Photos: Phocos AG

The municipal government of the Heilongjiang province in China installed 232 solar street lights equipped with Phocos CIS charge controllers along the 9.2-kilometer road to the airport in the Hegang district of Xing'an.

Sustainable installations

Power for remote areas: Phocos AG, a manufacturer of solar-powered charge controllers, components and energy-saving appliances, has always focused on off-grid applications, often in areas with difficult conditions in climate and infrastructure. A report on some of the recent projects.

For developing and emerging countries, one of the biggest challenges is the reliable availability of power for the growing number of electric and electronic systems used in industrial and home applications. Power supply solutions for these applications must be able to overcome infrastructural obstacles, long distances and often also challenging climatic conditions. Beyond that, they also require intelligent system design: the system has to meet the specific requirements inherent in the individual application.

System integrators face a multitude of challenges when it comes to providing efficient off-grid power solutions. Users tend to expect the convenience of on-grid power supply for their remote applications as well: they want reliable yet flexible installations. For system integrators, these expectations create a scenario in which they are not just required to engineer an integrated system matching the individual requirements – usually consisting of a power source, intelligent power management components, power storage, software to control all parts of the system, and the matching cables, plugs and interfaces. In addition, system integrators also have an increasing amount of teaching, training and servicing to do – especially in emerging and developing countries, where photovoltaic know-how and

Phocos charge controller in a solar lamp post in Hegan. A specific challenge to the project was the weather conditions in winter.

experience are not yet widespread among the users of remote electrical systems.

Intelligent power management, charge control and software solutions can contribute to achieving maximum flexibility and optimum yield with the individual system components. By doing this, they enable a wider distribution of autonomous off-grid power systems in developing and emerging countries. The following examples illustrate how system integrators have successfully overcome challenging conditions in off-grid power scenarios.

Solar street lights in China

Street lights increase road safety at night and in bad weather. However, their installation is often a major investment challenge, especially in areas where there is no established grid infrastructure. Solar street lighting is an attractive alternative for these scenarios.

The city of Hegang in the Heilongjiang province in China is a dedicated environmental protection area. Tourist guides call the area a "natural oxygen bar." As part of its public green energy initiative for more environmental protection and carbon emission reduction, the municipal government had 232 solar street lights with a solar matrix power of 214 watts installed along the 9.2-kilometer road to the local airport in the Hegang district of Xing'an. The specific challenge of this project was the low temperatures in the area. In the winter, even during the day, the temperature drops below minus 20 degrees Celsius, a severe test for any material used, including controllers. Due to the road's strategic role as an airport connector, the system integrator had to design a lighting solution that would allow the road to be reliably lighted even in weather conditions with little sunlight.

To solve this problem, the system integrator, Heilongjiang Xing'an New Energy Co., used Phocos CIS 10 24-V solar charge controllers to control the 232 solar lights. The fully encapsulated device with IP68 type protection was specifically designed to ensure reliable battery charge control for PV systems exposed to extreme weather conditions and to prevent damage to the power electronics due to corrosion. With its wide temperature range from minus 40 to plus 60 degrees Celsius, it will meet the requirements of the devices, which are exposed to harsh, wet weather conditions and extreme temperatures down to minus 20 degrees Celsius in the wintertime. Automatic day and night recognition, flexible electronic timer functions that can be programmed to adapt to different daylight scenarios, as well as variable dimming functions contribute to making CIS the perfect charge controller for street light projects. The industrial-grade charge controller is also suitable for all commercial PV applications. It features four-stage pulse-width modulation charging (PWM), combined with low-voltage disconnect and a multi-LED system status display.

Street lamps in Afghanistan

In a street light tender by USAID/PRT in Afghanistan, won by the German system integrator SonnenPlus GmbH (Neu-Ulm, Germany) and its partner company Zularistan Ltd. (Kabul, Afghanistan), 450 solar street lights had to be installed in various provinces in the south and east of Afghanistan. Before and during the installation of the street lights, many technical as well as political problems had to be overcome. In the beginning, only Kandahar had been selected as a province; however, in the course of the project and due to various municipal differences, the project was divided into seven provinces – posing a major logistical challenge to the system integrator, as several of the areas of installation were subject to open conflicts.

To overcome these difficulties, SonnenPlus carefully selected the technical equipment of the installation. They used a 120-watt-peak solar module (two monocrystalline silicium solar modules of type Solifant SF60 Wp, watt-peak, for 12-V and 24-V solar stand-alone systems). The 100-Ah lead/AGM battery was mandatory as part of the tender. A highly efficient NeoNeon LED light was chosen as the illuminant with a warranty of a minimum of 20,000 hours and a maximum luminosity degradation of ten percent. This was important, as most LED lights degrade much faster, something which had to be avoided in this project. As the charge controller, the system integrator

In Afghanistan, 450 street lights, equipped with Phocos CIS charge controllers, were installed in seven provinces as part of a USAID/PRT tender.

used the Phocos CIS 10 due to its special advantages in this demanding application. As the project required flexibility to meet the special needs of seven provinces, the charge controller had to allow for individual settings. Each village had different expectations of when the lights had to be on or had to be dimmed; the CIS charge controller's remote settings, which can be adjusted via CIS-CU remote control, enable easy adjustment of the operating and dimming times. The charge controller is completely molded with no moving parts and thus sealed and encapsulated to protect the electronics against the extremely dusty and hot weather conditions in Afghanistan. All materials required for the installation, the street light pole, the pole module mount and the battery/charge controller box were acquired locally to create maximum value and to integrate local partners. In addition, this approach enabled considerable savings in transport and logistics and also supported local businesses.

An important part of this project was customer training for start-up and operation of the systems. The system integrator SonnenPlus performed this training locally before and during installation to ensure successful implementation and, after start-up, safe operation. In addition, this approach enabled a network of trained solar installers to form in seven provinces of Afghanistan. These trained persons will not only be available as an experienced installation team for future PV system installations and projects, they are now also in a position to build a new professional existence as solar retailers. In this way, local training and support are a very sustainable method of building efficient servicing and maintenance networks in emerging and developing countries.

Cooling devices in Bangladesh

As medical care reaches even the more rural regions, storage of medical goods remains a major problem in many cases. Many vaccines and drugs require constant cooling and will spoil if the cold chain is interrupted even for a short time.

On the char lands along the Jamuna River in the Sirajgangj district in Bangladesh, the sandy soils are rarely able to sustain crops, so most of the people raise livestock. To prevent diseases from spreading, the animals need to be vaccinated regularly. However, vaccines require cooling and will otherwise spoil. Maintaining an uninterrupted cold chain in an area where most places are without access to the power grid and where the power grid itself only supplies power at irregular times is a major challenge. For this reason the Chars Livelihood Program CLP asked system integrator Grameen Shakti for advice. In the end they designed a solution with five 160 liter DC refrigerators and, following good results, with another thirty 120 liter DC refrigerators by Phocos.

The refrigerators are powered by 130-watt solar panels installed on the roof of the veterinarian's office. Each refrigerator requires 120 watts to run for 24 hours; the remaining ten watts are used to power a light in the office.

Due to their energy-efficient cooling concept, Phocos refrigeration devices are especially suited to solar-powered applications. An eleven centimeter thick insulation layer made of polyurethane ensures minimum thermal losses. The refrigeration system is equipped with a maintenance-free, brushless DC compressor. A patented low-frost system reduces the formation of condensation water and ice. A drainage opening at the base simplifies the cleaning of the interior.

PV power for a school in Brazil

Education depends heavily on reliable resources to enable teaching and learning. Especially when it comes to introducing young people to the modern communication and information tools of the industrialized world, the availability of power to operate lights, computers and IT systems is vital. However, in many areas of the world, this availability is still a big challenge, even in the major cities of developing and emerging countries.

Located in a shanty town in São Paulo, Brazil, is the Casa do Zezinho, an NGO which has been active for 16 years in São Paulo City's south zone. Over the years it has become more and more involved in the protection of not only the 1,200 children who are welcomed every day by the organization, but also of the environment. Since 2009, various programs have been implemented to contribute to a more sustainable world, e.g., selective garbage collection, recycling projects, responsible consumption of water and rainwater re-use. The donation of a solar system including PV modules and a charge controller was an excellent addition to these initiatives, fitting perfectly into the school's sustainability strategy. In addition to traditional educational programs, the school also offers sports courses such as swimming and soccer. The school's mission is to through education enable children and young adults from low-income families, vulnerable settings and socioeconomically risky situations to develop critical thinking and an autonomous attitude in order to make their own decisions in life.

To ensure a reliable power supply for their IT infrastructure, which was not possible with local grid power, the school asked the system integrator to develop an independent solar off-grid system. At the same time, this system also had to be able to serve as a back-up for

the complete power needs of the school during the many power outages in the region, which occur due to bad weather or accidents that destroy power lines that are run above ground. To achieve optimum yield from the solar modules installed on the roof, the system integrator Preserva Solar used Phocos CX 40 charge controllers. These intelligent charge controllers offer PWM regulation with integrated temperature compensation and feature intelligent display, programming and safety functions, e.g., deep discharge protection. Acoustic warnings and night-light functions can be programmed by the user. The school will also use energy-saving Phocos DC compact fluorescent lamps as back-up lights, which feature high illumination efficiency, a large number of switching cycles and protection against overheating.

Thanks to the PV off-grid system, the school can now offer the pupils IT training, which increases the prospects of the children dramatically. Beyond that, the system also functions as a back-up system to guarantee reliable power availability. The school has become a meeting point for the young population of the area. In the evenings, people stream to the school for reading, studying and learning as there is always light there at night.

PV for industrial stations in China

Reliability is the main challenge in operating important industrial equipment installed in remote locations. The user wants to be sure that all servicing and monitoring functions are automatically performed at the required intervals. Oil and gas pipelines or telecommunication stations need regular maintenance and surveillance by on-site electric systems like pumps, cameras, measuring gauges and many other devices. At the same time there must be the ability to change specific settings and operation modes via remote control. All this equipment requires a reliable power supply.

In Qinghai in China, a gas pipeline required a reliable energy source to power cathodic protection, valves, meters and communication equipment. The challenge was to ensure the permanent availability of a main-reserve working mode: If the main controller failed, an alternate controller was to switch on immediately. By establishing this process, logistics and repair costs were expected to decline, while reliability of the system as a whole was to increase. To achieve this, the system integrator TBEA Xinjiang Sunoasis combined a programmable logic controller (PLC), a Phocos Solar Regulation System (SPS), and a Modular Power Management (MPM) system, which consists of a Phocos Modular Central Unit (MCU) and a Phocos Modular Power Switch (MPS). The MPM works as main, and the SPS as reserve system together with the PLC. In case the PLC discovers a fault signal of the MPM, it immediately starts the SPS-system. As a consequence, the system reliability was significantly increased.

A remote installation in Xinjiang fulfills a vital function for the community: it provides power to telecommunication equipment. As the station is positioned at a strategic point far away from the grid, the operator asked the system integrator TBEA Xinjiang Sunoasis to develop a system that would be able to efficiently deliver power to telecommunication equipment while at the same time increasing reliability. The main challenge in this specific application was its location far away from the city, 500 to 600 kilometers, with no roads for a vehicle to get there. To overcome this situation, the system integrator selected an intelligent Modular Power Management system designed by Phocos. It enables easy, fast and individualized adaptation of a broad variety of control systems without requiring much effort or many different components. By means of the Modular Central Unit, the other components – e.g., a Modular Power Switch and a Modular Power Point Tracking (MPPT) unit – can be synchronized and configured effortlessly. The MCU features a data logger, adjustable deep discharge thresholds for easy consumer management, and control and alarm functions through an integrated relay exit. The MPM system is an ideal solution for off-grid power scenarios requiring high flexibility and reliability. Comfortable remote monitoring by modem and the Phocos MODCOM software enable convenient and fast configuration, control and surveillance even from the most remote location. The intelligent energy management concept also allows for individualized single or hybrid operations. This intelligent system provides power to telecommunication equipment and can be remotely monitored from the city to ensure reliable operation of the system. ◆

Ulrike Schramm, Susanne Kircher

Solar street lamps in Afghanistan. System integrator: SonnenPlus GmbH, with Zularistan Ltd, Afghanistan.

On top of the Casa do Zezinho School. Module supplier: Solara. System integrator: Preserva Solar.

Solar gas pipeline power system in Qinghai. System integrator: TBEA Xinjiang Sunoasis Co., Ltd.

Telecommunication station in Xinjiang. System integrator: TBEA Xinjiang Sunoasis Co., Ltd.