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Welcome to the Webinar on

Selecting critical components for Solar power plant

Time: 6 pm onwards (IST)

In conversation with

Mr. Jayachandra M.A.
Head - Rooftop and Distributed Solar BU
STERLING & WILSON

Mr. Gaurav Wadhwa
Head - Design Engineering & PE
ReNew POWER

Mr. Abhay Raina
Head - EPC
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Moderated by

Mr. Prashant Mathur
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Webinar on Selecting critical components for solar power plant

Organized by : M/s Adani Solar

15TH MAY 2020

M.A.JAYACHANDRA

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About Parent Company

Strong Parentage

- Shapoorji Pallonji and Company Private Limited – Holding Company
- Over 150 years of experience
- Headquartered in Mumbai
- Operations across 45 countries

BUSINESS AREAS

EPC | Infrastructure | Energy | Real Estate | Water

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Our Solar Journey

2011
- Diversified into Solar Operations in India with 1 MWp Elevated project in New Delhi
- EPC Projects of capacity 50 MWp

2012
- 36 MWp EPC Rajasthan, India
- Started International Solar Operations

2013
- 40 MWp Solar Park commissioned in Rajasthan, India
- Best Solar EPC Award by EY

2014
- 90 MWp South Africa and 51 MWp Philippines
- 300 MWp Commissioned

2015
- Largest Tracker Plant in India (60 MWp)
- Inter Solar Award 2015
- 9th Largest Global Solar EPC
- 50 MW NTPC in India

2016
- 6th Largest Global Solar EPC and 1st outside USA and China
- Cumulative 1 GW commissioned projects

2017
- India's No 1 Solar EPC
- World No. 2 Solar EPC
- 1223 MWp Commissioned in India
- 120 MWp Commissioned in Karnataka.
- Bagged 1177 MWp in Abu Dhabi

2018
- 1.63 GWp of Commissioned Projects.
- 1.3 GWp Commissioned in India.
- 86 MWp in South Africa.
- 52 MWp in Kenya

2019
- 2.17 GWp commissioned outside India
- 3.57 GWp commissioned in India
- 360 MWp won in Chile
- 125 MWp won in Oman

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Business Snapshot

- Began operations in 2011
- 183 solar power projects
- Presence in 26 countries
- O&M services to 82 solar projects
- Portfolio of 6.06 GWp
- 1179 Solar Professionals
- World's Largest Solar EPC Solutions Provider in 2018
  based on annual installations of utility-scale PV systems of more than 5 MWp, by IHS Markit
- Market share of 4.6% in 2018*

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Market Presence

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Business Overview

Solar EPC Portfolio

183 projects - 6062.83 MWp

India	South East Asia
158 projects - 3634.34 MWp	4 projects - 322.90 MWp

MENA	Rest of Africa	US and Latin America
11 projects - 1666.43 MWp	6 projects - 336.35 MWp	4 projects - 102.81 MWp

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Rooftop - Business Offering

Industrial Segment

Institutional Segment

Commercial Segment

Solar Park

- Design, engineering, Supply, Installation and Commissioning services of grid connected solar PV systems.
- Turnkey Engineering, Procurement & Construction of Distributed Solar PV systems.
- Single System capacities up to 5 MWp Domestic / 20 MWp International
- AMC/ O&M of the Installed Plant

Resource Map

- Business Development team strategically positioned
- Dedicated Project Planning & Execution teams
- Decentralized design teams for speedy delivery

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Types of Systems

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- Grid connect systems - sheet roof mounting / Flat roof mountings.
- Elevated Ground mounted systems, carport structures.
- Building Integrated PV (BIPV)
- Both LT or HT evacuation
- Off-grid / Solar with Storage solutions.
- Mini-grid and Micro-grid Solutions

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Typical System Components

PV Modules

- Polycrystalline.
- Mono-crystalline.
- Thin Film.

Module Mounting Structures.

- Aluminium Structures, GI structures.

Cables

- DC cables
- AC cables
- Communication cables

Inverter /PCU

- Grid Tie Solar Inverter .
- Off-Grid Solar PCU.
- Hybrid PCU.

Other BOS Materials as required

ACDB / LT Panels

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1. PV Module

- **Cells / Architecture**
  - Poly crystalline / PERC
  - Mono crystalline /PERC / Bifacial
  - Thin films
- **Construction:**
  - Glass + opaque back sheet
  - Glass to Glass – clear tedler
  - With Aluminum / PVC frame
  - Frameless
- **Variables:**
  - No of cells -60 cell / 72 cell
  - Wattage rating - 330 to 500 Wp
  - Glass thickness
  - Frame size (L , B, H)
  - Mounting hole location (in frame – Portrait/ Landscape)
  - JB location
  - Cable lengths

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2. Structures

- **Type of Mounting surface:**
  - RCC flat /sloped roofs/ Decked roofs
  - Sloped sheet roof – GI sheet / Asbestos sheet
  - Curved sheet roofs / Parking roofs
- **Material of Construction:**
  - Aluminum Extruded sections
  - Galvanized steel structures
  - Painted MS structures
  - FRP / Molded PVC structures
- **Variables:**
  - Long rail / short rail / Trapezoidal / clip lock
  - Penetrating / non penetrating
  - With foundations / with Ballasts / Water proofing protection
  - Module - Bolting arrangement / Clamping arrangement
  - No of rows per structure table.
  - Hight of module from sheet / roof surface
  - Wind speed considerations

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3 . Inverters

- Type : Central / String inverters / with optimizers
- Architecture : Single / Multiple MPPT / AC voltage
- Communication : built in protocols / compatibility with external data loggers / SCADA
- Capacity : Range available up to 250 KW in string and up to 5 MW in Central inverters.
- Cabling : Acceptance of copper / Aluminum cables, Requirement of special connectors (on AC side)
- Mounting : Out door / Indoor

  Ground mounted /sheet mounted / wall mounted / frame mounting

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4 . ACDB / LT panels

- Mounting Location :
  - Ground / Roof mounted/ wall mounted
  - out door / indoor. (IP rating)
- Cable Entry : Bottom / Top / side
- Components / Construction:
  - Component Ratings – voltage, Amperage and temperature
  - MOC of Busbar
  - Short circuit rating __KA / __ sec. / Type test approvals
  - Spare feeder requirements
  - Special features required – Indicators / Displays / controls / Meters
  - Busbar spacing – No of cable end terminations.
  - Access for maintenance
  - LOTO provisions

Factors affecting selection of critical component of PV plant

Adani Cell & Module Manufacturing Plant

- Adani Solar has India's largest integrated cell and module manufacturing facility of 1.5 GW
- All facilities are ISO 9001:2008 and ISO 14001:2004 certified and meet highest industry standards
- In-house testing facility For Cell sorting & Module flash test
- Strict adherence to Electroluminescence Testing ensuring micro-crack free Modules

- State of art facility (3 floor architecture) built in a year
- Best in class equipment from European suppliers
- Energy efficient building with IGBC Platinum rating

To be ramped up to 3 GW

Adani Solar Turn Key EPC Offerings across segments

Ground Mounts

RCC roofs

Car Park

Solar Water Pumps

Floating Solar

Industrial roofs

Solar PV Project

1. Land Acquisition / RoW
2. Regulatory Clearances
3. Power Purchase Agreements
4. Financial Closure
5. Selection & Sourcing of Materials
6. Project Execution
7. Operation & Maintenance

Solar EPC

Factors for Selection of Critical Components

1. Preliminary Inputs
2. Factors affecting the design of SPV Plant
3. Factors affecting the performance of SPV Plant
4. Levelized Cost of Energy (LCOE)

Preliminary Inputs

- Location of the plant, Land and Soil Type
  - Latitude / Longitude
  - Solar Park or Private land
- Capacity of the plant
  - As per the tender requirement
  - As per connected load details (mostly for private enquiry / Rooftops)
- Expected Generation (CUF)
- Distance of Transmission line
  - Park
  - Private Land
- Connection voltage / Power Evacuation

Factors affecting the design of SPV Plant

- **Plant location (or site specific parameters)**
  - ✓ Latitude / Longitude (Northern / Southern hemisphere)
  - ✓ Irradiation level (Solar insulation level)
  - ✓ Ambient temperature (temperature co-efficient & string length)
  - ✓ Wind Speed and direction
  - ✓ Type of soil (for foundation design and earthing system design)
- **Type of installation**
  - ✓ Ground mounted system (with flexibility to design the plant as we require)

    Fixed type MMS / Single Axis Tracker / Seasonal tile MMS
  - ✓ Roof mounted system (metal roof / RCC roof with limited flexibility)

    - Fixed type MMS (at optimum latitude or as per existing roof slope)
- S**ystem Voltage & Grid connection voltage (Solar plant synchronization voltage level)**
  - Solar plant system voltage (1000 V or 1500 V)
  - Grid connection voltage (415 V / 11 kV / 22 kV / 33 kV / 66 kV / 132 kV)

Factors affecting the design of SPV Plant

- Shadow effect
  - Self shadow (inter row shadow)
  - Shadow from surrounding object (like LA, building, trees etc.)
- Technology of PV Module
  - Crystalline silicon (mono / poly crystalline)
  - Thin film PV modules
- Type of Inverter
  - Central Inverter (mostly used for large scale plants)
  - String inverters (mostly used for small scale plants)
- Electrical losses
  - Cable losses (DC, AC cable losses, transmission line losses)
  - Transformer losses (no load or full load losses)

Performance of SPV Plant

- The solar plant performance is measured by:
  - Plant Load Factor (PLF / CUF)
  - Performance Ratio (PR)
    - ✓ Performance ratio is a measure of the quality of a PV Plant that is independent of location and it therefore often described as a quality factor.
    - ✓ PR is stated as percent (%) and describes the relationship between the actual and theoretical energy output of the PV Plant
- Factors affecting the performance
  - Solar irradiation / solar insulation
  - Ambient temperature
  - Soiling on PV Module
  - Routine maintenance (i.e. transformer oil filtration, tightening of electrical connections, cleaning of filters etc. to minimize the down time)
  - Grid availability

Selection of Technology

1

- **Selection of Modules**

- Multi Crystalline

/

- Mono PERC Crystalline

/

- Bi- Facial (P - Type / N – Type)

2

- **Selection of Structure**

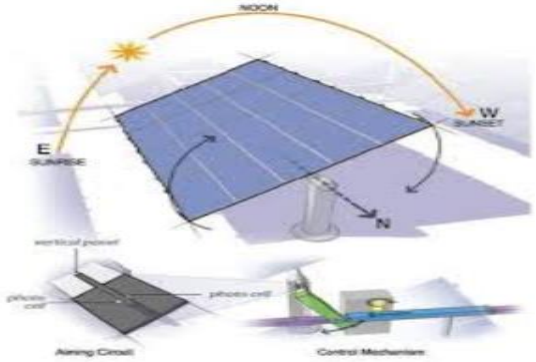
- Fixed Type

/

- Single Axis Tracker

/

- Seasonal Tilt.



3

- **Selection of Inverter**

- Central Inverter

/

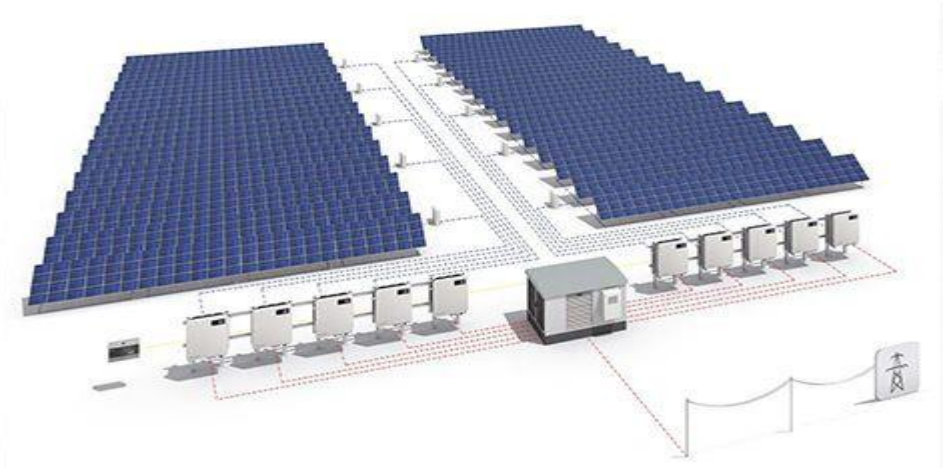
- String Inverter

/

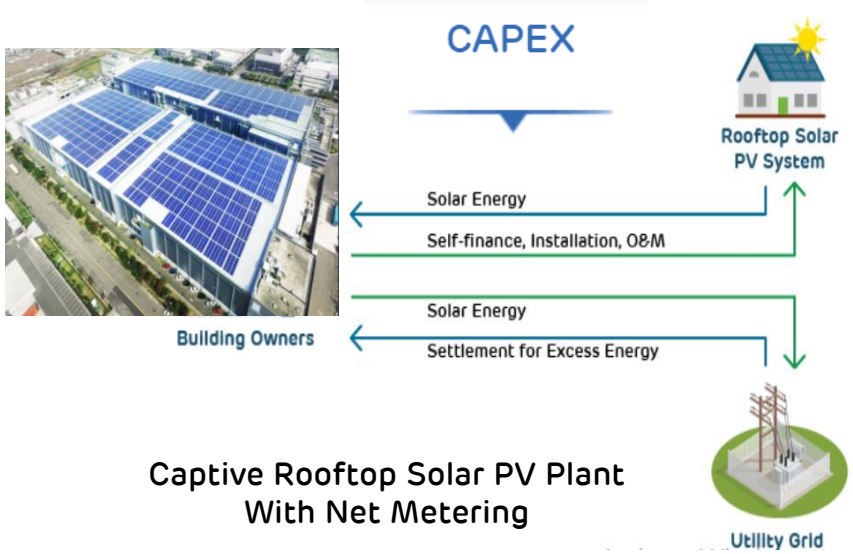
- PCU - for Storage Solutions

Different types of solar PV Plant

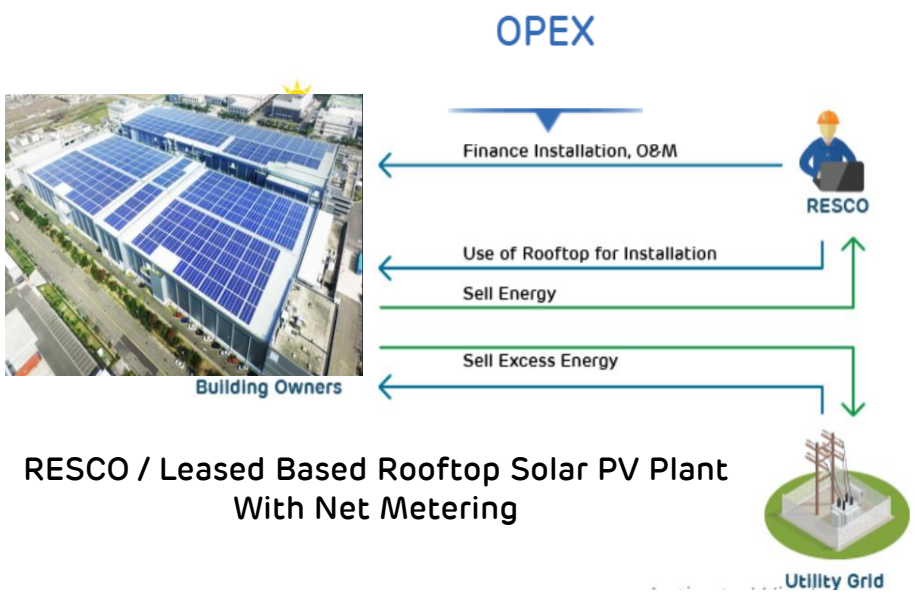
Solar Plant with Central Inverter



Solar Plant with String Inverter

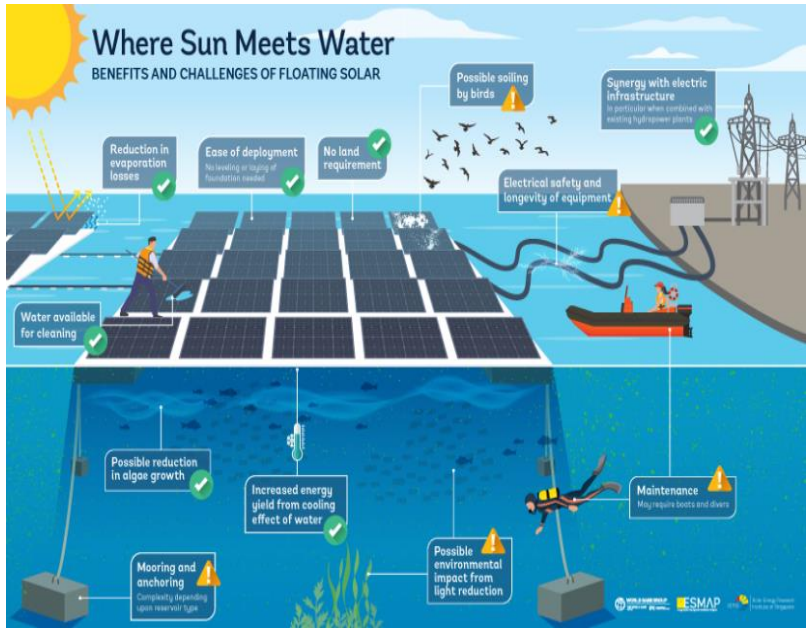


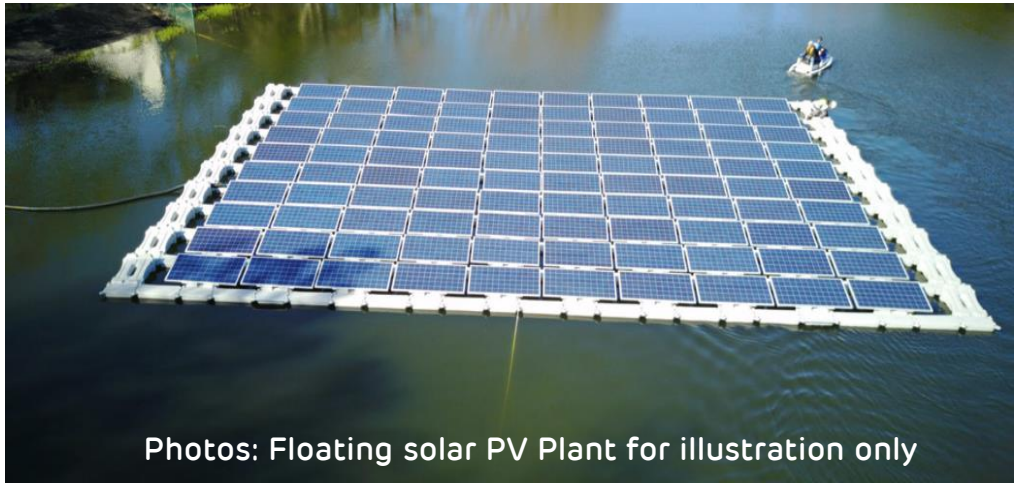
Captive Rooftop Solar PV Plant
With Net Metering



RESCO / Leased Based Rooftop Solar PV Plant
With Net Metering

Floating Solar PV Plants





Photos: Floating solar PV Plant for illustration only

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Thank You