An overview & Performance Analysis of 5 MWp Solar PV Plant at Khimsar, Rajasthan

Reliance Industries Limited

June 2, 2011
Contents

A. 5MWp SPV Plant at Khimsar, Rajasthan
B. 5MWp SPV Plant – Installed Technologies
C. 5MWp SPV Plant – Installed components
D. 5MWp SPV Plant – Challenges
E. 5MWp SPV Plant - Performance
5MWp ground mounted Grid connected SPV power plant in Khimsar, Rajasthan

- Largest SPV Plant in India with multiple technologies installed at a single location
- Evaluation of all existing and emerging technologies.
- World class Installation practices resulting in
  - Low O&M Cost
  - Highest performance factor
  - High Efficiency

RIL Solar has commissioned India’s largest ground mounted system with state-of-the-art technology
5MWp Plant : Salient Features

1. Location
   i. State          Rajasthan, India
   ii. Locality      Nagaur  district
   iii. Latitude     23.9 N
   iv. Longitude     73.4 E

2. Area of SPV Plant
   i. Area          35 acre
   ii. Location     Khimsar

3. SPV Power Plant
   i. Capacity      5 MWp
   ii. No. of Modules 24841
   iii. No. of Modules in series 18/20 modules per string
4. Technical details of a SPV Module

(a) PV Module type

Crystalline silicon

(b) Physical Dimensions

i. Length of frame 1500 mm

ii. Width of frame 990 mm

iii. Thickness 36 mm

5. Mounting Arrangement

i. Mounting Fixed (Ground mounted)

ii. Tilt angle (Slope) of PV module 26 deg
# 5MWp Plant: Salient Features

## 6. Inverter/Power Conditioning Unit (PCU)

<table>
<thead>
<tr>
<th>Feature</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>i. Number of units</td>
<td>432</td>
</tr>
<tr>
<td>ii. Rated Capacity</td>
<td>11 KVA</td>
</tr>
<tr>
<td>iii. Input Voltage Range</td>
<td>333 - 500V DC</td>
</tr>
<tr>
<td>iv. Output Voltage</td>
<td>230 V single phase</td>
</tr>
<tr>
<td>v. Frequency</td>
<td>50 Hz</td>
</tr>
<tr>
<td>vi. Efficiency</td>
<td>98 %</td>
</tr>
</tbody>
</table>

## 7. Grid Connection Details

<table>
<thead>
<tr>
<th>Feature</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>i. Electrical interconnection</td>
<td>33 kV, 4 pole sub station</td>
</tr>
</tbody>
</table>

## 8. Annual Energy Generation

<table>
<thead>
<tr>
<th>Feature</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>i. Annual Generation (estimated)</td>
<td>7.5 million units (per year)</td>
</tr>
</tbody>
</table>

## 9. Construction Time

<table>
<thead>
<tr>
<th>Feature</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>6 months</td>
</tr>
</tbody>
</table>
5MWp Plant location details

Map showing the location of Khimsar in relation to other major cities and stations.
## 5MWp Plant – Implementation Phases

<table>
<thead>
<tr>
<th>Phases no.</th>
<th>Project Phases</th>
<th>Phase Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Design phase</td>
<td>Designing of 5MWp System</td>
</tr>
<tr>
<td>2</td>
<td>Development phase</td>
<td>Development of System Components</td>
</tr>
<tr>
<td>3</td>
<td>Pre-installation phase</td>
<td>Inspection of input materials</td>
</tr>
<tr>
<td>4</td>
<td>Installation phase</td>
<td>Inspection/Audit of construction material and activities</td>
</tr>
<tr>
<td>5</td>
<td>Commissioning phase</td>
<td>Verify all installations against requirements</td>
</tr>
<tr>
<td>6</td>
<td>Post commissioning phase</td>
<td>Inspection of commissioned plant and machineries</td>
</tr>
<tr>
<td>7</td>
<td>Operational phase</td>
<td>Inspection / Audit and Monitoring of records and data for analysis</td>
</tr>
</tbody>
</table>
5MWp Plant – Construction phase
5MWp Plant - Array Layout
5MWp Plant - Power generation stages

- Solar modules are connected in series/parallel to form solar array
- Three 1-ph Inverters configured for 3 ph grid interface
- One Sub Power Junction Box (SPJB) for three Inverters
- Main Power Junction Box (MPJB) for Three SPJB’s
- One LT Panel for 16 MPJB’s (415V) for each 2 MVA transformer
- HT Panel for three transformers 2MVA each
- HT panel connection to 4 pole 33 KV feeder line with digital metering
Contents

A. 5MWp SPV Plant at Khimsar, Rajasthan
B. 5MWp SPV Plant – Installed Technologies
C. 5MWp SPV Plant – Installed components
D. 5MWp SPV Plant – Challenges
E. 5MWp SPV Plant - Performance
India’s first 5MW plant wherein multiple PV technologies are showcased for the purpose of performance evaluation of each technology.
Contents

A. 5MWp SPV Plant at Khimsar, Rajasthan
B. 5MWp SPV Plant – Installed Technologies
C. 5MWp SPV Plant – Installed components
D. 5MWp SPV Plant – Challenges
E. 5MWp SPV Plant - Performance
5MWp Plant - Installed Components

- Single phase – 11KVA String Inverter
- Main Junction Box
- Insolation measurement Device
- LT Panel 415V
- Sub Junction box

All components were chosen after detailed specifications’ study
5MWp Plant - Installed Components

**Module Mounting Structure**
- Galvanized steel structures designed to withstand 200 kmph wind load

**33KV Feeder to Grid**
- Equipped with measuring units & protections

**HT Panel 33KV**
- Each feeder has vacuum circuit breaker in it

**Gang Operating Switch**
- To operate at no load condition

**Transformer 415V/33KV, 2MVA**
- Critical components of plant are from well known leading equipment suppliers
5MWp Plant - Installed Components

- Sealed Energy meters installed by AVVN to measure export of Energy
- Standby Energy meters interfaced with SCADA
A. 5MWp SPV Plant at Khimsar, Rajasthan
B. 5MWp SPV Plant – Installed Technologies
C. 5MWp SPV Plant – Installed components
D. 5MWp SPV Plant – Challenges
E. 5MWp SPV Plant - Performance
5MWp Plant - Challenges

Mar - April 2010:
- > 47 Deg C temp.
- No work (11am to 5 pm)

May 2010:
- Dust storm and Twister
  (1st & 2nd week)
- High Temp. - no work
  (11am to 5 pm)

June - July 2010:
- Heavy Cyclone and Flooding
  (1st week)
- High Temp. - no work
  (11am to 5 pm)
33 kV Transmission line:

- Newly constructed 5km Transmission line from the 220 kV sub-station
- Commissioned just two days before
- Managed testing within available time
To get the optimum energy generation from the plant, O&M plays an important role with following key roles:

- Solar PV Modules cleaning
- Rigidity of electrical connections
- Tightness of Mechanical assemblies
- Verification of designed protections
- Ensure proper earthing & grounding

A dedicated O&M team is committed to achieve maximum uptime of SPV plant
5MWp Plant – Performance at a glance

Average Capacity Utilization Factor (CUF) of 19.5% achieved
Thank you

Reliance Industries Ltd - Solar Group
Reliance Corporate Park
Building 5C, First floor
Thane-Belapur Road, Ghansoli
Navi Mumbai-400701

www.relsolar.com
sales.reliancesolar@ril.com