

Introduction

Stand-alone wind/diesel (WD) power stations plans with high wind penetration of up to 100%, integrated with desalination systems for continuous production of electric power and fresh water within the range of 100-9,000 kW and 10-10,000 m³ desalinated water per day.

The system is designed for direct connection of standard wind turbines with a total capacity of 100-200% of the diesel power station, and depending on the actual wind conditions an annual penetration of 50-80% can be obtained. And still the WD system is controlled for supplying a high power quality with a frequency variation of less than $\pm 0.1-0.3$ Hz.

The environment is thus saved from the CO₂ outlet corresponding to the saving of 50-80% diesel generation, and the environmental benefits can be further increased by using plant oil for the diesel generators.

The reduction of diesel consumption, and the related cost saving, will in most cases easily justify the investment in the wind power plant and WD control System.

Waste heat from the diesel generation and excess power from the wind turbines can be utilized for sea water desalination, central heating and/or ice production, which will further improve the economy of the combined WD desalination concept.

The Danvest wind/diesel concept

The Danvest WD concept is based on a normal diesel based standard power station fitted with the Danvest control system for backing up the wind turbines from 0-100% wind energy supply. When the wind energy power production exceeds 100-110% power consumption the diesel engine is clutched out from the alternator and stopped.

Standard wind turbines are direct connected to the bus bar in the power station then comprising a total wind diesel system where the diesel generator set is able to back up the wind turbines from 100% load to 0% load. By this control system the annual fuel saving of 50-80% is obtained.

The Danvest WD concept is special designed and developed to be simple and robust for installation and operation at remote and isolated locations.

Local technicians can be trained in the daily operation and maintenance of the WD system and after the commissioning together with the supervisors of the supplier; they will be capable of operating and maintaining the plant.

The Danvest WD plants are containerised in standard 20' and 40' containers for safe transport and easy installation at the location of the Plant. The module capacity of the diesel generator units are from 100-1,500 kW.

Through test operations of a pilot plant with the Danish National Research Institute Risø as observer the system has been thoroughly tested, and test reports are available. Tests have proven that even at approximately 50% wind penetration the power produced from a Danvest WD system is lower than power produced purely on diesel generation.

The design lifetime basis for the main components including the diesel engine is 20 years.

Working Principle

The Danvest developed WD system contains a Low Load Unit (LLU), which ensures that the diesel generator set for extended periods can supply power backup for the wind turbines down to idle running, and still maintain a pre-set frequency and voltage quality.

The LLU ensures that the diesel engine has normal operating conditions down to idle, and at the same time the fuel consumption is reduced to 0%. At the same time the LLU ensures that the diesel engine is pre-heated and pre-pressured for quick and easy start-up and for minimising the soot formation in the engine.

The Danvest dump load controlling system - fitted to the alternator - is operating in parallel with the engine governor, stabilising the fluctuations in the system and obtaining a normal operation quality in the range of ± 0.1 -0.2 Hz.

By this the Danvest system ensures the highest energy utilization by optimal system integration and the LLU, prevents the diesel engine from deterioration, and secures an uninterrupted high quality power supply under all production and consumer load combinations.

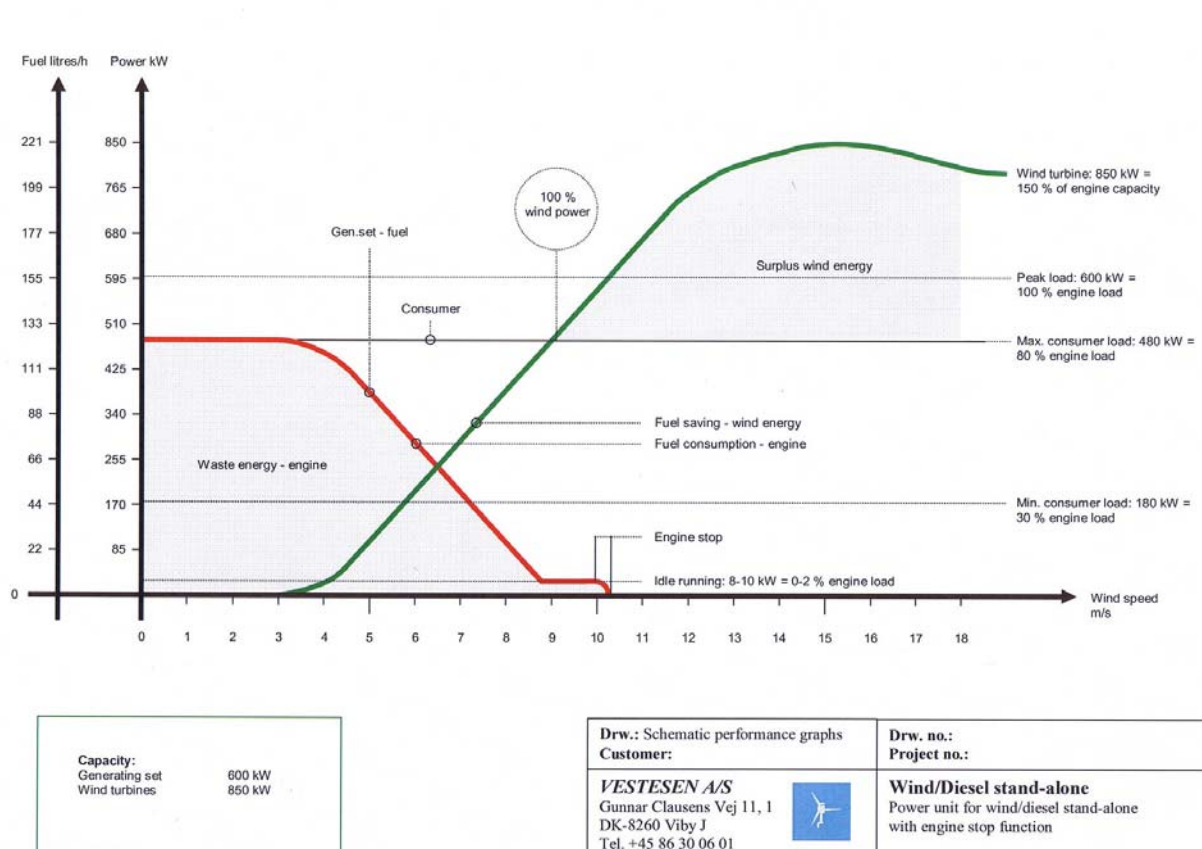


Fig. 1 - Schematic performance graph

Conversion of existing power stations

Vestesen A/S has developed design applications for converting existing diesel power stations into WD systems, including a modular design concept which makes it easy to extend for future increases in power demand.

The existing power station will be inspected and - if necessary - overhauled in order to meet the quality demands for the functionality of the WD system.

Desalination and/or central heating

All waste energy from the diesel engine and excess power from the wind turbines is absorbed in the special cooling system and utilised for desalination, central heating or other energy/power consuming processes.

For desalination a distillation process is integrated into the cooling system, and the production capacity will depend on the load pattern.

Furthermore, a reverse osmosis process can be integrated, utilizing the power from the WD system.

Quality

For the design and procurement of the Danvest WD desalination systems the following is taken into account:

- The WD system with wind turbines must be based on worldwide known and proven technology securing reliability and operational backup
- The system must be simple and robust, allowing local staff to operate and maintain the plant
- The system must operate automatically and continuously
- The diesel generator set must be able to backup the wind power from 0-100% to obtain the optimal fuel saving
- Power quality must be within predefined limits and is normally below:
 - Frequency ± 0.3 Hz
 - Voltage $\pm 5\%$
 - Sufficient reactive power supply
- Simple transportation, erection and start-up

Feasibility studies

For the specific projects, VESTESEN A/S can prepare feasibility studies for the investor and financier. The feasibility studies will be based on the investor's information related to climatic/wind conditions, consumer pattern etc., and the feasibility study can be based on various models in order to find the most optimal solution with the highest return on the investment.

Execution

VESTESEN A/S can offer to execute the projects either as turnkey solutions with the participation of wind turbine suppliers, desalination system suppliers and local civil and electrical contractors, or as supplier of the WD system.