Big solar's ascendancy as coal slips in the popularity stakes. How ready is the Australian solar industry?

The Adani-owned Carmichael mega-mine inches ever so slowly towards a final approval amid falling coal prices and fierce community opposition. At the same time Adani has recently expressed interest in solar farms in South Australia and Queensland. What will the growth of Australia's large scale solar sector be set to experience?

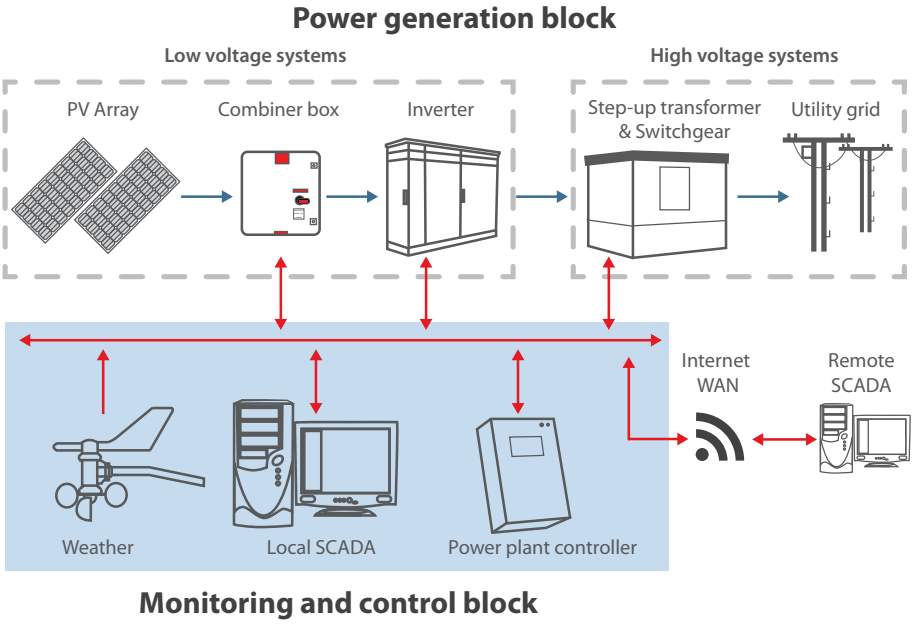
The large scale solar industry is still relatively new in Australia, with only a handful of installations online, most notably the Nyngan (102MW), Moree (56MW), and Broken Hill (53MW) solar farms. Many more utility-scale solar systems have been approved, and an indication of the boom to come is ARENA's release of 22 large scale solar projects invited to apply for ARENA funding.

The existing large scale solar proposals will form part of the solar development Australia see in the short term as the major energy players clamber to meet the Renewable Energy Target requirement by 2020. Failing to do meet this target will attract a penalty, which will then be passed onto energy consumers as an increase in electricity price.

The expansion of large-scale PV systems across Australia will create a resource demand for the construction, operation and maintenance of these sites. For the solar industry to respond to this demand, the industry needs to develop a sound understanding of what utility solar entails.

Utility scale solar PV systems differ from residential and commercial systems not only in scale, but also in the additional monitoring and control components on site. Operation and maintenance is a focus of large scale PV systems: any downtime or loss in power production is associated with potential financial losses incurred as the system's operation fails to capture high energy price events on the National Electricity Market (NEM), or fails to meet the requirements of a Power Purchase Agreement.

Figure 1: *Major components in a utility scale PV system*



Utility scale PV power plants can be broadly divided into two blocks: the power generation block and the monitoring and control block. The power generation block consists of solar PV modules connected in series and parallel combinations. The monitoring and control block contains monitoring equipment, Supervisory Control and Data Acquisition (SCADA) system, as well as a power plant controller. This block monitors commands from the control centre or grid operator and operates the plant equipment appropriate based on monitored data. In addition, the system may also incorporate energy storage devices (e.g. batteries) and/or power generating sources (e.g. fuel, wind, hydropower) to form a hybrid system with backup supply.

Operation and Maintenance Procedure

Utility scale PV system owners will often contract the services of an O&M specialist, whose roles may include normal operational procedures, executing the maintenance program, maintaining security around the site, environmental protection plan, and other responsibilities as required by the system owner.

The maintenance actions carried out at a utility scale system can be considered preventative maintenance, corrective maintenance, or condition based maintenance.

Preventative maintenance includes scheduled activities carried out to prevent system equipment impacts and failures that may lead to reduction in performance and loss of revenue. Actions which fall under this category includes vegetation management, regular checks of balance of system components, checking arrays for hotspots and anomalies, and inverter inspections.

Corrective maintenance is performed in the event of failures within the system. The speed of response and duration of repair will be determined by the problem identified, the amount of information available regarding the problem, and the relative impact that this failure has on the system's performance, e.g. given that the solar system will have a regular maintenance schedule, in some occasions it makes better economic sense to correct the identified problem at the same time as the standard maintenance visit. Corrective maintenance can include rectifying inverter faults, replacing damaged components, and rectifying SCADA faults.

Condition based maintenance comprises scheduled O&M activities that are carried out when deemed necessary based on the monitored data. It is a strategy that uses the monitoring systems present to reduce the need for regular preventative maintenance. The activities carried out during condition-based maintenance would depend on the level of monitoring that exists at site, as well as the data itself.

Monitoring at site

Weather monitoring and system monitoring are essential in order to evaluate and predict the PV plant's performance throughout its lifetime.

Weather monitoring provides adjustment factors for the evaluation of system performance. Weather data is also essential to analyse weather patterns and be able to extrapolate future power generation trends. A ground based meteorological station is typically installed with a range of components including but not limited to: pyranometer, anemometer, relative humidity sensor, temperature probe, dust monitor, and rain gauge.

Figure 2: *Weather monitoring at an installation site*

System monitoring involves remote monitoring of all the major components of the PV plant to allow for easy trouble shooting and fast and cost-effective repairs. Monitoring should include both array-side performance and grid-side status. Array side monitoring would produce typical PV data

such as array voltage, current, and power, as well as system communication status and array output comparison. Grid-side monitoring may include line voltage, frequency, power factors, and other information needed for the plant's participation on the NEM.

Supervisory Control and Data Acquisition (SCADA) System

The SCADA system describes a range of data acquisition and control equipment required by a utility scaled system, as well as the communication network that connects them all. The SCADA system brings in field information from the weather station, string monitoring, inverters, step-up transformers, switch gear, site security system etc. The SCADA system will present the information in real-time to ensure the system is operating as expected and will trigger alarms if it is not. The SCADA system may be able to respond to monitored data by using automatic controls or it may need operator input and use a human machine interface (HMI).

Conclusion

With the energy sector in Australia looking to solar, the industry needs to be prepared not only for the onset of the construction of utility scale solar power plants, but also for the opportunities which exist in the ongoing operation and maintenance of these plants.

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