

## SECTION 2

# MECHANICS, ENERGY & SOCIO-ECONOMIC ASPECTS

### REGULATION OF REACTIVE POWER PRODUCED BY DOUBLY FED INDUCTION WIND GENERATORS

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**Purpose.** Study the methods of providing balance of reactive power by means of the voltage applied to the rotor of doubly fed induction wind generators.

**Methodology.** The problem is investigated by application of the methodology of electric machines rotating magnetic field analysis taking into consideration influence of frequency and phase of voltage applied to wound induction machine rotor winding.

**Findings.** In electric power system active and reactive power balance must be provided for the system stable operation. As well such a problem arises in island wind stations where reactive power production is carried out by the station wind generators. Availability of reactive power and its reserves is also important for maintaining frequency and supply network voltage stability.

In the last years application of induction generators with semiconductor converters in rotor circuit for wind power stations is increased. Unlike the induction machine with single feed, doubly fed generators permit economically regulate the reactive power with leading and lagging reactive current. In the work, the relationships of the reactive power and reactive current produced by doubly fed induction machine and value of its power factor against the parameters of voltage applied to the rotor circuit are obtained.

The revealed relations make possible to represent the reactive power of doubly fed induction generator with curves which are analogous to V-curves of usual synchronous machines with electromagnetic excitation. In the range of power factor values between 0.9 leading and 0.9 lagging at rated value of apparent power, the range of reactive power regulation is between 43% generated and 43% consumed of the generator rated power. Doubly fed induction generator can be also used in the capacity of reactive power compensator.

Use of doubly fed induction wind generators provides higher reliability and efficiency of wind power units, and the generator speed regulation depending of wind speed can ensure operation of the generator at maximum efficiency. The machine is recommended to be used in synchronous mode. In transients, synchronous rotation can be violated, and the machine passes to another speed being in the mode of asynchronous rotation. At the end of transient, the conditions of synchronization are recovered, and the generator returns into synchronous rotation.

**Key words:** wind generator, doubly fed induction generator, reactive power

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## ANALYSIS OF NEUTRAL MODE SELECTION CRITERIA FOR DISTRIBUTION NETWORKS OF OPEN PIT MINES

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The effectiveness of any type of network neutral mode operation is determined by the appropriate technical and economic conformity of the uninterrupted power supply to consumers, the amount of capital investment and operating costs. Withal it is taken into account that all kinds of emergency disconnections of power transmission lines and substations, as a rule, lead either to the complete de-energization of consumers or to restrictions on electricity consumption. In general, the evaluation of efficiency and the selection of network neutral mode operation are carried out on the basis of a technical and economic comparison of options. At the same time, reliability of power supply, electrical safety and efficiency of the system should be considered as the determining criteria for evaluating the neutral mode operation of open pit distribution networks [1, 2].