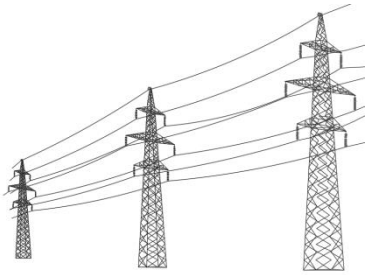
Sustainable Energy Design P/L
Level 3 Electrical Engineers



Solar PV Design Concept Report
Lachlan River and Akuna Road Pump Stations
Parkes Shire Council

Rev: 00
Issue Date: 29/04/2024

Document Title: Solar PV Design Concept Report

Project: Lachlan River and Akuna Rd Pump Stations

Author: Shinto Jose

Checked: Martin Davis

Rev	Date	Comments
00	29/04/2024	Initial Submission

SUSTAINABLE ENERGY DESIGN P/L
ABN: 84 100 777 955
1/10 Hawthorn Place
Orange NSW 2800

Office: 02 6361 7567
projects@sed.net.au
www.sed.net.au

Sustainable Energy Design P/L

Level 3 Electrical Engineers

Parkes Shire Council is proposing a grid connected PV system at their Lachlan and Akuna Rd Pump station sites to offset the site load as well as to export the excess energy.
Sustainable Energy Design Pty Ltd was engaged by the council to prepare a concept design report for the proposed PV systems at Lachlan and Akuna road pump stations.
This design report summarises the considered project aspects and calculations including Product selection, PV orientation along with sizing and yield calculations.

Lachlan River site

Inverter chosen: 6 x Sungrow SG110 CX
Panels chosen: 440 W Trina Vertex
Frame arrangement: Fixed frame with 2 panels in portrait

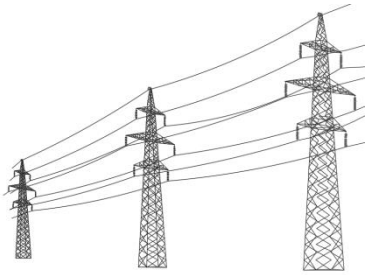
Tilt angle calculation

Panel Dimensions: 1762 mm x 1134 mm
Tilt angle should be with 5-10 degrees of the latitude of location
Latitude of site: 33.38 degrees
So tilt angle chosen is 30 degrees which is with 5 to 10 degrees of the latitude of 33.38 degrees.

SUSTAINABLE ENERGY DESIGN P/L
ABN: 84 100 777 955
1/10 Hawthorn Place
Orange NSW 2800

Office: 02 6361 7567
projects@sed.net.au
www.sed.net.au

Sustainable Energy Design P/L
Level 3 Electrical Engineers



Vertical Height Calculation

Module length = 2 panels in portrait = 2 x 1762 = 3524 mm
Allowing 20 mm space between panels = 3524 + 20 = 3544 mm
Vertical height = sin (tilt angle) x module length
So Vertical height = sin (30) x 3544 = 1772 mm

Shadow length calculation

Shadow length behind module = vertical height x {cos (azimuth angle) / tan (altitude angle)}

The idea is to calculate the minimum row spacings to ensure that shading from front row panels is avoided between 8am to 4pm.A worst case date of June 21(winter solistice) is chosen.
The Azimuth angle and Altitude angle was obtained from Geoscience Australia website for Winter Solstice (June 21) at 10 am and 2 pm.

Calculation @ June 21, 10 am
Altitude Angle= 25.40 deg
Azimuth Angle= 32.88 deg
Shadow length= 1772 x {cos (32.88)/tan (25.40) = 3134 mm

Calculation @ June21, 2 pm
Altitude Angle= 27.39 deg
Azimuth Angle= 331.33 deg
Shadow length= 1772 x {cos (331.33)/tan (27.39) = 3000 mm

So the minimum row spacing is established to be 3134 mm.

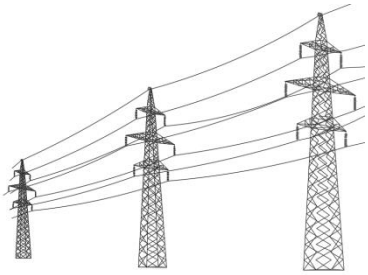
We recommend a minimum row spacing of 4 m which further reduces the self-shading effects.

We did calculate the shadow lengths at 8 am, 9 am, 3 pm and 4 pm for the same day (June 21) before arriving at the recommended 4 m row spacing.

Ground Mount Frames

Please refer to drawings for details.
An example product would be PV-ezRack®SolarTerrace II-A™. Similar product could be employed.
Minimum spacing (from edge of panels to panels) should be 3134 mm.
Panel Stringing

18 panels in one string.
Each frame has 2 sets of 18 panels in portrait.
Each row has 3 such frames.
Total no: of rows is 18 arranged as 9 rows each side. Each inverter takes 3 rows of panels.
Inverters chosen: 6 x Sungrow SG110CX
Total No of panels= 1944
DC size= 1944 x 440= 855 kW
AC size= 6 x110= 660 kVA



Orientation

Three cases were chosen for analysis using PVsyst.

Case 1: North: all panels oriented North.
Case 2: North West : All panels oriented North west (parallel to the lagoons/ponds onsite).
Case 3: North west and North East: Half of the panels oriented north west and the other half oriented north east.

Daily /hourly/yearly production were obtained using Pvsyst and compared for each of the cases .

Findings are,

Total production:

North: 1455 MWh/year
North West: 1415 MWH/year
North West and North East: 1384 MWH/year

Daily Production

4 dates were chosen June 21, Dec 21, March 21 and September 21

- North:

June 21 (Shortest day): 3293 kWh/day
Dec 21 (Longest day): 5047 kWh/day
March 21: 4406 kWh/day
September 21: 4722 kWh/day

- North West:

June 21 (Shortest day): 3092 kWh/day
Dec 21 (Longest day): 5116 kWh/day
March 21: 4274 kWh/day
September 21: 4488 kWh/day

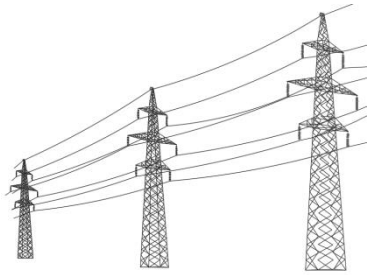
- North West and North East:

June 21 (Shortest day): 2850 kWh/day
Dec 21 (Longest day): 5144 kWh/day
March 21: 4176 kWh/day
September 21: 4376 kWh/day

The findings are, North orientation yields the highest yearly production.
With daily production, the north orientation yields the highest for all dates except for Dec 21. For Dec 21(summer), the highest production is seen for North west/North east orientation followed by North West orientation.

It is clear that the North orientation clearly wins followed by North West orientation. The North West and North East mixed orientation yields the lowest of all the three options.

So North orientation was considered, however it seems that the north orientation takes up more site space compared to North west orientation.



Hence North West orientation is chosen as the preferred option. With this arrangement, the panels are parallel to the lagoons onsite and takes up the lowest spacing. No space goes wasted with this option still earning very close production figures to the North Orientation.

Staging

The system is designed such that the project can be staged easily.
The total size of the system is 855 kW DC/ 660 KW AC consisting of 6 x 110 kW Sungrow Inverters.
The stringing arrangement is such that each 3 rows of panels feeds a single 110 kW inverter.
So no: of inverters and corresponding rows of panels can be decided for each stage as required.
The one thing that needs to be considered in staged installation is that the main AC cable should still be sized for the total system size to avoid future issues. The main AC switch also should be sized to suit the full system size.

Concept:

Field distribution board takes AC cables from each inverter. Main cables connects the field distribution board to main LV switchboard. No building or shed proposed for housing the inverters nor the LV field distribution board. Inverters to be mounted under the panels .The field distribution board should be an appropriately IP rated free standing board.

Spare conduits are planned as per the drawings. These spare conduits to be extended to inverters as required.

The solar need to be nonoperational when the grid goes away and generator is connected. Or in other words, the solar should be turned off when generator is on.
Contactors and relays should be engaged to make this happen.

Sustainable Energy Design P/L

Level 3 Electrical Engineers

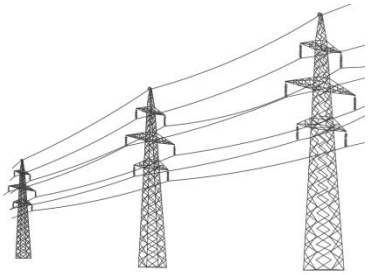
Akuna Rd Site

Inverter chosen: 6 x Sungrow SG110 CX
Panels chosen: 440 W Trina Vertex
Frame arrangement: Fixed frame with 2 panels in portrait
Panels chosen: 440 W Trina Vertex
Frame arrangement: Fixed frame with 2 panels in portrait

Tilt angle calculation

Dimensions: 1762 mm x 1134 mm
Tilt angle should be with 5-10 degrees of the latitude of location
Latitude of site: 33.16 degrees
So tilt angle chosen is 30 degrees which is with 5 to 10 degrees of the latitude of 33.16 degrees.

Sustainable Energy Design P/L
Level 3 Electrical Engineers



Vertical Height Calculation

Module length = 2 panels in portrait = 2 x 1762 = 3524 mm
Allowing 20 mm space between panels = 3524 + 20 = 3544 mm
Vertical height = sin (tilt angle) x module length
So Vertical height = sin (30) x 3544 = 1772 mm

Shadow length calculation

Shadow length behind module = vertical height x {cos (azimuth angle) / tan (altitude angle)}

The idea is to calculate the minimum row spacings to ensure that shading from from front row panels is avoided between 8am to 4pm.A worst case date of June 21(winter solistice) is chosen.
The Azimuth angle and Altitude angle was obtained from Geoscience Australia website for Winter Solstice (June 21) at 10 am and 2 pm.

Calculation @ June 21, 10 am
Altitude Angle= 25.62 deg
Azimuth Angle= 32.89 deg
Shadow length= 1772 x {cos (32.89)/tan (25.62) = 3103 mm

Calculation @ June21, 2 pm
Altitude Angle= 27.56 deg
Azimuth Angle= 331.22 deg
Shadow length= 1772 x {cos (331.22)/tan (27.56) = 2975 mm

So the minimum row spacing is established to be 3103 mm.

We recommend a minimum row spacing of 4 m which further reduces the self-shading effects.

We did calculate the shadow lengths at 8 am, 9 am, 3 pm and 4 pm for the same day (June 21) before arriving at the recommended 4 m row spacing.

Orientation

Two cases were chosen for analysis using PVsyst.

Case 1: North: all panels oriented North.
Case 2: North East: all panels oriented
Production was obtained using Pvsyst and compared for both the cases .

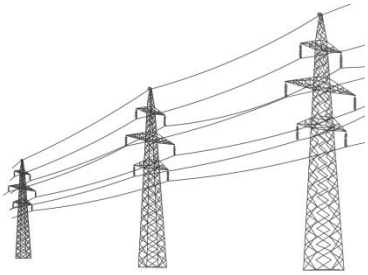
Total production:

North: 1570 MWh/year
North East (Azimuth -8.7 degrees): 1566 MWh/year

North orientation is chosen which matches with the orientation of existing panels on site as well therefore being the most space effective for the site.

SUSTAINABLE ENERGY DESIGN P/L
ABN: 84 100 777 955
1/10 Hawthorn Place
Orange NSW 2800

Office: 02 6361 7567
projects@sed.net.au
www.sed.net.au



Staging

The system is designed such that the project can be staged easily.
The total size of the system is 855 kW DC/ 660 KW AC consisting of 6 x 110 kW Sungrow Inverters.
The stringing arrangement is such that 3 of rows of panels feeds a single 110 kW inverter.
So no: of inverters and corresponding rows of panels can be decided for each stage as required.
The one thing that needs to be considered in staged installation is that the main AC cable should still be sized for the total system size to avoid future issues. The main AC switch also should be sized to suit the full system size.

Concept:

Field distribution board takes AC cables from each inverter. Main cables connects the field distribution board to main LV switchboard. No building or shed proposed for housing the inverters nor the LV field distribution board. Inverters to be mounted under the panels .The field distribution board should be an appropriately IP rated free standing board.

SUSTAINABLE ENERGY DESIGN P/L
ABN: 84 100 777 955
1/10 Hawthorn Place
Orange NSW 2800

Office: 02 6361 7567
projects@sed.net.au
www.sed.net.au