradiation	EArray	Effective energy at the output of the array
DiffHor	Horizontal diffuse irradiation	E_Grid	Energy injected into grid
T_Amb	Ambient Temperature	PR	Performance Ratio
GlobInc	Global incident in coll. plane		
GlobEff	Effective Global, corr. for IAM and shadings		

Loss diagram

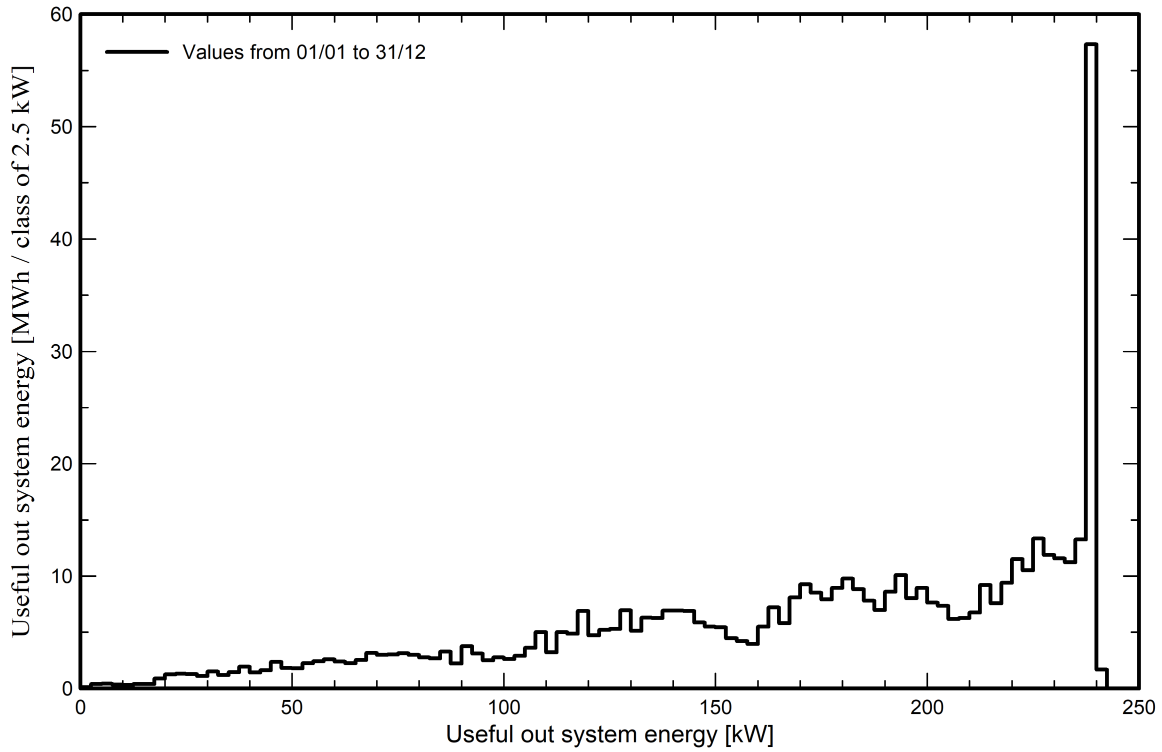


Predef. graphs

Daily Input/Output diagram



System Output Power Distribution



P50 - P90 evaluation

Weather data

Source	SolarGIS Monthly aver. , period not spec.
Kind	Monthly averages
Synthetic - Multi-year average	
Year-to-year variability(Variance)	5.6 %

Specified Deviation

Climate change	0.0 %

Global variability (weather data + system)

Variability (Quadratic sum)	5.9 %

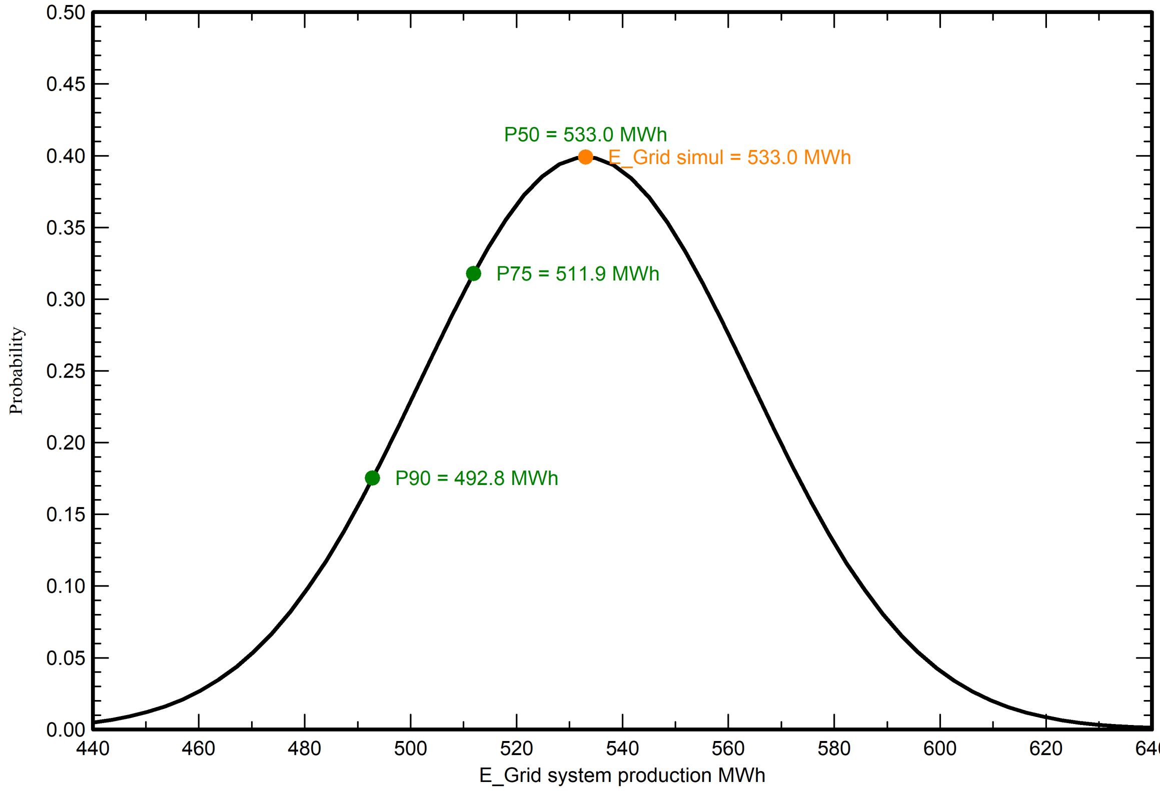
Simulation and parameters uncertainties

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

Annual production probability

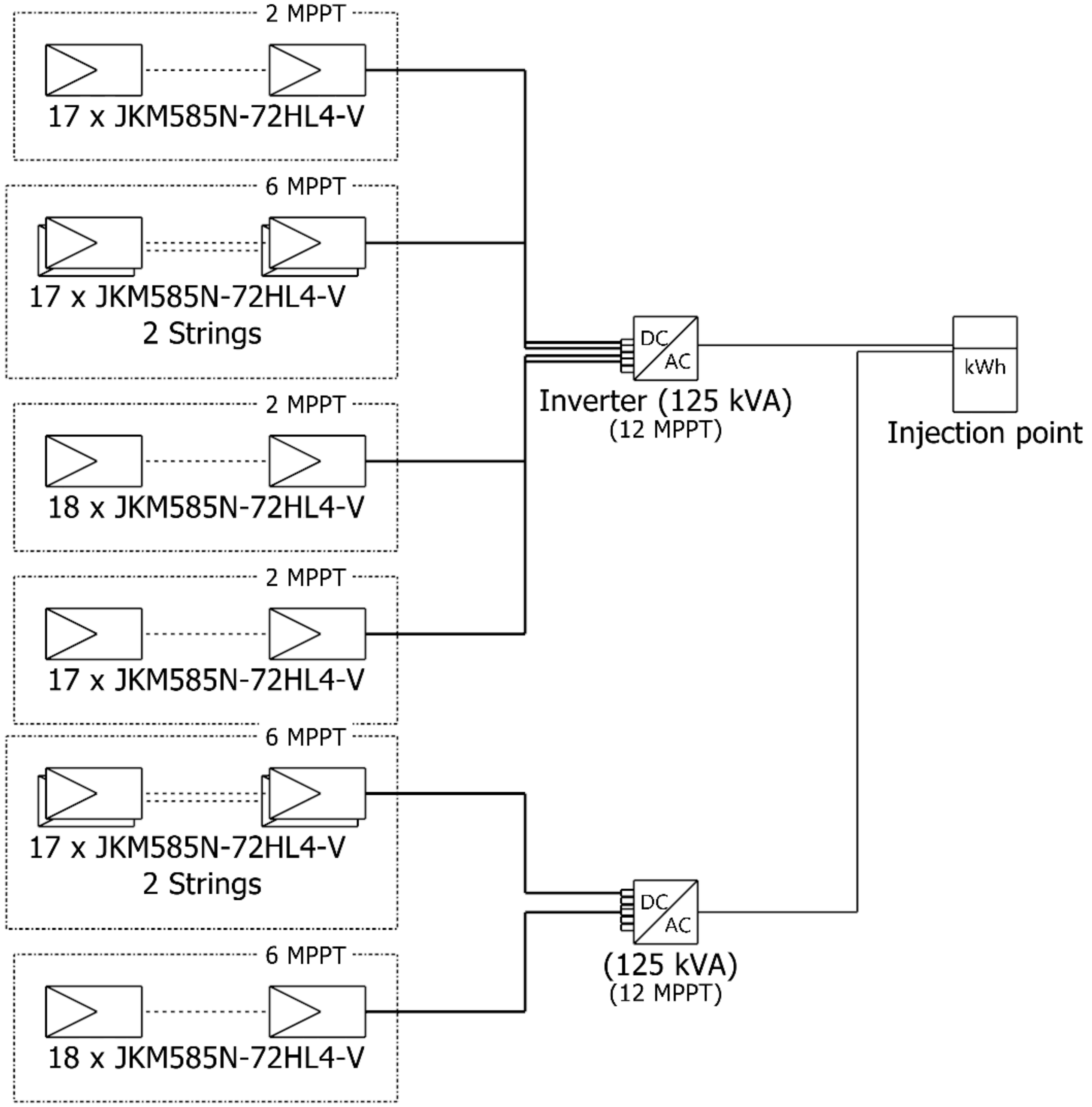
Variability	31.4 MWh
P50	533.0 MWh
P75	511.9 MWh
P90	492.8 MWh

Probability distribution



Single-line diagram

PVsyst V7.4.8
VC1, Simulation date:
12/03/25 15:37
with V7.4.8



PV module	JKM585N-72HL4-V
Inverter	SG125CX-P2
String 1 String 2	17 x JKM585N-72HL4-V 18 x JKM585N-72HL4-V

	BSL KHARKHODA with Solargis	Solo Power (India)
	VC1 : New simulation variant	12/03/25

BILL OF MATERIAL

Site Name : Bharat Seats Limited, Kharkhoda					
362.7 kWp Solar Photovoltaic Power Plant					
EPC Developer: - Sunbeam Real Venture Pvt Ltd.			25-04-2025		
			Prepared By : Ayush Kumar		
Client : Bharat Seats Limited, Kharkhoda			Checked By : Ankit D.		
Sr. No.	**Components on Supply**	**Technical Specification**	**MAKE**	**UOM**	**Quantity**
1	Solar PV Module	585 Wp	Jinko	NOS.	620
2	Inverter	125 KW	Sungrow	NOS.	2
3	RMS		Standard	NOS.	1
4	ACDB	2-in(1R-3.5C-240 Sq.mm AL with 250A 4P MCCB) and 1 out(2R-3.5C-240 Sq.mm AL with 500A 4P MCCB) with AL BUSBAR, IP5X at 415V	Standard	NOS.	1
5	MFM	CT Ratio 500/5A, 0.5 Class in ACDB	Secure	NOS.	1
6	DC Cable	DC Solar cable 4 Sq.mm. (Single core,XLPO-UV stabilized) as per TUV 2Pfg 1169/08 2007, CE	Seichem/Polycab	Meter	6700
7	AC Cable	Al-3.5C-XLPE(1.1 kV), 240 Sq.mm. ,Class 5 Multistrand, Armoured	Seichem/Polycab	Meter	360
8	Earthing Cable	4 Sq. mm 1C Cu	Seichem/Polycab	Meter	280
		50 sq.mm 1C cu	Seichem/Polycab	Meter	15
9	Earthing Strip	25 x 3 mm GI FLAT for DC & AC	Seichem/Polycab	Meter	400
10	Earthing Electrode	17.2 mm dia and 3 meter long CU Coated(250 Microns) Steel Rod Earthing Electrode with 22.5 kg Earthing Backfill Compound Chemical, with Pre Cast Chamber pit cover,Electrode	JMV/VNT/Standard	NOS.	4
11	Lightning Arresters	Level III with 95 m radius With 1C 50 Sq.mm Cu Down Conductor, With 3m Mast Height with 17.2 mm dia and 3 meter long CU Bonded Earthing Electrode, 1 set with 2 Electrode	Onay Plus	Set	1
		50 Sqmm down conductor	Standard	Meter	50
12	Safety Life Line		Standard	Meter	350
13	Walkway	300mm wide GI	Standard	Meter	350
14	Mesh for Skylight	20X0.5 Meter	Standard	NOS.	20
15	Module mounting Structure	Flush Mount Structure_Standing seam with clamps	Standard	kWp	362.7
16	DC Cable Tray with Cover	40mmx25mm Perforated type	Standard	Meter	160
		70mmx40mm Perforated type	Standard	Meter	125
		130mmx40mm Perforated type	Standard	Meter	35
17	AC Cable Tray	200mmx75mm Ladder type	Standard	Meter	160
18	MC4 Connector		Standard	Set	260
19	Sensor	Pyranometer, Ambient Temperature & Module Temperature Sensors	Standard	NOS.	1
20	Fire Protection	ABC Type		Set	2
21	Communication Cable	RS 485 cable	Standard	Meter	400
		HDPE Conduit Pipe 40 mm Dia	Standard	Meter	400
22	Module Cleaning System	1 " UPVC Pipe	Standard	Meter	70
		0.75" UPVC Pipe	Standard	Meter	230
		Flexible Rubber Pipe	Standard	Meter	30
		Ball Valve	Standard	Nos.	15
		Gate Valve	Standard	Nos.	5
		Motor	Standard	Nos.	1
23	Others	In Line Connectors (Pin & Ring type lugs), Insulators, Ferrules & Cable Tags, Silicon Sealant, Safety Tags, Electrical Tapes, PVC Clips, Anticorrosive Paste, Cable ties, Stainless Steel Screws, Nuts, Lugs, Bolts etc.	As Requirement		

This Bill Of Material can be change as per Site Condition