PV System Design: How to compete effectively in the wider market place

Commercial scale PV systems present enormous opportunities to our industry. However the requirements to source and verify a range of site-specific data over a large site is challenging. To then ensure this data correctly forms part of all aspects of the system's performance and installation requirements can be complicated and unfamiliar to some system designers and installers.

Possible scenarios: How to ensure the correct cable distances and gauges have been calculated; the site requires zero PV export or additional grid protection – what products support this and how are they programmed; how to avoid confronting the need for unplanned additional work on site; is the Bill of Materials for this installation comprehensive - are there sufficient materials to complete the installation? Clients often request financial data for the proposed installation: IRR, LCOE – as system designers, these calculations must be able to be justified by the system design and performance data. The prospect of engaging in quotations for larger installations is daunting – do you have the skill set to meet the market?

> *"A system design created by an engineering consultant provides the installer with complete information to deliver an installation efficiently and smoothly"*

Having a detailed site-specific system design will provide the Bill of Materials, the system cost range, and the system performance data in a clear and logical fashion. Once successful, this information will ensure a smooth installation process and that the system is delivered according to specifications.

In this article GSES outlines design techniques and supporting processes – these maximise installer's onsite efficiency, the required time for complete installation, the system costs and customer returns.

Why use a system design?

A system design created by an engineering consultant provides the installer with complete information to deliver an installation efficiently and smoothly. Using a specialist for this design work provides benefits, including:

- Increased margins – engineering design will optimise cable, module and racking locations resulting in quicker installation and reduced material requirements.
- Access to projects beyond current skill level – engineering design services can provide the the installation methodology for projects that require advanced control and monitoring systems using PLCs and zero export relays.
- Market access to larger project pools – larger projects often require detailed engineering designs that an installer does not have time to complete. An engineering consultancy can complete these and complement them with professional presentations to improve contract chances.
- Optimised installation processes and time – detailed designs optimise the installation of modules, cables, inverter and racking to reduce installation times.
- Maximise customer profits – detailed engineering designs provide the installer with accurate analyses of power generation and cost savings.
- Reduce return-to-site obligations – The detailed engineering design will provide a full account of all the materials and equipment

required, eliminating delays in sourcing of additional supplies

By using an engineering consultant for this type of work, additional services can be offered, such as DNSP liaison services, site assessments and power station registrations – all of which assist the installation process and ensure a smooth transition of control to the owner.

What comprises a System Design?

Preliminary and detailed system designs are a very obvious way to differentiate your installation practices from competitors. These documents provide the analytical platform underpinning the optimisation of system installation and performance. Important considerations include: shading, row spacing, module tilt and orientation, oversizing ratio, wiring runs and cable size.

A preliminary design offers information vital for winning a contract, including elements such as plan view diagrams, fly over video presentations, monthly power generation analyses, required design calculations and material costings.

A detailed design is the installation road map: it provides site layout plan drawings, string layout drawings, elevations, inverter station drawings, electrical drawings, protection and zero export schematics and a bill of materials. In addition the accompanying detailed report explains the design choices and installation methodology. An installer can safely follow these drawings knowing the system will meet the CEC, Australian Standards and best practice guidelines. GSES' design report also complies with the DNSP document requirements and can be submitted alongside the application to connect.

High quality system designs should contain the following:

- ***Site Assessment*** – A complete site assessment will include: the roof structure, roof obstacles, building height, shading, roof type, access, and existing electrics. This assessment can be conducted by the engineering consultant or by the installer. When the latter is used the consultant provides questionnaires and forms to the installer to ensure adequate information transfer. The site assessment is essential to complete the system design.
- ***Plan view diagrams*** – Include module layout, module spacing on roof, row spacing, shading, purlin spacing, feet and rail spacing.

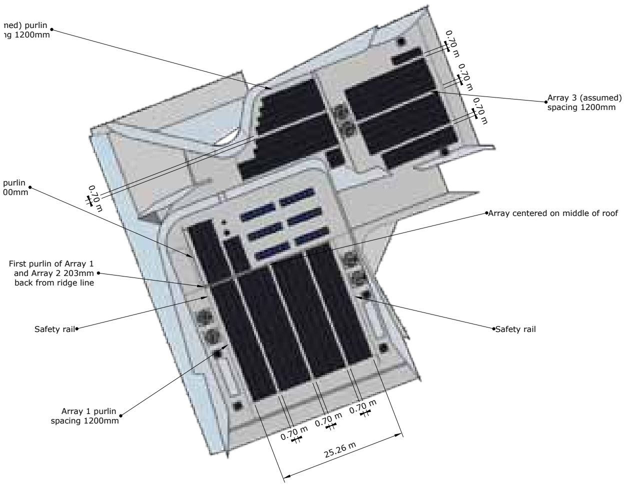

Figure 1. 3D view of object or structure (i.e. the PV Array and related structures) as seen from above.

- ***System design calculations*** –The number of modules in series and parallel, cable, isolator, circuit breaker sizes, MPPT configurations, inverter inputs and system protection requirements.

DUAL MPPT STRING CALCULATIONS		
Array Overview Calculations		
	MPPT1	**MPPT2**
Panel Type	Jinko JKMS255P	Jinko JKMS255P
Number of Panels in Series (N)	20	19
Number of Parallel Strings	3	2
Total Number of Panels	98	
Inverter Type	SMA STP25000TL-30	
Number of Individual MPPT's	2	
Rated Power (W)	15302	9691
Total Rated Power (W)	24993	
Panel Voc (V)	33.60	33.60
Panel Isc (A)	8.92	8.92
Fill Factor (%)	0.851	0.851
Input Voc (V)	672	638.4
Input Isc (A)	26.76	17.84
MPPT Input Current Ok?	Checked	Checked
PV Array Max Voltage	718.37	682.45

Figure 2. Extract of a System design calculation

- ***Electrical schematics*** – Include electrical information about cable sizes, isolator rating, fusing and MPPT configuration requirements as well as additional safety and protection integration information.

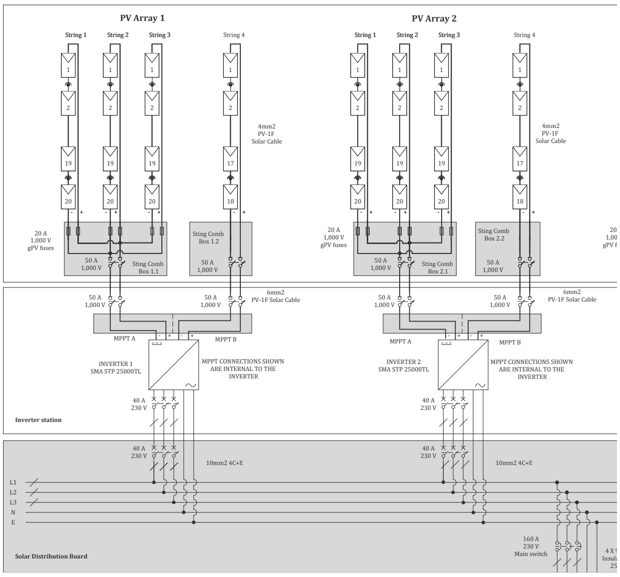

Figure 3. Single Line Diagram (SLD) depicts the electrical connections between the PV array, inverter, electrical protection equipment and MPPTs.

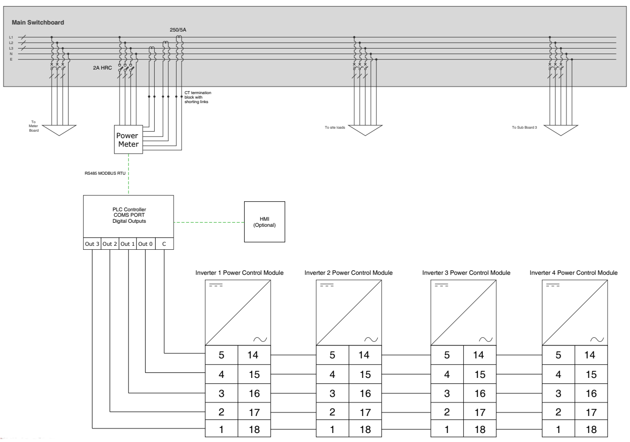

Figure 4. SLD of the electrical schematic of a custom zero export device.

- ***Bill of materials*** – The bill of materials (BOM) is based on the design drawings and schematics. This allows for the quantities of all major and minor components to be defined.

DESCRIPTION		QTY	RATE	TOTAL	$/w
MODULES				$ 149,968.00	$ 1.03
YINGLI PANDA 280W with SOLAR EDGE (P300)	Capacity (Watts): 280	520	$ 288.40	$ 149,968.00	
INVERTER				$ 23,992.00	$ 0.16
Solar Edge SE16K-AUS		8	$ 2,999.00	$ 23,992.00	
Solar Edge-P300-MC4		520	$ 76.30	$ 39,676.00	
MOUNTING				$ 18,506.94	$ 0.13
ER-R-ST2560 EZYRACK ST RAIL PAIR 2560MM LENGTH		88	$ 30.58	$ 2,691.04	
ER-R-ST3405 EZYRACK ST RAIL PAIR 3405MM LENGTH		52	$ 40.67	$ 2,114.84	
ER-R-ST4200 EXRACK ST RAIL PAIR 4200MM LENGTH		22	$ 50.16	$ 1,103.52	
ER-SP-ST EZYRACK ST SPLICE KIT 1 PAIR		58	$ 3.26	$ 189.08	
ER-IC40 EZYRACK MID CLAMP SUITS 32.5MM to 42MM FRAME		678	$ 0.78	$ 528.84	
ER-EC40 EZYRACK END CLAMP SUITS 40MM FRAME		648	$ 0.78	$ 505.44	
ER-IB-SR240/100 EZYRACK ISOLATOR MOUNTING BRACKET		16	$ 5.44	$ 87.04	
EZ-GC-ST EZYRACK GROUND WASHER SUITS R,ST and T RAIL		408	$ 0.17	$ 69.36	
EZ-GL-ST EZYRACK GROUND LUG SUITS R, ST, and T RAIL		162	$ 2.39	$ 387.18	
ER-IK-05CA CLENERGY L-FEET X 10		100	$ 14.14	$ 1,414.00	
ER-CC-PV/4 MODULE CABLE CLIP		520	$ 0.30	$ 156.00	
EZ-CC-R/ST/6 RAIL CABLE CLIP		1040	$ 0.17	$ 176.80	
ER-Z-STBW EZYRACK Z MODULE WITH BOLT AND WASHER (SPARE)		200	$ 0.57	$ 114.00	
CLAMPING SYSTEMS					
ER-IK-09 KLIP LOK INTERFACE KIT 10 X BRACKETS AND FITTINGS		100	$ 60.03	$ 6,003.00	
ER-IK-05CA CLENERGY L-FEET X 10		40	$ 14.14	$ 565.60	
ER-IK-09 KLIP LOK INTERFACE KIT 10 X BRACKETS AND FITTINGS (Cable Tray Support)		40	$ 60.03	$ 2,401.20	

Figure 5. Extract of a BOM used to specify equipment for a project.

- ***String layout and electrical wiring drawing*** – Highlights the module strings, method of connection and cable run locations within roof space, conduit and cable tray.

Figure 6. String layout, designating modules to selected inverter and string.

Figure 7. Module and wiring layout with directions for roof entry point.

- ***Financial Analyses*** – An analysis of consumption data and predicted system yield information will allow for an accurate calculation of system return and savings.

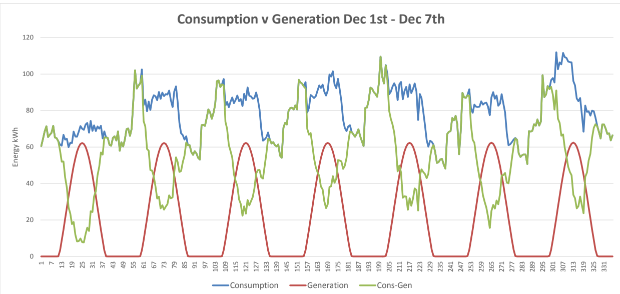

Figure 8. Data from an interval analysis of the comparison of consumption and generation data collected using a power analyser or interval meter.

Conclusion

The system design process and the documentation provided allows the installer to visualise the installation, predict and mitigate installation issues and provide accurate data on performance and performance and financial returns to the customer. At the same time, this information provides a potential for installation cost savings by reducing the material requirements and the time to completion – this improves the installer's margins. System designs can be used as promotional material to win contracts and differentiate your service from the competition.

GSES offers engineering consulting services, including feasibility studies, system design, tender preparation and evaluation, commissioning, inspection and performance review services.

GSES welcomes feedback on technical papers and other resources available on www.gses.com.au, please contact GSES by email at info@gses.com.au or by telephone on 1300 265 525.