PFISTERER

Mongolia – CrossPower SG 25-Mobile Version.

SG

PFISTERER

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A.1. General

A1-1 Background

The world of power supply is going through a process of fundamental change. Critical issues do not just concern how and where we are going to produce electricity but also where and how we will use it. Recent developments, such as smart energy, and our 100 years' worth of experience in the field of energy networks has driven the evolution of PFISTERER's CrossPower System.

CrossPower generates power at the places it is needed most – in refugee camps and remote villages or building sites, on islands, industrial plants, and research stations. CrossPower is an environmentally-friendly alternative wherever power normally comes solely from diesel generators, wherever it is difficult to install cables, or where existing networks are unreliable. If necessary, the entire system can be stored in two standard containers.

Redundant energy production using sources such as wind power, photovoltaics, hydropower, and diesel on the one hand combined with powerful battery storage systems on the other guarantees a reliable and stable supply of energy 24 hours a day, 7 days a week. In terms of energy production, the intelligent management system makes sure that preference is given to renewable energy and battery storage. Fossil fuels are only used when really necessary.

In normal operation, CrossPower guarantees the safe supply of energy for consumers at all times. If necessary, consumers can be prioritized, say if diesel levels are low. In this case, the intelligent management system makes sure that critical consumers, such as operation rooms or cooling cabinets, are supplied with power at all times. Less critical consumers are turned off as required.

PFISTERER is looking forward to this project, as it comprises manifold challenges, which have to be coped within a professional and suitable manner in order to provide a reliable hybrid system of high renewable energy share, associated with high quality standards.

It is PFISTERER's proven approach to have as many items of a hybrid system pre-assembled and tested so that the system will start on site in a plug and operate manner. This helps to preserve the local flora and fauna and reduces the disturbances to the extent possible.

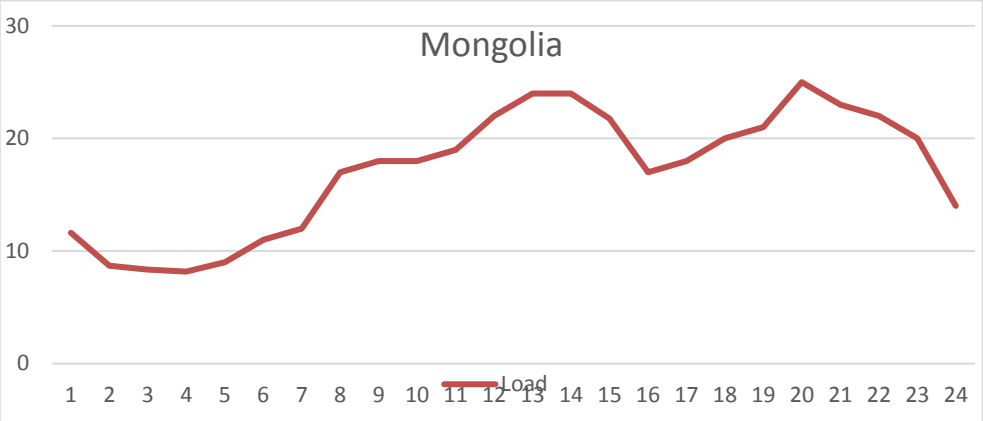
PFISTERER designs every CrossPower system according to the customer's individual requirements, needs, and locations. Compiling individual components without being tied to a single manufacturer offers benefits when it comes to costs and makes sure that the best and most suitable technology is used.
The concept of CrossPower includes different manufacturers for the individual parts of the subsystems, which have to be combined to a well-functioning hybrid system. Consequently, the below mentioned manufacturers and equipment suppliers are acting as a example, may be exchanged during the detailed design but always under consideration of the principle that the new equipment will equal or better quality and performance. This philosophy assures that at the time of project implementation the best available solution will be realized. Our goal is to generate more than 50% of electricity from renewable sources at all times, no matter where the system is located.

A.2. Load Profile

Assumed data by PFISTERER for the proposal:

Peak load:	25 kW
Daily consumption:	500 kWh/d
Annual consumption:	180,000 kWh/a

The load profile assumed is a typical load profile for a tourist camp, with a peaks during the day.



This assumed load profile makes it easy to calculate the hybrid configuration as follows:.

For the first option PFISTERER suggests a set up as follows:

- 25 kWp PV system
- 25 kWh battery storage
- 25 kW dieselgenset (provided by the customer)

The high irradiation of solar power is perfect for PV. A 25 kWp solar system is able to cover the load under the day and produce also exceed energy to store power for the nighttime in the 25 kWh battery.
With the average value that with dieselgensets 3 kWh can be produced with 1 l diesel the annual consumption would be 60 000 l. With the minimum saving of 50%, per year the system will save an amount of 30 000 l. With costs for diesel and transportation of 1 € per l within one year 30.000 € can be saved. A return on invest of less than 3 years will be reached.

A2-1 Suitable PV Modules

For a mobile system, the main requirement for the PV panels is a quick installation and a simple reinstallation. PFISTERER is using semi flexible modules which are fixed on a plane.

PV Modules

Number of cells	60
Weight	4.5 kg
Power	250 Wp

A2-2 Suitable PV Inverters

For the PV inverters, PFISTERER selected two representative market standard string inverters. Recommended supplier is SMA.

A.3. Energy Storage System (ESS)

For hybrid plants lead-acid, lithium and redox flow batteries are the most common technologies.

Lithium batteries are the most reliable battery technology in terms of low maintenance and long cycle stability. Additionally, they offer very high cycle efficiencies and high depth of discharge rates as well as the highest specific power and energy density per kg. Therefore, lithium batteries shall be used for this project.

Which technology of the lithium based cells is recommended is in the end a financial decision depending on the utilization of the battery. Lithium-Titanate has higher cycle stability and allows a depth of discharge of up to 100% but is more expensive compared to e.g. Lithium-NMC with only 80% depth of discharge and lower cycle stability.

In general it is important that the transport of possible lithium cells has to be certified according to UN38.3.

The cell itself needs to be combined with a battery management system (BMS) to a battery which is mostly not the cell manufacturer but an external manufacturer. These external manufacturers provide the lithium battery in a cabinet or container with air conditioning as required for envisaged environmental conditions.

The manufacturer **ads-tec** has been chosen for this project as they offer the storage system and the Battery Management System (BMS).

Storage Rack System SRS0112 / SRS0120

All ads-tec battery modules are UN38.3 certified and meet the current regulatory requirements.

A3-1 Battery Life

The information on 100% is provided directly by the cell manufacturer. The values for 50% discharge are not defined by the cell manufacturer but provided by the manufacturer of the battery system.

Battery life and number of cycles
Cycles: 13,000 @ 2C/2C, DOD 80%
Battery life: > 20yrs @ 25°C

It is important that the end-of-life definition by the manufacturer is adequate and that reasonable warranty conditions exist related to the end-of-life definition.

A3-2 Energy Management System

The energy management system was designed by PFISTERER according to the exact requirements and need of the customer.
This ensures a well-functioning system with the above mentioned components.

The housing of the battery, the inverter and the EMS (controlling unit) is equipped with 3 out coming sockets, sockets for PV and one socket for the connection of an external genset.

A.4. Equipment Warranty Periods

General warranty of 24 months on works and materials will be provided by PFISTERER.

A.5. Payment and delivery conditions

- 30 % of the total price within 30 days after PFISTERER's confirmation of the CUSTOMER's order.
- 40 % of the total price within 30 days after delivery of all Components.
- 30 % within 30 days after Commissioning on site

Delivery time after PFISTERER´s confirmation of the CUSTOMER`S order is 5 month.
Delivery conditions are EXW.

A.6. Draft Operations and Maintenance Plan

All Operation and Maintenance works shall be discussed with the Customer after the final system configuration is clarified.
It is PFISTERER's intention to do as much as possible of the operation and maintenance works together with local partners in Mongolia, concrete actions can be discussed after more information about the site and where the system is located. Nevertheless PFISTERER is designing the system in a way that no special education of the staff is needed to do operation and maintenance works. The big advantage of the CrossPower is the very low maintenance effort of the system in comparison to a conventional system. Necessary trainings for the operation are provided by PFISTERER.

A.7. Hybrid Configuration and Optimization

After a detailed investigation of the project PFISTERER designed a basic system for a mobile hybrid CrossPower system. This basic version is able to cover the full load with a little usage of fossil fuels and reducing diesel usage to a minimum.

A.8. Conclusion & Offer

After a detailed investigation of the project PFISTERER designed a basic system for a mobile hybrid CrossPower system. This basic version is able to cover the full load with a little usage of fossil fuels, reducing diesel usage to a minimum.
In this system configuration we guarantee diesel savings of more than 50 % according to the assumed data.

The generation profiles of PV suits well during the day and on a yearly basis to the assumed load profile. A storage system could help using excess energy of renewable sources and enables the diesel generators to operate at their point of maximum efficiency, when they even are needed. It is even able to power the load without diesel power during a day due to the grid-forming power electronics included (Energy-Management-System) in the Storage System.

PFISTERER suggests the following options:

CrossPower SG 25:

- 25 kWp PV system
- 25 kWh battery storage (Li-Ion NMC)
- Energy Management System
- Incl. installation and commissioning on site

Price: € 80´000. -

In PFISTERER's opinion this solution is the most suitable for the customer, according to a high share of renewables, with a small amount of fossil fuel. Therefore an enormous substitution of diesel is gathered.

Peak load:	25 kW
Daily consumption:	500 kWh/d
Annual consumption:	180,000 kWh/a

With the obtained results of the simulations a good starting point is reached for a promising project to be realized. Even more this pilot project will be basis for a successful cooperation in the future.

PFISTERER Kontaktsysteme GmbH

Winterbach, 12.02.2018

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