

Off-Grid Case Study Luxury Resort South Africa



Project Overview

Located in the world-famous Sabi Sand Game Reserve, the newly renovated Cheetah Plains lodge offers ultimate luxury in the middle of the bush. Within its pursuit to be fully sustainable, Cheetah Plains decided to abandon its single-phase grid supply in order to implement a more powerful three-phase power system by a solar photovoltaic (PV) facility and a high-quality lithium ion battery energy storage system (BESS).

The solution developed by a combination of the South African solar expert company Blockpower and the German microgrid integrator DHYBRID consists of:



Figure 1: Cheetah Plains System Configuration

The Challenge

Initially Cheetah Plains suffered from a single-phase power supply (max. 64 kVA) provided by the local utility Eskom. Besides the peak power limitation, the energy supply was unreliable and showed drastic voltage fluctuations, which eventually led to a burning transformer.

The implementation of the new power system at Cheetah Plains provides the following advantages:

- 3-phase power supply for larger electrical consumers such as cooling facilities or motors.
- 250 kW peak power supply with stable voltage and frequency output
- Nearly 100% renewable energy utilization through PV system and BESS.
- Fully customized SCADA system for real-time monitoring with integrated control for breakers.
- Fully monitoring transparency on the system loads, hence possibility to improve energy efficiency & load optimization.

The Technology

The microgrid at Cheetah Plains contains state-of-the-art industrial components. The BESS is a containerized solution with the following specification:

- 250 kW bi-directional grid forming inverter
- 1,027 kWh of Lithium Ion Battery System from Samsung SDI
- Battery Management System (BMS)
- 5,000 cycles, 10+ years battery lifetime



Figure 2: Cheetah Plains Battery Container

The PV system consists of high efficiency mono-crystalline 370 Wp PV modules from Canadian Solar, which are connected to the microgrid through 6x 60 kW Huawei String inverters. The utilization of string inverters ensures a high level of redundancy for the PV system.

The PV modules are installed on three different mounting structure types:

- 160 kWp of Roof Mounted System
- 100 kWp of Carpot Structures
- 40 kWp of Dual Axis Trackers

A 150-kVA diesel generator is used as back-up source of power. The genset was upgraded from a stand-by generator to a remotely controllable generator that is suitable for parallel operation. In order to integrate the generator into the system a Deep Sea 8610 MKII genset controller, as well as an electronic governor were installed, to make a dispatch of the generator as grid following device possible.

Smart Grid Control Platform

The entire power system is monitored and controlled via the **DHYBRID Universal Power Platform (UPP)**. The UPP is a customized and advanced energy management system (EMS), which allows the parallel operation of different energy sources. Through utilization of the UPP, the following services are achieved:

- Power System Stability
- Active & Reactive Power Control
- Maximization of Renewable Energy Fraction
- Diesel Off Operation / Diesel as back-up
- Generator Reverse Power Protection

The **UPP** is a smart control platform and provides full transparency and control of the power system. The UPP measures grid parameters such as frequency (f), voltage (V) and further electrical data. Additionally, it monitors the active & reactive power setpoints of any connected power generating device such as the PV inverters, the diesel generator, as well as the BESS. The **DHYBRID SCADA HMI** is providing real-time monitoring for local supervision. The communication is made via the industrial communication protocol Modbus.



Figure 3: New 3-Phase Distribution Board with motorized Breakers

Moreover, a new 3-phase distribution board was designed and installed by the team, which has motorized circuit breakers that can be actively controlled by the **UPP SCADA HMI**.

The real-time monitoring allows the operator and maintenance personnel to be informed at any time about the system operating status and its performance.



Figure 4: DHYBRID UPP SCADA System for Real-Time Monitoring

Additionally, the **DHYBRID Web Portal** is a sophisticated high-grade monitoring solution which covers all aspects of modern power generation and allows access to historic data, also as .xls downloads, from anywhere – at any time - in the world.

The Operation Mode

The newly implemented power system at Cheetah Plains has been designed to supply clean and renewable energy to the facility. The figure below shows a typical solar-battery day. The battery (green area) is running as the grid forming entity and supplies power during night-time to the load (red line). The batteries' State of Charge (SoC – green line) is reducing constantly over night. In the morning, once the PV system (yellow area) starts generating energy, the load is directly supplied with energy from the sun, and excess energy is stored in the battery. Once the PV generation diminishes in the evening, the battery has been fully charged and takes back over.



Figure 5: Profile of the System running on PV-Battery only

The ability of the system to run on PV-Battery only depends on the following parameters:

- Load level during the day
- PV generation based on irradiation

During days where one of the two above factors limit the ability to charge the battery to a sufficiently high SOC, a diesel generator is utilized as back-up source of power.

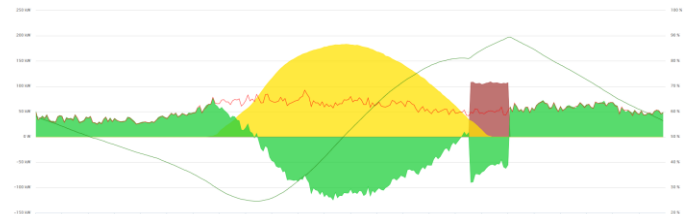


Figure 6: Utilizing the Diesel Generator as Back-Up source of Power

The application at Cheetah Plains requires a high level of flexibility for the system operator. While the diesel generator is used as back-up source of power, it is very noisy, affecting negatively the stay of the guests. Hence the diesel generator is upon a time of use criterion, which is activated once it is foreseeable that the battery SOC is insufficient to supply the load during the entire night without additional power supply of the generator.

However, the implementation of the **DHYBRID UPP**, allows for such kind of flexibility for the operator to either start the genset manually upon the time of use criterion or to manage the system entirely automatically.

Since the implementation of the microgrid at Cheetah Plains, the following advantages could be achieved:

- **Increased Peak Power Supply**
- **Stable System Voltage & Frequency**
- **Integration of 3-phase consumers**
- **Grid Independence**
- **Reliable Power Supply with high Power Quality**

DHYBRID and Blockpower offer their solutions for commercial & industrial clients with various size of PV, Battery and Diesel systems, ranging from 200 kW up to multimegawatt and multimegawatt hour solutions. Due to the fact, that the DHYBRID UPP is manufacturer independent, any kind of known PV inverter and Battery inverter brands can be integrated into the system, providing an ultimate level of independence to the end-customer.

Please contact us for further information, system design support and quotes. We will be happily assisting you with your requirements.

OUR POWER.YOUR ENERGY.

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