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CONSTRUCTIVE AND TECHNOLOGICAL CRITERIA FOR PRODUCING WINDTURBINES IN WEST BALKANS

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ABSTRACT
Climatic, geological, tectonic and traffic properties of the Dinarides condition a corrected approach to the research of wind potential characteristics, designing windplants locations in wind farms' systems, and very structures of mechanical and civil engineering equipment, in relation to existing standards in Western Europe.
For the needs of designers and contractors there is a defined list of demands from the construction and technological area for this type of product which is implemented in electrical systems of Croatia and Bosnia and Herzegovina.
The paper presents the results of the author's several years of research in the area of optimal designing of wind turbines in complex areas of the Balkans
Keywords: wind turbines, technological modeling

1. INTRODUCTION
Region of Bosnia & Herzegovina, Croatia and Slovenia has been covered with a meteorological station system since the Austro-Hungarian period until today, together with a system of the state, military and economic meteorological stations. In the ex-Yugoslavia state, based on the data from meteorological stations, in line with JUS M.D1.050 standard, wind intensity zones and methodology for calculating wind intensity were defined in relation to the height of a designed structure. Defined methodology was used for designing of building structures, cranes and metal structures in mechanical engineering.
Disadvantage of these standards in their application at a local level was that they did not take into consideration influence of terrain orography, roughness, „tunnel effect" in mountain valleys and basins, as well as the edge effect at the locations of hills, saddles etc.
Development of technology for gaining electric energy from wind by using wind turbines in European Union introduced a specific model and regulations for wind characteristics assessment and designing of locations for wind turbines in a wind farm.
Wind characteristics assessment in the area of Bosnia Herzegovina in the period 2000-2007 proved complexity of this type of research and designing in complex terrains in Bosnia & Herzegovina and the Dinarides area in general, [1,2]. Applying the WMO (World meteorological Organisation) criteria, a working model was developed, adjusted to the terrain conditions, which allows precise technical optimization of wind farms projects.

2. TECHNICAL PRECONDITIONS FOR WIND FARM DESIGNING
A basis for an initial phase of a wind energy project is criteria of the market of produced energy consumers, namely:

a. EU market,

b. B&H and neighboring countries,
c. Local market, in the vicinity of the energy plant,
d. Individual consumers of electric energy.

Based on the consumers' market, a capacity of installed power is designed, as well as the capacity of an annual production of electric power.
Orientational capacities of the installed powers based on the market are as follows:

- For EU market over 100 MW,
- For B&H market over 60 MW,
- For the market around a wind farm, through the distribution network up to 30 MW,
- For individual consumers (households and mini industrial plants) up to 200 kW.

Selection of an area for installation of wind farms (Fig. 1) in the form of market, installed power and produced electric energy is based on:

- Area necessary for installation of the equipment,
- Wind characteristics in a given area (speed, direction, vertical speed distribution, turbulence zones, humidity, temperature, atmospheric pressure),
- Terrain configuration in form of classes for wind roses for entire areas,
- Transportation infrastructure at the location, as well from the location to a motorway or a sea port for cargo ships with adequate equipment for load transfer cranes,
- Existing high-voltage transmission networks and capacities of the existing substations in the area, and from the location to the existing electric-energy transversals,
- Characteristics of the closest electric power sources (classical, possible alternative in the location or in its close vicinity),
- Characteristics of the urban area as a whole (locations of settlements, recreation centers, tourist facilities, historical monuments, national parks, protected areas etc.),
- Characteristics of plant and animal life in terms of species and their characteristics for growth in a natural environment. Routes of migratory birds (corridors and height of their over flight)
- Zoning development plans for the local community (municipality, canton-region) as well as the state plans on infrastructural development,
- Social characteristics of population in the area around location, cultural preconditions for adoption of new technologies.

Upon selection of an area for adequate capacity of installed power, further selection is made, namely:

- Into adequate number of macro-locations of the capacity above 100 MW and
- Division of macro-locations in the system of wind farms of the capacity of above 30 MW.

For individual consumption and production of electric power, the entire process of observation is performed at the very location of production and consumption.
Technology of wind energy assessment in complex terrains of highland conditions, in the observed area would be performed in line with the following criteria:
The first phase would include selective research in the locations:

a. By using information on wind characteristics based on meteorological satellite records (100 000 €/month),
b. By installing mobile 10-m stations within the zone of macro-locations, based on the cartographic terrain analysis, terrain observation in terms of orography and plant life, as well as the information from the local population,
c. Time frame of selective research is one-year period, in accordance with WMO criteria,
d. Based on the results of selective measurements of wind characteristics, supported by computer programs for the entire area by using simulation method, wind characteristics are roughly determined.

Second phase of the research at selected macrolocations includes the following process:

a. In each microlocation (2 × 2 km) wind characteristics are measured with mobile measuring stations (50-60 m) with three or four sensors at heights of 10, 30, 50 m or 10, 20, 40, 60 m for

determining of vertical wind distribution for all dominant directions, as well as influence of terrain orography and roughness. Influences of turbulence caused by the terrain are necessary to be determined by using SODAR or LIDAR system with resolution of speed measurement at every 5 or 10 meters. Measurement should be implemented within 1-3 year period,

b. On the basis of experimental results on meteo characteristics (atmospheric pressure, air temperature, humidity) and wind characteristics, and all that in line with WMO standards, designing of location for each wind turbine can start. Optimization of their distribution is made in line with criteria for already selected equipment (manufacturer, installed power, type), and these are:
    a. Maximum annual production in GWh for each wind turbine
    b. Minimum energy losses due to turbulence among wind turbines (less than 3%),

Based on long-term meteorological results (longer than 50 years) from the nearest meteorological stations and measurements at microlocations in the three-year period, it is necessary to determine wind correlation factors. This data should be finally used for prognosis of energy production for designed wind farms for their life cycle (20 years 120 000 working hours) in order to gain economic efficiency parameters.

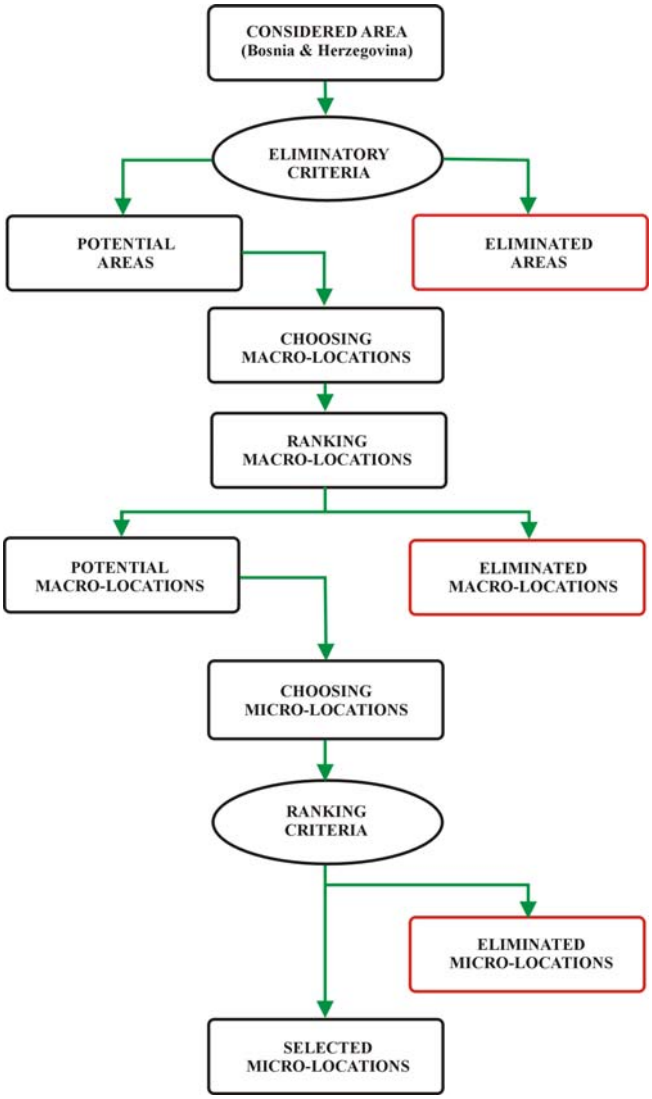

Figure 1. The Selection of an area for installation of wind farms

Design of distribution of wind turbines should be done only with certified computer programs that are accepted by EU banking institutions, [3].
Project revision should be carried out by a reputable EU institution (e.g. DEWI, RISO).

3. SELECTION OF EQUIPMENT AND TECHNICAL CONDITIONS

Selection of equipment for a designed wind farm is based on:

- Total and required installed power,
- Available quality space,
- Turbulence level,
- Wind speed, wind shifts frequencies,
- Air temperature range,
- Allowed noise at the location and its frequency range and influence on environment (humans, animal life),
- Time and conditions for installation and climate conditions for installation,
- Conditions of communications for transport of parts of equipment and pre-installment conditions,
- Energy efficiency for defined wind characteristics,
- Reliability level of machinery and electric equipment in defined working conditions (climate and human factors for maintenance),
- System of providing service of spare parts, tome of reaction and prices,
- References, tradition and development policy of the equipment manufacturer,
- To avoid installation of old, repaired equipment that doesn't meet ecological criteria and reliability for a designed life cycle (min. 20 years) and energy production capacity for defined wind and terrain characteristics.

4. CONCLUSION

In complex terrains of the West Balkans, energy assessment procedures are specific, which is confirmed by the authorities at EWEC 2007 Congress. Criteria for selection of research technology in the highland areas in the Balkans, practically tested in the period 2000-2007 in the area of Herzegovina by the authors, proved to be fully justified for application.

5. REFERENCES

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