A NEW GENERATION SCHEME OF WIND POWER PLANT

R.I. Mustafayev, A.I.Abdulkadirov

Scientific Research Institute of Energetic and Energy Design, Baku, Azerbaijan
Azerbaijan State Oil Academy, Baku, Azerbaijan

ABSTRACT

A principally new scheme of electric part of wind power plant consisting of two asynchronous generators one of which – smaller by power – is made with phase-wound rotor is considered and discussed in this paper. This generator functions by direct current feed to rotor winding as synchronous one and joins into work at low speeds of wind. Generator of higher power capacity works at high speeds. In the second mode, the generator of smaller power disconnects by special sleeve and moves into synchronous compensator regime.

Keywords: Asynchronous, Synchronous, Generator, Wind-driven power plant.

I. INTRODUCTION

Utilization of wind power by its transformation into electric one by wind power plants (WPP) is connected with certain difficulties arisen from irregularity and inconstancy of wind stream as energy carrier. Also, it should bear in mind that two machines properties of which are not suit for joint work in full measure join in WPP. So, for example, windmill makes maximal power at variable rotational frequency. At the same time, electric generator, as rule, is intended for operation at constant rotational frequency. These complications and variances bring necessity to find new solutions of WPP devices including its electric parts.

II. MAIN PART

An analysis of WPP modes working at fixed rotational frequency shows that most appropriate variant of WPP is one consisting two electric generators according to low and high speeds of wind stream. Especially, it is actually for asynchronous WPP. It should be noted that many firms – producers of WPP, especially European ones, prefer WPP with asynchronous generators [1]. They think that asynchronous generators in the best way meet requirements of WPP operation characterized by drastic and frequent changes of wind speed; there is noted their great stability, simplicity of lead-in parallel work and etc.

As it is known, most time of year WWP works at low speed of wind, accordingly at less power output than installed capacity. Use of two generators for different rotational frequencies allows to increase efficacy of wind power transformation at low speeds [2].

However, usage of asynchronous generators in WPP is connected with necessity to consume reactive power from network system. It should be noted that energy datum of asynchronous generator become worse at low speeds of wind. The reduced facts were conclusive for firms-producers at choose of WPP variants with two asynchronous generators including WPP with two-speed asynchronous generator.

It is obvious that although a generator with smaller power uses smaller reactive power, nevertheless the mentioned defect remains especially at operation of generator with high power capacity.

We put WPP variant with two asynchronous generators to the test essence of which is following. An asynchronous machine of smaller power (attitude of generator powers is 1:5 on average) makes with phase-wound rotor. Some functions are charged on this machine. First, it is used for soft electric start of WPP (at confined starter current). Second, it works as generator in synchronous mode at low speed of wind. Excitation is realizing by constant current feed to rotor winding according to special scheme [3] and is being regulated for keeping of $\cos\varphi=1$.

Third, at high speed of wind, when big generator works, shaft of machine with small power disconnects from reducer shaft by means of special sleeve and it moves into synchronous compensator mode. The installed capacity of this machine is enough to compensate reactive power of big generator. For the following reasons, utilization of such compensation scheme for asynchronous WPP with high power is more profitable than utilization of static condenser :

- opportunity of full automation of reactive power regulation process;
- opportunity of voltage and frequency stabilization, and it's especially important in the case of weak connection of WPP with power system;
- much less overall dimensions and price.

Magnetic slip coupling can be used as a sleeve for disconnection of shafts of smaller generator and reducer. To reduce mass and overall dimensions it is enough to have a sleeve with 2,5% slip. Along with stated function a sleeve can be also used for stabilization of rotational frequency of small generator.

III. CONCLUSION

There is worked out a principally new scheme of WPP allowing:

- to increase power output at low speed of wind;
- to provide full compensation of reactive power of plant;
- to stabilize tension and frequency, and it is more important at weak connection of WPP with power system.

REFERENCES

1. Wind Stats Newsletter, 1996, vol 9, No2, Spring
2. Wind Stats Newsletter, 1997, vol 8, No2, Autumn
3. *Mustafayev R.I., Abdulkadirov A.I.,* The characteristics and field of application of synchronized synchronous machine a new type. TPE-2004, Tabriz, Iran.