New approaches to solar O&M in China

Operations & maintenance | Proposals by Chinese authorities to scale back the subsidies available for grid-tied PV will require new efforts to maximise the performance of power plants. Karl Hong Wan of the GCL Design & Research Institute explores some of the innovations in O&M practices that will help China's solar industry cope with decreasing financial support

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In October 2015, the National Development and Reform Commission (NDCR) of China released a discussion paper entitled "Notice on perfecting the policy about the benchmark price of onshore wind power and photovoltaic power generation" (hereinafter referred to as "2015 notice"). This stated that during the "13th five-year plans of China", the benchmark price of onshore wind power and photovoltaic power generation would be reduced with the scale of development to achieve the aim that "by 2020, the on-grid prices of wind power generation and coal-fired electricity are equal, photovoltaic power generation price and power grid sales price are equal". Its proposals are summarised out in Table 1.

In December 2016, the NDRC followed this earlier pledge by issuing a notice setting out its intentions that from January 2017 the on-grid benchmark electricity price of newly built PV and onshore wind power plants would be lowered. To continue encouraging the development of distributed PV, the NDRC notice said there would be no changes to the subsidy criteria for distributed PV power generation (Table 2).

Resource area		PV power plant online electricity price benchmarking						Accumulative adjustment for five years
		Now	2016	2017	2018	2019	2020	
Class I areas	Electricity price (yuan/kWh)	0.9	0.85	0.82	0.79	0.76	0.72	Falling 18%
	Decrease (%)	5.56	3.53	3.66	3.80	5.26		Falling 20%
Class II areas	Electricity price (yuan/kWh)	0.95	0.92	0.89	0.86	0.83	0.8	Falling 15%
	Decrease (%)	3.16	3.26	3.37	3.49	3.61		Falling 16%
Class III areas	Electricity price (yuan/kWh)	1	0.98	0.96	0.94	0.92	0.9	Falling 10%
	Decrease (%)	2.00	2.04	2.08	2.13	2.17		Falling 10%

Source: NDRC.

Table 1. PV power plant price reduction analysis as set out in 2015 notice. Note: Chinese government classifies 3 different classes of areas based on irradiation level. Each area has its own subsidy policy.

Subsidy reduction – cause and effect

Why are new energy subsidies facing these sharp cuts in China? According to National Energy Administration (NEA) officials, the development of the new energy industry will face two main areas of difficulty and contradiction. On the one hand, the increased capacity of new energy is much higher than the grid's ability to absorb this new generation, and the problem of curtailing wind and PV power is thus becoming serious. On the other hand, financial subsidies for PV and wind still face a big gap, and the original subsidy model is thus unsustainable. Decision makers are facing great pressure and real challenges on the best policy choices to underpin the future energy system in China.

Meanwhile, industrial technological progress and increased production capacity are bringing the costs of PV down; lowering the benchmark price of PV power plants and land-based wind power helps alleviate the pressure of new energy subsidies, so the subsidy cut is also an inevitable

Resource area	Now (yuan/kWh)	After adjustment (yuan/kWh)	Adjustment range
Class I areas	0.9	0.65	Falling 27%
Class II areas	0.95	0.75	Falling 21%
Class III areas	1.0	0.85	Falling 15%

Source: NDRC.

Table 2. PV power plant price adjustment summary as set out in 2016 notice.

trend of industrial development.

While price reductions are the inevitable trend of industrial development, they will cause many adverse effects. Power generation enterprises, power grid enterprises, equipment manufacturers industry and the financial industry will suffer varying degrees of profit loss. Investments in PV power plants will be significantly reduced. Owing to the complexities of renewable energy subsidies in China and the large number of different organisations involved, constant adjustment of subsidy levels may mean PV power companies do not receive payments promptly, making debt repayment periods longer.

In short, with subsidies going down, how PV companies survive is becoming a big problem. In order to keep and pursue higher profits, some companies may lower power plants' design and construction standards, resulting in plants of poor quality that will be harder to operate and maintain. Investors may be discouraged by the undulation and uncertainty of the benchmark PV price.

Operation is a long-term focus for the profitability of PV plants

In the face of the gradual reduction of subsidies, the PV industry's reliance on government support is becoming a thing of the past. PV enterprises should thus focus on upgrading the technical content and the quality of PV power plants they build to maximise their generation potential.

According to the 25-year theoretical life-cycle assessment of PV power plants, the electricity income from power plant operation is fixed and stable for a long time. The answer to declining prices lies in the application of intelligent operation and maintenance (O&M) methods and technological innovation to boost a plant's generation capacity, lower the levelised cost of electricity, improve the internal return of the power plant and protect the power plant's revenue. That will bring into reach the final goal of parity, which will be the key of the future PV power generation business.

The following is our experience in the operation and maintenance of photovoltaic power plants and technical innovation.

1 – Establish a reasonable O&M architecture and efficient management methods

According to power station investment and development, location and solar resources, a reasonable O&M structure should be formulated, and both centralised and regional O&M operations should be adopted.

The development of appropriate systems covering areas such as power plant standards, evaluation, equipment, defect elimination, emergency response, training, technical communication and other management functions will ensure the right personnel are in place and improve the overall quality of a plant's operation. Building an area detection centre combining daily operations staff and professional mechanics to design optimised programmes will help enhance plan performance and contribute to improved power generation.

Selecting a professional and experienced maintenance employee to form an effective regional maintenance core team will ensure maintenance tasks can be undertaken and completed as quickly as possible, maximising the benefits of having an efficient O&M regime.

2 – Establish a scientific and quantifiable evaluation index

As we all know, the construction period of a PV power plant is generally short and not all projects are completed to a high level of refinement. Each project covers a large area, has many different categories of equipment and is affected easily by natural environmental factors. Due to the bad matching index and poor compatibility caused by differences in the sources and technical attributes of items of equipment, equipment can be inefficient with a high failure potential.

Based on data gathered from a plant covering aspects such as system-level operation, equipment and O&M, and using numerical system evaluation, it is easy to develop relevant operating system procedures and eliminate hidden dangers and possible malfunctioning of equipment, thus making the plant safer and more reliable. Two methods for doing this are as follows:

System efficiency analysis. 'System efficiency' refers to the ratio of annual utilisation hours of a PV power station to peak sunshine hours. It is the core index to evaluate the operational level of the whole PV power system. If the

Intelligent management solutions enable large numbers of plants to be centrally operated

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system efficiency indicators are beyond the reasonable range, it is necessary to make a further analysis of the energy loss distribution across the entire system of the power plant, from the array, cables, power distribution equipment and so on. Any abnormalities at any of these points need to be found and eliminated.

Equivalent utilisable hours analysis. 'Equivalent utilisable hours' refers to the working hours of power generation under full-load operating conditions, which is an important index for evaluating the operational level of the power station. The system performance of the whole power plant can be evaluated through comparison with surrounding PV power plants under the same area and resource conditions, to optimise the daily management level and efficiency and equipment utilisation rate, so that the potential for generating power can be improved.

3 – Build intelligent power stations, establish an intelligent operation and maintenance system

The evolution of "Internet+", the "Internet of Things" and other advanced information platforms offers the opportunity to deploy intelligent management solutions. The need for intelligent PV power station operation and maintenance systems is growing as the scale and geographical distribution of the industry, offering companies the ability to centrally operate and manage large and widely dispersed portfolios and optimise O&M regimes across their fleet.

Intelligent systems enable equipment running data and on-grid information to be collected automatically so that abnormal equipment or system faults can be alarmed in real time and responded to immediately. This frees up operating crews to focus on maintaining equipment and overall plant efficiency.

Through the intelligent gathering and use of data, companies can continuously monitor the operating conditions of power plants, allowing them to realise the standardised, refined and automated operation of their assets. With the assistance of statistical information it is relatively straightforward to centrally or regionally operate large number of plants, remotely diagnose any problems and deploy human resources in the most efficient manner as they arise. In this way, it is possible to reduce O&M costs and increase project revenue, while at the same time acquiring a valuable mine of data as a reference for future project development.

Automatic cleaning is just one of the technological innovations emerging for improving solar O&M practices

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4 – Technical methods for optimisation of O&M

Equipment inspection is the regular and basic work of the operation and maintenance process for PV power plants. Intelligent monitoring systems can assist manual tasks such as evaluating component degradation and soiling pollution and technically improving the system configuration and so on by allowing system failures and defects to be processed as soon as possible to deal with equipment system failures and improve the intact rate and efficiency.

Array dust is one of the important factors affecting PV power generation and the question of what cleaning methods are the most effective has also gained more and more attention recently in the context of optimal O&M. Common cleaning methods include manual cleaning, specially engineered cleaning vehicles and a new breed of intelligent cleaning systems. This latter category makes intelligent judgments on when to clean based on continuous monitoring of generating production and are likely to become a standard tool in the future operation of large power plants.

O&M central to competitiveness

With the rapid development of the PV market, the number of domestic PV power plants in China is rising exponentially and the effective operation and maintenance of PV plants is becoming a vital long-term consideration for the photovoltaic industry business, whose market prospects are very broad.

With the advancement of electric power reform in China, the independent development of electricity sales business has become possible; the customer group for PV operation and maintenance businesses is expanding from single power production enterprises to financial power investment owners and individual owners of distributed generation plants. Power plant O&M practices are changing too, as is the variety of different power plant types and dispatch modes. Innovation in operation and maintenance therefore lies at the core of the long-term competitiveness not just of O&M enterprises themselves but of the PV industry at large.

Although the imminent decline in on-grid tariff subsidies for PV power China is a natural corollary of a maturing industry, the challenge now for that industry will be to find the best technologies, systems and skills to ensure the safe, productive and profitable running of PV power plants over their lifetime. ■

Author

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