

The Power of Light: Blazing the Way to a New Era of Energy

IHI Plant Construction's engineering brilliance is helping to spread renewable energy

In March 2013 IHI Plant Construction Co., Ltd. (IPC) began operation of the Tatsuno Solar Power Station as an independent power producer. This initiative of our photovoltaic power plant construction company is aimed at developing more efficient operation methods and maintenance technologies. Based on previous experience and achievements in providing power boilers and various plants, IPC will offer complete services in the field of renewable energy — both in photovoltaic and wind power generation.



Tatsuno Solar Power Station

Solar Park

Despite ill-timed rain, the completion and unveiling ceremony of the Tatsuno Solar Power Station in Tatsuno, Hyogo prefecture was held on March 27, 2013. The specially invited guests made the best of things under the umbrellas they clutched in the cold rain as they walked between the neatly aligned solar panels. Their expressions seemed to say, “We came all the way to see the 0.5-MW solar park, and now this rain...” But their expressions lit up

when they were guided to see the power conditioner. The power output meter of the solar panels indicated an output of nearly 20%. Sunlight still reaches the panels even in the rain. That was the moment when everyone was awed by the greatness of natural energy.

Surprisingly, the output of solar panels is indeed as much as 20% in a rain. Few people know that. There are many such little-known facts. For example, did you know that a higher output is achieved during slightly overcast weather than in the blazing mid-summer sun? While the amount of

sunlight after it has passed through the clouds is less than it is under a clear sky, the repeated bouncing of the light between the panels and the clouds results in more effective use of the sunlight that does come through. There are plenty of other factors that when taken into consideration leave one wondering what to do. Is it sufficient to leave the cleaning of the panel to rain water? Does simplified yet periodic cleaning reduce the total power cost? What frequency of replacing solar panels that are partially damaged by pebbles or the like minimizes the total cost? Is application of weed barrier sheets effective? What is the best way to operate photovoltaic power plants for optimal power generation?

IPC took a bold initiative to build and operate a solar park as an independent power producer in its endeavor to find the optimal method for operating photovoltaic power plants and developing efficient and low-cost maintenance technologies. This of course is intended as a showroom, or rather a “showpark,” for clients who are considering becoming photovoltaic power producers.

A reliable partner in the solar power business

Even before the decision to introduce a Feed-in tariff for renewable energy in Japan, IPC had been providing photovoltaic power generation systems to apartments and manufacturing plants. In combination with the wind power generation mentioned later, it has been a desire of our company to contribute to society through the renewable energy business. As soon as the decision to introduce a Feed-in tariff was made in Japan, our company boosted construction of photovoltaic power plants for independent power producers. IPC had gained confidence because of its long history in the construction of power generation



Example of installation at an apartment

facilities for power companies. Civil engineering, strength designing, piping, cabling, handling of electric devices, and connection to power systems, etc., IPC boasts experience and achievements in all of them. We are thus able to propose optimal construction plans and system architecture for solar power producers.

The necessary procedure prior to starting a power generation business is surprisingly unknown. The key is to prove your ability to reliably supply power on the basis of the system architecture and numeric data from each power device. But doing so step by step would require half a year before the license to become an independent power producer is granted. It only takes about 3 months to construct a photovoltaic power plant — an extremely short



Example of installation at a manufacturing plant

amount of time compared to the construction of other types of power plants. Such a long licensing period is a waste of valuable time for such a short construction project. IPC can mobilize its rich experience in power plant construction and obtain a license in three months by efficiently collecting the necessary data for applications. We waste no time thanks to our complete knowledge on the interlinkages between relevant data.

Having already constructed photovoltaic power systems ranging from 10 to 470-kW, as well as a 0.5-MW power plant, our company is currently constructing a 2-MW power plant in Soma, Fukushima prefecture.

Photovoltaic power plant construction

Solar panels are not only electronic components for converting light into electricity, but also construction members. This is where IPC shines brightest, maximizing the performance of solar panels as electronic components while achieving a structure that can be reliably operated.

Maximum light input may be achieved if the panels are always facing directly toward the sun. However, solar trackers are expensive, given the current technology. It is therefore necessary to pursue the optimal performance of fixed installations. Important points to consider here are the angle and direction of solar panels. Obviously panels should be facing roughly southward, but this should be balanced with an angle for minimizing the impact from wind and other factors. Raising panels too high increases the impact from wind or casts a shadow on the panels behind them. Laying panels too flat, in turn, reduces both the light-receiving efficiency and the number of panels that can be installed at a site. Stacking too many solar panels gives rise to turbulence just like that of building-induced wind and eddies around tall buildings. In order to address these problems, we propose optimal civil engineering after performing appropriate airflow computations for each site, strength calculations against wind pressure, and a detailed geological survey.

Take a sloped site for instance. A cost advantage may be obtained from a shorter construction period by laying foundations at different heights without flattening the ground then installing panel mounts at matching heights rather than first flattening the ground to align the foundations and panel mounts to the same height. IPC mobilizes its technologies to determine and propose the best option for clients.

Aluminum frames are often chosen as materials for panel mounts because they are light weight, do not have to be painted, have high corrosion resistance, and have an aesthetically pleasing appearance. But that lightness is inevitably associated with vulnerability to wind. IPC can overcome this challenge because of its technological competence not only in facility construction, but also in foundation construction.

Construction work on electric facilities includes the

connection of power lines with electric facilities such as power conditioners and transformers.

In normal electric construction, it suffices to turn off the supply power. However, in the case of solar panels, they always generate electricity though with only a small amount of light. For this reason, due care must be given to safety, for example by performing the work involved with charging components at night.

In general, one solar panel has an output of only about 250 W. Thin power lines extending from these solar panels are bundled together again and again until it forms thick wiring. Perhaps you have noticed the fact that these electric connections are all made outdoors, where it rains, the wind blows, and dust gets stirred up. Each terminal box for connecting lines is designed to reliably deliver electric power. Starting from individual components and extending to both operation and maintenance, we provide photovoltaic power plants by applying the entirety of our technological abilities.

Wind power generation achieved by assembling gigantic components

IPC's efforts for renewable energy power generation do not stop with photovoltaic power generation. The company has been engaged in wind power generation from early on and has made numerous achievements in the construction of wind power facilities.

Most of our equipment for wind power facilities is imported. It is thus necessary to discharge the equipment at an international port, transfer it to a barge, and unload it at a port near the construction site. Aside from the tower, which is divided into pieces, there are many large, single-member components such as the wind turbines which are called blades, the axis of these blades a housing (called a nacell), and units with built-in generators or gear boxes. Their transportation takes a lot of time and effort.

For example, a 2.5-MW class blade has a length of 43 m, the equivalent of two bullet train cars. During transport of



Blade being transported



Installation of a blade



Maintenance

the blade by road in urban areas, it is impossible to turn unless the intersections are large enough. It is necessary to transport the blade at night with appropriate traffic control while temporarily removing road signs. Transportation of a cylindrical tower component having a diameter of 4 m is also extremely difficult. Since the height limit of typical tunnels and bridges is 4.5 m, a low-floor vehicle that can adjust the air pressure in its tires is employed. Onshore wind turbines are often installed on top of hills to obtain good wind conditions, which sometimes require the development of forest roads.

Though their sizes are gigantic, their installation and assembly demand highly precise work. A robust foundation is necessary to underpin a wind turbine with a total weight of 340 tons. The base of the tower is connected to the foundation with about 160 bolts. In order to install the tower, the positions of the holes in the flange of the tower must coincide with the positions of the bolts sticking out of the foundation. The task of matching the bolts and holes of the tower components each weighing 30-50 tons becomes even more difficult as the components of the second, third, and higher tiers are piled up, especially because of the small size of the bolt holes with a diameter of only a few centimeters and the increasing effect of wind and other factors. The difficulty in matching the bolt and hole positions is experienced also during blade installation. Each blade is attached with about 60 screws. Three blades must be set in the right position at a height of more than 80 m.

In addition, the nacell must be mounted as soon as the tower is assembled because wind turbines are designed taking the weight of the nacells into account. If the tower stands without a nacell, the tower may be damaged by mechanical resonance caused by winds. If the nacell cannot be installed immediately after the tower is installed for any reason, ropes are wound around the tower to cause turbulence on the surface to prevent mechanical resonance in some cases.

Maintenance is the key

Sufficient maintenance is indispensable to reach the desired operating rate of these wind turbines. For instance, there are many reports of damage to blades being caused by lightning. In addition to the direct damage, the damage caused by lightning includes phreatic explosions. This is because water sometimes accumulates inside the hollow space of the blade as a result of condensation, seepage, etc., which then explodes as it is heated by the lightning. Thus, it is necessary to periodically check for such damage just in case the water in the blades has not been drained by the drain holes.

In addition to ensuring the soundness of blades, there are many mechanical components requiring maintenance, such as gear boxes and generators. This maintenance is a time-consuming but rewarding experience, as the outcome of the effort clearly manifests itself as an improved operating rate of the wind turbines.

With a view to the advent of a new era of energy, IPC continues to pursue a society where all people can live in peace while fully harnessing the blessings of nature.

At present IPC's efforts related to renewable energy as described above are limited to businesses inside Japan.

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