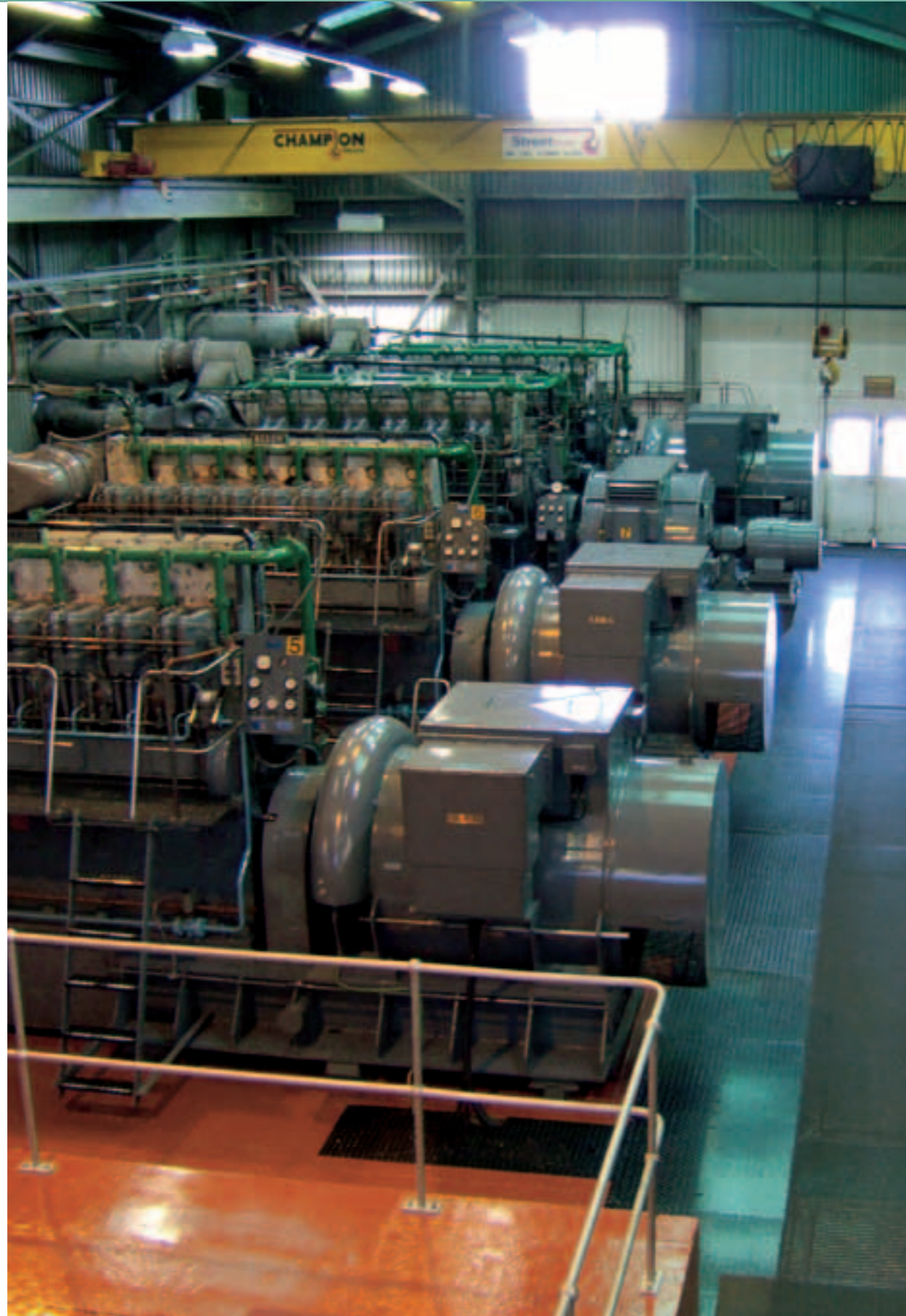




**ENERCON WIND-DIESEL  
AND STAND-ALONE SYSTEMS**  
SELF-SUFFICIENT POWER STATIONS USING WIND ENERGY



*Diesel Power Station in Stanley  
(Falkland Islands)*



*3 x E-33 on Falkland Islands*

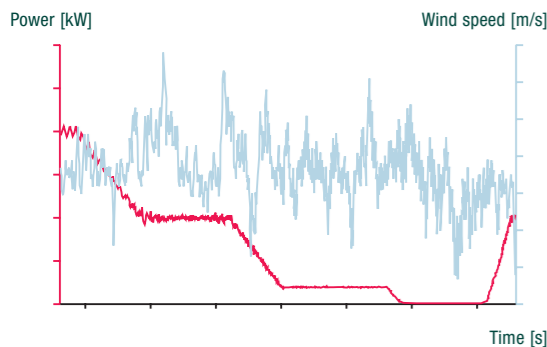
## **WIND-DIESEL OR STAND-ALONE**

### **CHOOSE YOUR PREFERRED OPTION**

ENERCON wind turbines up to 900 kW are well suited for locations on islands or in smaller rural communities to complement the diesel stations that normally supply the energy there.

In order to achieve a high penetration of wind energy in the energy mix for saving a maximum amount of diesel-fuel, ENERCON has developed the necessary equipment for grid stabilisation and system control.

In order to get accustomed to wind turbines and their behaviour in the local diesel grid, the way towards a self-sufficient energy supply using only wind energy (diesel-off mode) is usually done in several steps.



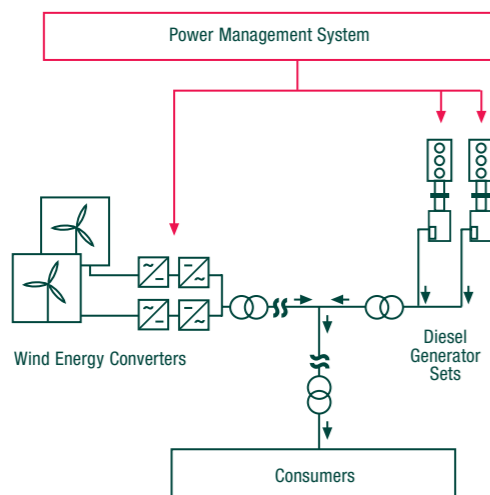
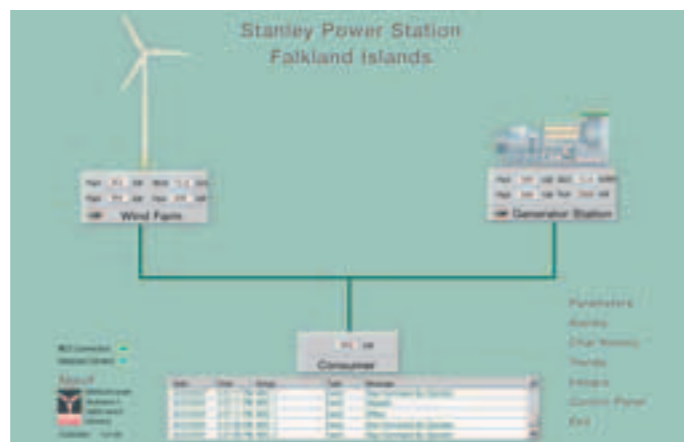
ENERCON wind turbines can operate with any power set point required and increase or decrease of power is done with a selectable  $dp/dt$  rate

### 1. WIND-DIESEL APPLICATION

With ENERCON wind energy converters and their standard integrated system controls for variable speed and variable blade pitch it is possible to safely connect and operate wind turbine capacity in the range of up to 35 % of the installed diesel capacity in parallel to the diesel gen-sets. As the turbines power output is freely selectable and reliably controlled via rotor speed and blade pitch, no dump loads are necessary and a maximum use of the wind energy is possible while the diesel machines keep their grid forming tasks (diesel remains to be the main energy source).

In order to efficiently manage the supply and demand side and to control the interaction of diesel gen-sets and wind turbines, ENERCON offers a Power Management System for this application (example see below).

Power Management System in Stanley, Power Station (Falkland Islands)



Step1: Wind-Diesel

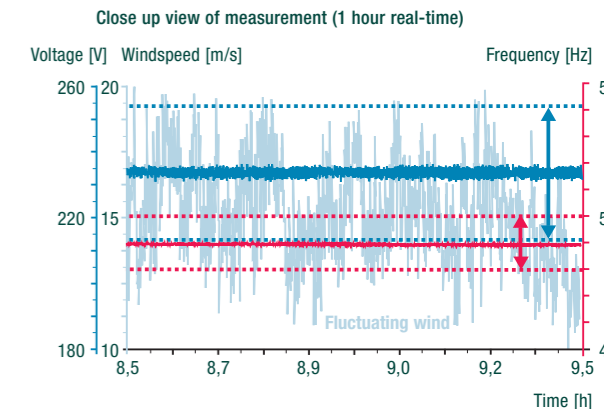
### 2. STAND-ALONE APPLICATION

If the fuel saving results are encouraging and the grid and/or power station operators are satisfied with the grid behaviour of the wind-diesel system, the installed wind capacity can be increased. Then an energy storage system comes into play in order to balance the wind fluctuations and to allow for a diesel-off mode ("zero-emission") where 100 % of the energy demand can be supplied by the wind turbines, when the available wind power meets the demand of the consumers.

The schematic drawing below shows a stand-alone system with all necessary components. With such a system wind energy can completely supply the consumers, depending on the system layout, i.e. balance between wind turbine installed capacity and load demand (wind turbine takes over as main energy source).

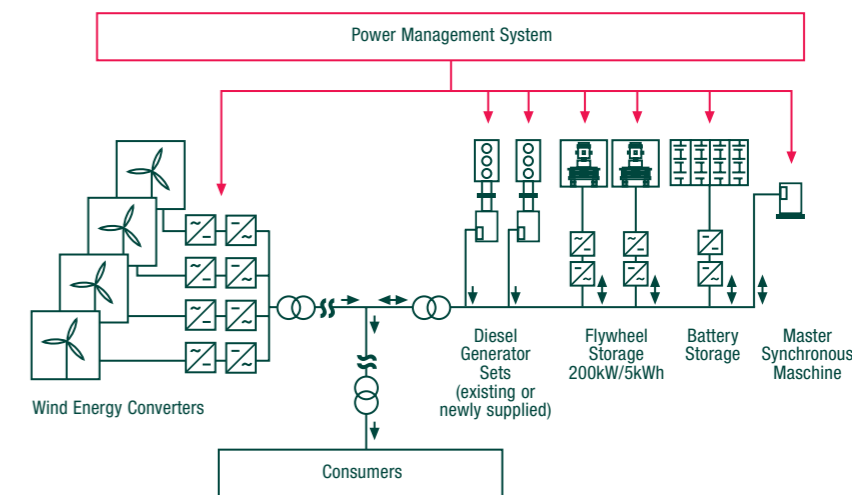
ENERCON has developed all relevant system components including the main control system (Power Management System) and can thus even supply a complete power station (based on wind energy) to provide consumers with power at locations where no energy supply has been available so far or where old diesel engines have to be replaced.

In all configurations and operational modes the system delivers stable and uninterruptible power with very high grid quality (well within the limits of e.g. EN 50160 – see measurement on the right above). And this precisely according to the demand – which is the main challenge in small local grids. Only the required amount of energy is produced and dump loads to dispose of excess energy are not necessary.



The dotted lines show the allowed limits for grid voltage and frequency

Grid voltage and frequency in the ENERCON Stand-Alone System are well within the admissible limit values according to EN50160



Step 2: Stand-Alone



2 of 3 E-33 on Falkland Islands

### COMPONENTS IN THE ENERCON STAND-ALONE SYSTEM

#### Wind turbine

- Main energy source

#### ENERCON products

- E-10, E-20, E-33, E-44, E-53

#### Flywheel

- Short-term energy storage to compensate the wind energy fluctuations in the seconds range
- Frequency controller in the stand-alone grid (diesel-parallel and diesel-off mode)

#### Battery storage

- Emergency back-up in the stand-alone grid (diesel-off mode) for power supply in the minute range
- Frequency control in emergency cases

#### Master Synchronous Machine used in diesel-off mode for

- Voltage control
- Supply of reactive power
- Short circuit current supply
- Flicker filtering

#### Controls

- Power management in the wind-diesel mode or stand-alone grid
- Safe and economic automatic operation of the system (manual mode also possible)
- Data processing and process visualisation

#### Diesel generator (or other combustion engine)

- System start-up
- Power supply at lack of wind and empty storage facilities

### FLYWHEEL STORAGE SYSTEM

In the year 2000 ENERCON decided to develop an energy storage system specially suited to compensate wind power fluctuations. It has been designed according to the following requirements:

- Low cost
- Low maintenance
- Robust design
- Long lifetime
- Standard components and materials as far as possible
- Possibility for individual applications (modular, containerised etc.)
- Rated power 200 kW
- Energy storage capacity 5 kWh
- High efficiency / low losses
- Extremely fast reaction time
- Optimum grid behaviour

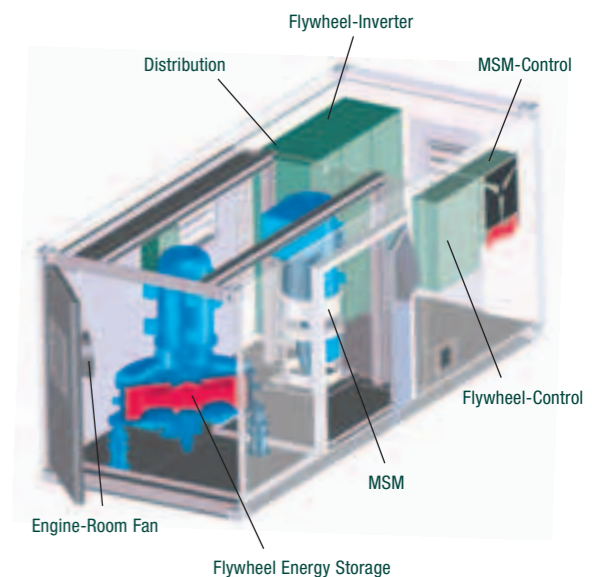
The ENERCON flywheel is a very simple and robust system, which is proven by more than 20,000 operating hours without maintenance work. The mechanical design using standard materials and well-proven components for example bearings and other machine parts ensures a reliable operation and a long-term supply with spare parts. Access to e.g. bearings is easy and for their replacement no specially trained personnel is required.

The use of standard well-proven ENERCON inverters ensures very high grid quality and allows for the use of standard spare parts necessary for wind turbine maintenance.

The ENERCON flywheel comes in a standard 20ft sea container convenient to transport and ready for connection to the grid. All components are installed and completely cabled. The system undergoes extensive testing before delivery. Thus the time for installation and commissioning on site is very short.



ENERCON Flywheel



ENERCON standard energy storage container (example with flywheel)



*ENERCON Stand-Alone System  
(Utsira/Norway)*

**POWER MANAGEMENT SYSTEM AND HMI/SCADA**

The core component of the sophisticated power management system is the main control unit. It manages all components efficiently to ensure a reliable power supply under all operating conditions.

The main controller for the power management of the overall system is a standard industrial state-of-the-art controller. Because of its modular design it can be adapted to the specific requirements of each system.

The strategy for running the complete system in safe and economic automatic mode is implemented in the software of this controller. This software of course has to be adapted to each individual application (number and type of energy sources and consumers etc.).

A manual mode is also possible where all functions of the controller can be activated by the operator. For this, the so-called HMI (Human-Machine-Interface) is used. It is realised with an industrial PC with touch-screen connected via Ethernet-link to the main controller.

**ITS TASKS ARE**

- **Process visualisation of all details**

The main menu gives an online overview of the complete system with the status of all individual components. From there the sub-menus for each single component can be selected, showing all sensor data monitored (online).

- **Data processing**

On a 10-min basis, a selection of data, as well as all status messages are stored (starts, stops, alarms, etc.).

- **Manual operation**

Via the HMI, the operator has access to the main control panel and is able to give commands to all system components (start, stop, power set-point, operating mode etc.).

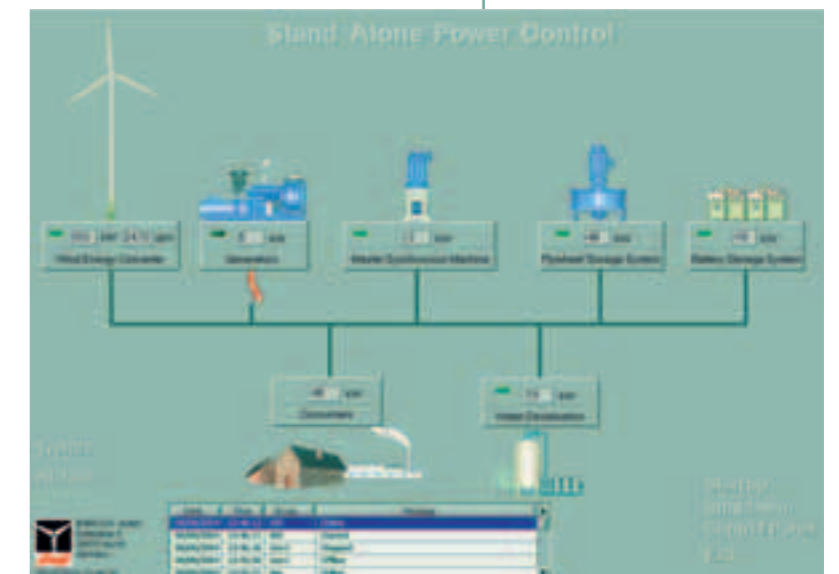
- **Scada**

The HMI is connected to an ISDN line offering the possibility of remote communication. The following functions are available:

- Sending alarm messages via SMS and/or email
- Online monitoring of the whole system from any office PC
- Access to the complete data stored in the system database



*Plain control desk  
(Power Management System)  
in Stanley Power Station*



*Main menu of the HMI  
(Human-Machine-Interface)  
of the Power Management System*



#### ADVANTAGES OF THE ENERCON STAND-ALONE SYSTEM

- ~ The wind turbine is the main energy source, wind penetration up to 100% is possible (diesel-off mode, zero-emission). No dump loads required. Suitable wind turbine sizes available (30–900 kW).
- ~ Continuous power supply is guaranteed, all emergency scenarios are backed-up.
- ~ Excellent grid quality through use of the well-proven ENERCON IGBT inverter technology.
- ~ High reliability, long service life, easy maintenance and good availability of spare parts due to the use of standard, robust, well-tested components.
- ~ Ideal mix of mechanical and chemical storage systems. Each type of storage is used according to its intended purpose, therefore long service life guaranteed.
- ~ Fully automatic control with state-of-the-art hardware technology.
- ~ Compact modular containerised design for easy transport and simple extension.
- ~ Quick on-site installation of pre-assembled components fully tested before delivery.
- ~ All components and overall responsibility from one supplier (wind turbine, flywheel, controls etc.) with long-term experience in wind turbine behaviour and controls.
- ~ Existing or new components can easily be integrated (e.g. diesel generators, photovoltaic systems, desalination units, hydrogen equipment etc.).

E-33 on Bonaire

