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Mobile wind energy plant – MoWEC

Described here is the construction principle for a mobile wind-powered generator MoWEC which, contrary to conventional wind driven power production plants, can be easily transported. On cost and practical experimental grounds, power transference between rotational energy and generator in this prototype is currently via chain to a central shaft. Later crown and bevel gearing and universal-joint shaft joints are envisaged. Current power output capacity with 80 m^2 rotor area and conversion gearing is 10 to 20 kW depending on application. MoWEC is not a construction requiring planning permission. In production the applicable machinery directives must be followed. Thus the safety elements determined for wind-powered generators must be applied here too.

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Keywords

MoWEC, mobile wind energy plant, wind energy converter, double rotors, small wind energy plant, wind energy

The Renewable Energies Law (EEG) covers arrangements for supplying electricity from renewable sources to the national network in Germany. The network operators have to pay suppliers an agreed minimum amount per kWh without upper limit for wind-produced energy. The agreed minimum payment for new wind-driven power plants is to be reduced by 1.5% annually as from January 1, 2002. The minimum electricity supply price for every new plant is determined over a 20-year period. With this, the EEG supports a politically desired financial encouragement for renewable energy producing technology over a limited period. In total, some 120000 now people work in the renewable energy sector, more than the total employed in the coal and nuclear power industries together [1, 2].

The EEG can be correctly understood as an environmental law but one, however, that does not apply to all other wind-produced energy outside that supplying the electricity network although the latter still has the potential of reducing fossil fuel consumption. Such production systems include isolated operational plants, so-called island units, with their different possibilities for energy transformation. The political aim of all parties represented in the Bundestag is to substantially increase the proportion of renewable energies in the total energy supply – especially through energy carriers that can save the use of fossil fuels, so that the major changeover from fossil to renewable energies can be successfully achieved in the present century.

Through the MoWEC work, an agricultural research project has begun with the aim of being able to utilise wind energy outwith the most suitable sites without constructional complications. A plant concept is to be processed and tested that will in future offer rural areas a new product (for buying, renting or leasing) offering renewable energy outwith vegetation times (electricity for supplying the network, or for own use, heating energy in winter, seasonal drainage and other applications).

Construction of MoWEC mobile wind energy plant

The task is to develop a wind energy plant with the following attributes:

1. Use at different locations should be possible.
2. In on-farm application the MoWEC should have the capability of being pulled to new sites, even on the public roads.
3. Masts should be foldable for servicing and transport.
4. A lee reaction system should face the plant into the wind.
5. One or more rotors should be winwardly installed.
6. The user should be able to freely select the energy converter (i.e. compressor, generator, etc).
7. Both island and network operation should

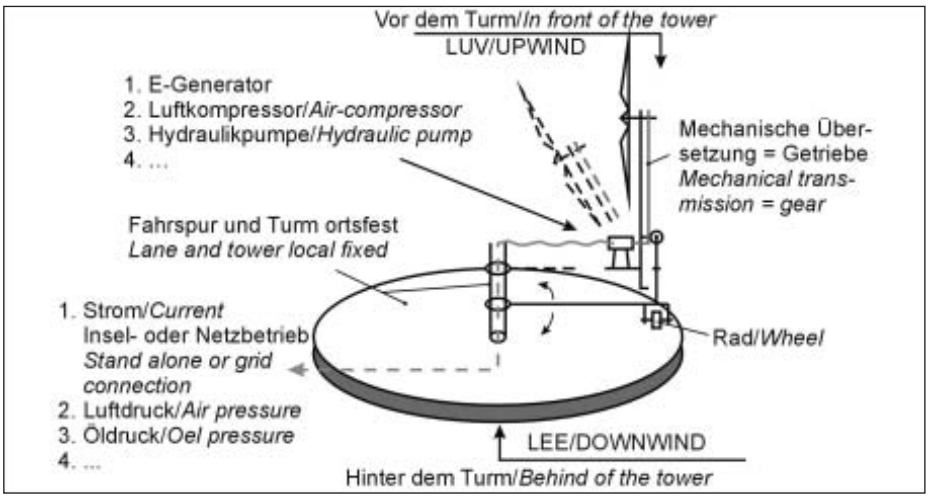

Fig. 1: Construction details of the MoWEC prototype

be possible.

8. At predetermined wingtip heights a maximum of air-contact rotor surface should be realised. A first prototype should have a maximum wing tip height of 10 m.
9. The lee and windward construction should enable various model types for rural use.
10. The storm safety system must be able to be corrected at any time from the ground and construction should in general be simple – as required for rural areas.

Solutions

In lower altitudes wind directional and velocity changes occur often and the related constructional stresses have to be considered. Every attentive observer will have noticed the widely varying behaviour of small wind turbines with wind vane steering, especially at low wind velocities, compared with the forced directional systems of the large wind energy plants. Gusts also lead to multiple increases on forces acting on the structures, particularly where the construction is too easily accessible to the gusts, often associated with wind directional changes. In that MoWEC should be constructed mainly of cost-effective mechanical elements the mass inertia has particular importance so that the construction does not immediately follow every smallest alteration of wind flow.

Figure 1 explains the chosen construction principle. The foldable tower with rotor is positioned leeward from the central tower. The rotor rpm must be increased in this performance class. To reduce weight at the tower peaks power transference from rotor shaft to energy converter is via gearing transmission (in the prototypes via cost-efficient and easy to adjust chain drive with conversion ration currently of 1:3). Later, crown and bevel drive and universal joint shafts should be applied. Chosen as rated rpm was the agricultural tractor pto speed of 540^{-1}. This means that tractor-driven equipment such as water pumps, generators or compressors could be driven through simple connection to the plant's central shaft. Additionally this rpm has also the advantage that in the case of an unbridgeable wind calm a tractor can take over the energy supply. Figure 1 shows the different energy converters. A further installation point for energy converters is the permanent drive points on the MoWEC frame.

Fig. 2: Erected mobile wind energy plant MoWEC

Figure 2 shows more detail of the total construction now in test. Setting wingtip height at 10 m means a rotor diameter of 7.10 m was chosen. Two contra-rotating rotors give a total movement area of 80 m^2. Depending on energy converter, this offers a rated performance of from 10 to 20 kW. In the trials, special attention was paid to identifying a MoWEC variant that enabled island application. In this way, farm use of the energy is cost-efficient. For export too, the industry requires an island solution. For this reason simple technology is currently being worked on for „turning into the wind" and „turning out of the wind" without energy storage. Parallel to this, plant safety and vibrations are being observed.

During 2002 the prototype was set-up on FAL experimental station pastureland. Under the four supports and the framework, altered agricultural concrete slat elements from cattle housing were laid as the only ground attachments. Should a correction to horizontal positioning be required this can easily be achieved by a fitted hand winch.

Literature

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